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INCREASING THE DIVERSION OF HOUSEHOLD WASTE THROUGH KERBSIDE RECYCLING SYSTEMS

A Thesis submitted to Cardiff University for the Degree of

Doctor of Philosophy

By

Tom Woollam

Institute of Sustainability, Energy and Environmental Management,
School of Engineering, University of Cardiff.

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ProQuest LLC
789 East Eisenhower Parkway
P.O. Box 1346
Ann Arbor, MI 48106-1346

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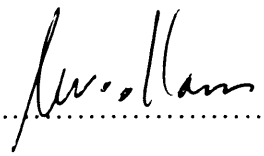
Signed  (Tom Woollam)

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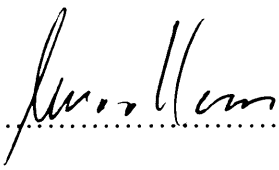
Signed  (Tom Woollam)

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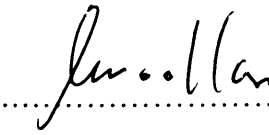
Signed  (Tom Woollam)

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ABSTRACT

Kerbside recycling schemes in the UK are voluntary. In 2003/4, 61% of households in Wales had some form of kerbside recycling scheme collecting at least one material. Householders are encouraged in a variety of ways to segregate targeted recyclables from their general waste and to put this at the kerbside in any number of separate receptacles. There are many ways of increasing the diversion of household waste into kerbside recycling systems. A plethora of incentives, penalties and communications can be offered and many awareness raising schemes can be employed. This thesis uses a case study authority to trial, then subsequently examine the effectiveness of specific methods to increase the diversion of household waste into kerbside recycling systems. A public waste awareness campaign and a schools waste education programme are implemented within the authority a range of incentives were used, some using voluntary approaches and others financial carrots. Key aspects of the work include a legislative overview of household waste in Wales, a quantitative examination of the scale of the household waste problem and a study of attitudes towards waste, actual recycling behaviour and the effectiveness of a waste awareness campaign and a schools waste education programme.

It is thought local authorities which implement kerbside recycling and composting schemes, and still have significant tonnage to divert to meet their 2010 diversion targets, will not meet them by implementing voluntary/carrots and financial/carrots incentives alone.

Ultimately, alternative waste treatment technologies that do not require households to participate in segregation or a significant change in kerbside recycling behaviour (thought only possible through financial/stick incentives or alternate weekly collections) will be needed for local authorities to meet the 2010 Wales Waste Strategy targets and reach the required BMW diversion set in the Landfill Allowance Scheme. Waste awareness campaigns and schools education campaigns have a role to play, but, should not be solely relied on to meet short term diversion targets.

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TABLE OF CONTENTS

CHAPTER 3

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICIES

APPENDIX #	(All Appendices are on the CD at the rear of this thesis)
4.1	List of bring sites in case study area
4.2	Council leaflets about the kerbside recycling scheme
4.3	Driver survey form – Front Page
4.4	Driver survey form – Set out survey
4.5	Quality assurance – Difference in reporting of set out
4.6	Quality assurance – Reporting of set out at varying times
5.1	Example of pre and post (follow-up) Beddau survey
5.2	Full list of streets selected for study in Beddau
5.3	Example of survey used in targeted areas 1,2 and 3
5.4	Full interview (areas 1,2 and 3) analysis
5.5	SPSS data file for survey of areas 1,2 and 3)
5.6	Explanation of ACORN Scoring system
6.1	Townsend Score of Areas 1-5
6.2	Protocol for the interview
6.3	List of SORT Team activities June 2003-April 2004
6.4	Material equivalents of weight differences shown in Table 6.5
6.5	Example of analyse for two twelve week periods on individual household participation frequency in Area 1
7.1	Pictures of the SORT Team and University in school assemblies
7.2	A map of each trial school's catchment area
7.3	Example of the survey conducted into attitudes and behaviour towards waste in children aged 7-11
7.4	Waste Watch comments on draft survey
7.5	Data from the survey conducted into attitudes and behaviour towards waste in children aged 7-11
7.6	Example of the survey included on the reverse of the Pledge

	ACRONYMS/ABBREIVATIONS

3R's – Reduce, Reuse, Recycle
ABPR – Animal By-Products Regulations
ACORN – A Classification Of Residential Neighbourhoods
AEA - Atomic Energy Authority
Alu Pro – Aluminium Can Recycling Programme
AWC – Alternate Weekly Collection
BPEO – Best Practicable Environmental Option
BMRB - British Market Research Bureau
BMW – Biodegradable Municipal Waste
BW - Biodegradable Waste
CABE – Commission for Architecture and the Built Environment
CACI – California Analysis Center, Inc
CA Site – Civic Amenity Site
CCBC – Caerphilly County Borough Council
CHP – Combined Heat Power
CO_2 – Carbon Dioxide
COPA – Control Of Pollution Act 1974
CIWM – Chartered Institution of Wastes Management
DEFRA – Department of Environment, Food and Rural Affairs
DETR – Department Environment, Transport and Regions
DOE – Department of Environment
EA – Environment Agency
EAP – Environmental Action Programme
EC – European Commission
EEA – European Environment Agency
EfW – Energy from Waste
EPA – Environmental Protection Act 1990
ENCAMS- Environmental Campaigns
EU – European Union
EU–15 – Refers to the 15 member states prior to EU enlargement in 2004
ERRA - European Recovery and Recycling Association
FOE – Friends of the Earth
GIS – Geographical Information Systems
HWRC – Household Waste Recycling Centre
HDPE – High Density Poly-Ethylene
IPPC – Integrated Pollution Prevention and Control
IWM – Institute of Wastes Management
kg/h/w – Kilogrammes per household per week
kg/ph/w – Kilogrammes per participating household per week
KPI – Key Performance Indicators
LA - Local Authority
LAS –Landfill Allowance Scheme
LAWDC – Local Authority Waste Disposal Company
LDPE – Low Density Poly-Ethylene

LEQSE – Local Environmental Quality Survey of England
LTCS – Landfill Tax Credit Scheme
MBT – Mechanical Biological Treatment
MORI – Market and Opinion Research International
MRF – Materials Recovery Facility
MSW – Municipal Solid Waste
NAWPI – National Assembly for Wales Performance Indicator
NHS – National Health Service
NOP - NOP Research Group Ltd
ODPM – Office of the Deputy Prime Minister
OECD - Organisation for Economic Co-operation and Development
PAY-T – Pay-as-you-throw
PET - Polyethylene Terephthalate
RAI Score – Recyclate Awareness Index Score
RCT – Rhondda Cynon Taf
RCTCBC – Rhondda Cynon Taf County Borough Council
RCTimes – *Rapidly Changing Times*
R^2 – Correlation Co-efficient
SD – Standard Deviation
SPPS – Statistics Package for the Social Sciences
SORT – Sorting Out Recycling Together
SWAC – Schools Waste Action Club
SWAP – Save Waste and Prosper
TPB – Theory of Planned Behaviour
UK – United Kingdom
UNCED - United Nations Conference on Environment and Development
WAW – Waste Awareness Wales
WAG – Welsh Assembly Government
WDA – Waste Disposal Authority
WET – Waste Emissions Trading Act 2003
WIP – Waste Implementation Programme (DEFRA)
WRA – Waste Regulatory Authority
'z' score – Townsend Index Score

CHAPTER 1

1 INTRODUCTION

Most environmental problems are rooted in the increased demand for natural resources and in the increased pollution and waste associated with current patterns of economic development. The adoption of greater reduction, reuse and recycling of wastes, are a means by which humans can minimise their impact on the environment and live more sustainable lifestyles. With every household in Wales producing the equivalent weight of a family car in household waste every year, the 'household' as a unit is an ideal focal point to try to change attitudes and behaviour.

The research presented in this thesis, funded by the Landfill Tax Credit Scheme through ENTRUST and sponsored by AMGEN Cymru and Rhondda Cynon Taf County Borough Council, will look specifically at kerbside recycling schemes as means to divert household waste away from landfill in the UK. Kerbside recycling schemes in the UK are voluntary, householders are encouraged in a variety of ways to segregate targeted recyclables from their general waste and put this at the kerbside in some form of separate receptacle. In the financial year 2003/4, 61% of households in Wales had some form of kerbside recycling scheme collecting at least one material (Data from Waste Awareness Wales, 2005). There are many different ways of increasing the diversion of household waste into kerbside recycling systems. A plethora of incentives or penalties can be applied and many awareness raising schemes can be employed. This thesis uses a case study authority to trial, then subsequently examine the effectiveness of specific methods to increase the diversion of household waste into kerbside recycling systems. A public waste awareness campaign and a schools' waste education programme are implemented within the authority under study. The thesis looks in-depth at the significance of implementing such incentive/awareness methods with regard to whether or not they help the authority meet its MSW diversion targets.

Chapter 2 of the thesis examines the history and development of the legislative framework for household waste in Wales, since the foundation of any recycling scheme is its legal framework.

Chapter 3 quantifies the scale of the waste problem in the European Union (EU), the United Kingdom (UK) in general and Wales in particular to set the scene for the research case study.

Chapter 4 details the infrastructure for diverting household waste into recycling and composting systems within the case study authority (RCTCBC).

Chapter 5 presents the attitudes and behaviour of residents in RCTCBC towards waste disposal, recycling, and composting.

A targeted waste awareness campaign was implemented to change household recycling behaviour. **Chapter 6** explains the purpose of the waste awareness campaign and the aim of accompanying experiments.

A trial schools' waste education programme was undertaken to try to change 7-11 year old children's attitude towards waste and ultimately their kerbside recycling behaviour at home. **Chapter 7** describes the purpose of the schools' waste education programme and the aim of accompanying experiments.

Chapter 8 briefly explains the alternate ways of increasing the diversion of households waste through kerbside schemes.

Chapter 9 concludes the thesis and proposes several areas for future research.

CHAPTER 2

2 THE LEGISLATIVE FRAMEWORK FOR HOUSEHOLD WASTE

Chapter 2 will examine the legislative framework for household waste in Wales, since the foundation of any recycling scheme is its legal framework.

In Wales, there are now challenging diversion targets for Municipal Solid Waste (MSW) and subsequently household waste. In the UK, MSW is currently defined in terms of the waste collection operation rather than in terms of source or composition (Burnley, 2001). MSW is generally defined as "household waste plus other waste of a similar composition collected by (or on behalf of) the local authority" (*Official Journal*, 1999). In practice, this means that if the waste generated by a particular commercial business is collected along with household waste, the material is MSW. On the other hand, if this same commercial waste is collected in a separate commercial waste collection round it becomes 'commercial waste' and is not subject to the Landfill Directive (see Section 2.9).

There are concerns about Wale's present and future recycling rate, in particular the amount of Biodegradable Municipal Waste (BMW) being diverted away from landfill. It is necessary to understand the 'waste legislative' umbrella covering Wales in order to grasp the need for kerbside diversion of household waste.

"The UK waste hierarchy has been broadly accepted as the guiding principle in trying to develop a more sustainable waste management system. The hierarchy defines reduction as the most desirable option, followed by reuse, then recovery (classed as recycling, composting or energy recovery) and finally the least desirable option, disposal" (Select Committee, 2001).

These options set, in order of priority, the foundation underpinning any steps taken to promote waste management in Wales. In order to ascertain whether existing waste legislation supports the waste hierarchy, the legislative history of Wales and England will be investigated to determine their legal stance on household waste. The examination will show how Welsh devolution has enabled Wales to develop a different response to that in England to the same problem. Devolution prompted the setting up of the National Assembly for Wales and the emergence of a more distinct Welsh legal order. The roots of the waste hierarchy are identified as originating in Europe and subsequently adjusted

by the UK government to meet its own waste management needs. UK statutory instruments employed to tackle household waste issues are looked at in chronological order and examined in-depth.

2.1 THE PAST

Waste management as a government activity has existed in most present day countries belonging to the Organisation for Economic Cooperation and Development (OECD) since the early part of the 20th century (Pongraz, 2004).

As UK industry bloomed in the years between 1750 and 1850, the production of goods and rate of consumption increased at an exponential rate, in parallel with population growth and massive population shifts from rural to urban areas. A consequent increase in the accumulation of 'waste', posed dangers to human health (e.g. through attraction of vermin and disease carrying insects and the pollution of water course and associated public health impacts) and the first pieces of legislation aiming to regulate the disposal of waste were passed. Governmental action, which began at a local level, was largely a response to the *laissez-faire* disposal of all types of wastes in the urban environment. Hygiene and public health were the main drivers for government intervention and so the history of waste disposal regulation began with the *Nuisance Removal and Disease Prevention Acts* in the 1800s and led to two *Public Health Acts* in 1875 and 1936. A cholera outbreak in London claimed many lives and led to the *Public Health Act of 1875*. This was quite a step forward, as it charged local authorities with the duty to arrange the removal and disposal of waste. To comply with the *Public Health Act 1875*, refuse was collected regularly (weekly in most cases). The weekly collection of refuse was recommended to provide a routine for householders and also to reduce infestations of the housefly; the 10 day life cycle, from egg laying to the emergence of the adult insect was taken into account for the choice of weekly collection. The *Public Health Act of 1936* had a provision allowing District Councils to collect waste if they so wished and if they opted to do so and didn't, after seven days members of the public in their areas could claim 5 shillings per day for failure to collect, which is probably where the idea that a weekly collection should be imposed came from. Nevertheless, waste continued to be dumped illegally, and even controlled disposal sites were most of the time poorly

managed. Although improvements in the management of landfill areas were later made, (Mc-Bean et al. 1994) for example thin layers of soil covered such sites when their capacity reached its limits, and no preventive measures were taken to avoid pollution to any media.

Further attention was drawn to the deficiencies of the existing system in 1972 as a result of the contamination of playground areas in an area of Warwickshire after the dumping of toxic sodium cyanide drums. Known as the 'Nuneaton incident', its effect was an immediate legislative response in the passing of *The Deposit of Poisonous Substances Act 1972* making unregistered deposits of poisonous, noxious or polluting and environmentally hazardous wastes an offence. In 1974, the *Control of Pollution Act (COPA)* was and introduced more legislative controls in the area of waste treatment disposal. Eventually, recognition came that there was need for greater innovation in methods of treating waste. The number of incinerators in the UK between 1969 and 1981 had risen by thirty as landfill disposal problems started to arise (Williams, 1998). However, landfills remained the main disposal option as European legislation on emission controls started damning the use of incinerators (Dir.89/369/EEC & Dir.89/429/EEC amongst other European statutory instruments set emission limits, specifically with regard to emissions from new and existing municipal waste incinerators).

The need to manage the waste produced became imperative as Europe and the developed world started running out of space to dispose of this waste. Over time, the regulatory and institutional mechanisms of waste management policy evolved. Politically, governments could no longer ignore the adverse effects of poor waste regulation. Waste management laws and specialist agencies were established to better confront the challenge. Elements of waste management in the UK can be traced back to the Control of Pollution Act 1974, under which a waste disposal licence became a requirement before the disposal of even non-toxic waste. Local authorities were in charge of both the duty to regulate and operate waste management. Unfortunately, there was overlap in regulatory and operational responsibilities. An authority both regulating and operating waste disposal management would have an inherent conflict of interest, which led to an undermining of public confidence in the system.

Also, as with much environmental legislation of that era, there were difficulties enforcing waste disposal licences as the decision in *Leigh Land Reclamation Ltd v Walsall Metropolitan Borough Council* (1991) 155 JP 547 shows that as long as the deposit of waste was in accordance with the licence conditions, it was irrelevant if other conditions relating to the site were not being complied with, basically making operational and administrative licence conditions unenforceable (Bell, 1997). Licence holders also had the right to surrender a disposal licence at any time, relieving themselves of any conditions attached. Accordingly, an operator could abandon a site and relinquish any future supervision of it.

However, the most important criticism of COPA 1974 is that it created a regime to deal with waste disposal not one that aimed to tackle the problem of a continuous rise in the amount and volume of waste. The only pro-active element of the regime was the drafting of disposal plans whose completion was in reality substantially delayed and not practised by all authorities. Only one-third of the plans that should have been produced were actually drafted in the first fifteen years of COPA's operation.

Moreover, WDAs as sole operators of waste disposal licensing regimes enjoyed unrestricted powers and were not willing to surrender such powers.

2.2 EUROPEAN WASTE MANAGMENT DRIVERS

European waste law and recognition of a number of fundamental principles enshrined in Treaties, such as the precautionary, proximity and polluter pays principles, have evolved together. Originally, European waste law had to take the form of Directives as required by Article 100 of the Treaty of Rome. However, the Single Act of 1986 provided for a choice between Directives and Regulations for the formulation of European legislation on waste (Hanneguart, 2000). In practice, however, European waste law has almost always taken the form of Directives. The European Union's waste legislation comprises three main elements:

- **horizontal legislation**, establishing the overall framework for the management of wastes, including definitions and principles

- **legislation on treatment operations**, such as landfill or incineration, which may set technical standards for the operation of waste facilities
- **legislation on specific waste streams**, such as waste oil or batteries, which may include, for example, measures to increase recycling or to reduce hazardousness

There are a significant number of EU Directives affecting waste management, including some which may not immediately appear relevant, such as the Directive on Groundwater or the Habitats Directive. In addition to the EU legislative umbrella, there are other strategic policy commitments to which member states are expected to adhere. A key document is the 6th Environmental Action Programme (EAP) entitled *Environment 2010 : Our Future, Our Choice (*EU, 2002). The programme takes a wide-ranging approach to environmental challenges and gives strategic direction to the Commission's environmental policy over the next decade, as the Community prepares to expand its boundaries. One of the four prioritised areas for urgent action is Natural Resources and Waste. Thematic Strategies are one component of the actions within the 6th EAP. Seven Thematic Strategies (Commission of European Communities, 2003) have been developed according to a common approach independent of the specific content requirements relating to their subject matter - Soil protection; Protection and conservation of the marine environment; Sustainable use of pesticides; Air pollution; Urban environment; Sustainable use and management of resources; and, most relevant to this study, Waste recycling.

Existing and future supra-national legislation from the European Union regarding waste is now defining and changing the way in which the UK addresses waste management and deals with its household waste.

2.2.1 Waste Framework Directive

Legislation originally focused on the disposal of waste, but since the introduction of the Waste Framework Directive 1975 (Dir. 75/442/EEC as amended Dir. 91/156/EEC and 91/692/EEC) control over waste has extended to include the storage, treatment, recycling and transport of waste.

The Waste Framework Directive 1975 was the first European reaction to the waste problem and was inspired by the UK's timid step towards a more comprehensive waste

regulation regime (COPA). The Framework Directive required the consideration of waste minimisation, recycling and energy recovery, as well as the need to protect human health and the environment from potentially polluting developments. The Directive as an instrument aimed to introduce waste management in all European Member States and attempted to define what was to be the focus of that management. The definition of waste as found in the Directive itself (which remained the same after its amendment in 1991), is: 'Waste is any substance or object which the holder discards or intends or is required to discard'. Naturally, such a definition has been subsequently criticised as *"...imprecise and open ended, and ... member states have found difficulty applying it to the various situations which may occur in practice"*[1]. However, it seems the definition was left deliberately ambiguous. As the Directive was intended to be a framework and its aim to include as many types of waste as possible, therefore, because it would be implemented by different countries, a wide definition of waste was necessary to assist its implementation and allow countries to choose measures which could be adjusted to suit their different waste priorities. The same definition has been used in the UK since 1995 (Environmental Act 1995 under Schedule 22 repeals s.75(2) of the EPA 1990). Both the Directive and the Environment Act 1995 have a provision in their definition of waste which includes a catch all category to cover anything not on the list. Moreover, this definition has the benefit of being able to include any changing notions in the future that might occur in the waste management regime. The most relevant European Union (EU) target for household waste concerns the diversion of biodegradable waste, as set out in the EU Landfill Directive (see Section 2.9), which is a daughter Directive of the Waste Framework.

2.3 THE ENVIRONMENTAL PROTECTION ACT 1990 (EPA 1990)

In 1989, the EC issued the Community Strategy for Waste Management (EC, 1989), which was responsible for reactive changes in attitude towards the waste problem in the Community and in the UK. Based on it, the amended Waste Framework Directive in 1991 inserted an obligation (Article 3) to consider primarily the reduction of waste and its

[1] *Criminal proceedings against Euro Tombesi and Others*, Joined Cases C-304/94, C-330/94, C-224/94. Advocate General's opinion, 24 October 1996[1997] ECR I-3561, at p.9, Pocklington, D *UK Perspectives on the Definition of "Waste" in EU Legislation*, European Environmental Law Review, March 1999.

recovery instead of its disposal. In the UK, the aims of the Community Strategy (EC, 1989) were expressed in a similar manner in *This Common Inheritance* (DoE, 1990) and consequently the Environmental Protection Act 1990 introduced obligations aimed towards reaching such goals. Its main change was that it imposed an obligation on the relevant authorities to promote recycling, as well as tighten disposal controls. Section 46 of the Act gives local authorities the power to not only specify the type and number of receptacles a household requires for waste, but also the "..separate receptacles or compartments of receptacles which may be required to be used for waste which is to be recycled...", although this section was not used by many local authorities at the time. In fact, the Act was delayed and many of its provisions came into force after May 1994. What remained common under the last two relevant Acts (COPA 74, s.30 (1) & EPA 90, s.75 1), was that it was still for the holder of waste to prove that what he was in possession of, was not waste.

2.3.1 Institutional change

It was Part II of the EPA 1990 that created a network of waste managing authorities, which would balance each other in their functions and eliminate bias. Responsibilities were divided between: a) the Waste Regulating Authorities (WRAs), b) the Waste Collection Authorities (WCAs), responsible amongst other things for the drafting of recycling plans and collection of waste, and c) Waste Disposal Authorities that, in addition to other functions, practised recycling.

2.3.2 Licensing and Monitoring

A new regime was intended to be introduced under Part II of the Act. Licencing controls were intended to be stricter in the relevant provisions. However, it was not until the *Waste Management and Licensing Regulations 1994 (replacing part 1 of COPA 1974)* that most of the licensing controls were enforced. It is not considered appropriate here to analyse the provisions because they are too detailed and this chapter's aim is to provide an overview. The shift towards severity and the creation of a duty of care[2] imposed on producers, importers, keepers, disposers, etc., for the control of the waste they produce,

[2] Section 34: duty requires the prevention of commitment of offences under s.33 of the Act , escape of waste under people's control, transfer of waste to authorised person only, description of waste transferred.

shows an intention to treat the problem of waste much more seriously. It is a recognition that there is a need to tighten measures in order to ensure the bodies involved take prevention of waste more seriously.

2.3.3 Drafting Plans

Under section 50 of the EPA 1990, *Waste Disposal Plans* became an obligation of WRAs. The Plans were an attempt to assess the scale of the waste disposal problem and then devise a strategy to deal with waste more sustainably. Under section 49, *Recycling Plans* were to be drafted by WCAs, to whom discretion was given as to whether or not to require waste to be put in separate receptacles. Recycling was to take effect with the assistance of WDAs. Such plans were to be considered during the drafting of *Disposal Plans.* As recycling was afforded some statutory status, disposal seemed to be less favoured, at least in theory, and this was a major turning point in the UK for the recycling of household waste.

2.4 NATIONAL WASTE POLICY

In 1991, the amending Waste Framework Directive inserted the requirement for each member state to have a National Waste Strategy. The UK was lacking a central framework that would become the "bible" of waste management for the numerous local bodies in which the main priorities and aims would be stated. Incorporation of such a controversial and urgent matter in policy papers such as *This Common Inheritance* (DoE, 1990) and *Sustainable Development: the UK Strategy* (DETR, 1994) was not enough, as there was need for a separate document dedicated solely to managing waste. Moreover, it was not until section 44 of the Environment Act 1995 (EA, 1995) that it was formally required by the Secretary of State to draft a National Waste Strategy for England and Wales. Further, in order to stress the need for more central coordination, the Environment Act 1995 repealed the requirement under s.50 of the EPA 1990 that obliged WRAs to create regional waste disposal plans, and assigned all Waste Regulatory functions to the newly formed Environment Agency (Bell, 1997).

2.5 THE WASTE HIERARCHY

A waste management hierarchy can be traced back to the 1970s, when the environmental movement started to critique the practice of disposal based waste management. Rather than regarding rubbish as a homogenous mass that should be buried, they argued it was made up of different materials that should be treated differently – some should not be produced, some should be reused, some recycled and or composted, some should be burnt and some buried (Schall, 1992). Waste targets subsequently set in 1990 (DoE, 1990) were not statutory and lacked supporting actions and mechanisms, so it is no surprise they were never attained. In 1995, the UK government produced a White Paper called *Making Waste Work* (DETR, 1995) setting out waste targets in hierarchical order, namely, to: a) reduce landfill waste by 10% by 2005; b) recycle or compost 25% of household waste by 2000; and c) recover 40% of municipal waste by 2005. The timescale and targets set, however, were unattainable and unrealistic, probably as the government did not intend this document to be a statutory plan. Britain, unlike Europe, lacked action programmes, whether on a local or central level, and steps towards targets were only taken when targets became statutory.

2.5.1 Pre-1995

The *1991 Waste Management Paper on Recycling* (DoE, 1991) set out an order of alternatives to waste disposal as follows:

Waste minimisation
Re-use
Materials' recycling/recovery
Energy recovery
Landfill or incineration

The major new introduction in terms of priority setting was the requirement to draft recycling plans and the introduction of the *recycling credits system,* which would allow savings on the costs of disposal and collection attained through recycling to be shared

between the appropriate bodies. Aiming to guide local bodies' actions, recycling was placed above energy recovery and was to be preferred.

Despite all the new sections and guidance in 1995, the amount of controlled waste (household, commercial and industrial) continued to rise (Eurostat, 2005). *One hundred and seventy-four million tonnes of controlled waste were produced in the UK annually, of which seventy per cent ended up in landfill* (DoE, 1995). Landfill, as the least costly option was preferred. Moreover, the means to promote recycling were scarce and needed upgrading. Even though landfill was comparatively cheap the government was realising that the practice was unsustainable and that the space within landfills was limited. An alternative disposal route was needed which required the government to rethink the waste hierarchy.

2.5.2 Making Waste Work

The *Making Waste Work* (DETR, 1995) document presents the waste hierarchy as known today as:

Reduction, instead of waste minimisation;

Reuse;

Recovery, including materials' recycling, composting and energy recovery;

Disposal, landfill or incineration *without energy recovery;*

The government, instead of resorting to immediate action in establishing the facilities to deal with recycling and composting, reformed the hierarchy. Energy recovery was to be promoted to replace landfill as the most favoured disposal route. This decision relieved pressure on the UK's inadequate recycling and composting infrastructure, which at the time was much too expensive a route to deal with the diverted material (Callan, 2001). If the government could not meet the aims of a stricter pre-1995 hierarchy, it seemed prepared to adjust it to its political needs, rather than promote recycling composting and reuse. Table 2.1 shows the waste hierarchy of countries as of 1996. The UK government was in the same position as a handful of other countries, including France and Germany, which were not showing preference for material recycling over energy recovery and recycling/recovery over landfilling. However, the government's option of taking further steps to move up the hierarchy was limited by the notion of Best Practicable

Environmental Option (BPEO) which enabled decision-makers to by-pass the four levels of the hierarchy if required.

The defining criteria were set by the Royal Commission on Environmental Pollution which stated that the BPEO is the option that can provide the most benefit or least damage to the environment as a whole, at acceptable cost, in the long term as well as short (Turner, 1990). Read (2003) argued that the 'P' in BPEO should have meant 'political' rather than 'practicable'. In allowing this option to operate alongside the waste hierarchy, the government created a planning framework with built in tensions and contradictions.

Even though a draft, the *Making Waste Work* document was a statement of strategy for future waste management, the targets set omitted reference to re-use and concentrated on recovery, in particular recycling of municipal waste. Moreover, the only reduction target referred to the disposal of landfill waste, which was hardly a shift to a pro-active regime.

2.6 ENVIRONMENT ACT 1995

This Act made the important introduction under section 93-95 of '*producer and handler (of waste) responsibility*' whether in private or public sectors. Powers were given to the Secretary of State to impose responsibility on the producers of waste in the following waste sectors: a) packaging, b) newspapers, c) automotive and consumer batteries, d) electrical and electronic goods, and e) tyres and motor vehicles. The aim was to include producers in the cost of waste disposal, thereby shifting the burden of cost from the government. Additionally, deterring producers from creating the need for disposal of wastes by increasing the cost of waste management and urging them to act was now in their own interests.

In essence, a cooperative approach that moved away from strict 'command and control' and was in accordance with the principles of the free market was adopted (with value being added to waste) (Bell, 1997). The aims of the government's legislative move was to stimulate inventiveness and innovation in measures aimed at tackling *re-use, recycling and composting.*

Table 2.1 The waste hierarchy of selected Countries as of 1996 (Eurostat, 2005)

	Hierarchy exists		Waste prevention over recycling			Material recycling over energy recovery			Recycling / recovery over landfilling		
	Yes	No	Yes	No	=	Yes	No	=	Yes	No	=
	=: Same priority										
Australia	X		X			X			X		
Austria	X		X			X			X		
Canada	X		X			X			X		
Czech Republic	X		X			X			X		
Denmark	X		X			X			X		
Finland	X		X			X			X		
France	X		X					X	X		
Germany	X		X					X	X		
Hungary	X		X			X			X		
Italy		X[1)]	X			X			X		
Japan	X		X			X			X		
Korea	X		X					X	X		
Netherlands	X		X			X			X		
New Zealand	X		X			X			X		
Norway	X		X					X	X		
Poland	X		X			X			X		
Spain	X		X			X			X		
Switzerland	X		X					X	X		
Turkey	X		X			X			X		
United Kingdom	X		X					X[2)]	X		
United States	X		X			X			X		
Total	**20**	**1**	**21**	**0**	**0**	**15**	**0**	**6**	**21**	**0**	**0**

1) A hierarchical structure is applied according to the understanding of waste minimisation in the country.

2) Case-by-case evaluation is based on Best Practicable Environmental Option (BPEO).

The status of recycling was also given a boost as the relevant WCAs and WRAs (now assimilated into the Environment Agency) were given more specific recycling duties in their areas. Moreover, a duty was cast on the relevant authority to have due regard to the desirability, where reasonably practicable, of giving priority to recycling waste. Therefore, although the Act seemingly promotes recycling activities, it inserts economic considerations in the process of choice between the options of waste management.

However, even prior to its passing, the EPA 1995 and the changes it would effect, were heavily criticised as *"half-hearted and unlikely to alter the operational reality of waste recycling and disposal in any substantial way"* (Williams, 1998). Indeed, the changes effected by the 1995 Act can be described as small little steps towards waste minimisation. As the approach seems to be one of gradually moving up a choice of options of waste management, the first obvious alternative is recycling or composting. A cautious approach, however, to introducing more drastic legal measures for the promotion of waste minimisation and claiming that everything can be recycled can be justified. A Utopian ideal, such as Zero Waste, would be, in our current society, unattainable, therefore, disposal has to be closely monitored and registered. Moreover, as Turner remarks (Turner, 1990), it had been envisaged that recycling practices would reduce the amount of disposed municipal solid waste but, in reality, experience in the separation and collection of domestic waste has shown that significantly smaller amounts of waste have actually been recovered (due to contamination and lack of markets for re-sale). The increased cost of kerbside collection schemes and separation of material at the household is another justification for not recycling or composting household waste. However, this excuse is weak as, in the long term, the cost of rectifying the problematic consequences of continued and increased disposal in the UK will be considerably higher.

At this chronological stage, despite the policy statements and legislative amendments, the waste management system could be correctly described as being based on a *dispose, dilute and disperse approach* (Williams, 1998).

2.7 DISPOSAL TAX

A switch from the *dilute and disperse* approach to a new *recycle, concentrate and contained one* (Williams, 1998) can be seen at this stage. The change did not mean that disposal was not practised, but merely that it was made considerably more expensive.

A tax was introduced under the *Finance Act 1996,* aimed at *"shifting the burden of tax from labour, onto the consumption of resources"* (Waste Watch, 2006). Initially, the landfill tax was set at £7 per tonne for active waste (household waste included) and £2 per tonne for inactive waste.

It is clear that the *Polluter Pays Principle* is the basis of this legislation. The producer will bear the cost that will reflect the environmental impact of the disposal activity. The government simply aims to make disposal expensive and to promote alternative methods of waste treatment. Recycling is specifically promoted, so now waste producers in order to reduce the amount of waste go to the length of separating material into categories, some of which are not to be disposed of. As increased weight is placed on recycling and/or composting as an alternative to disposal, there is a beneficial rise in the value of recycling credits under the 1990 Act recycling credit system.

It should be noted that as the pressure on government to deliver results that are more tangible has risen, so has the rate of the landfill tax. In 1999, a £3 escalator system was introduced aiming at a culminating rate of £15, by the last financial year 2004/5[3]. In the 2003 budget, landfill tax was continued by £3 per tonne per year, moving from April 2005/6 towards a long term rate of £35 per tonne. The tax could however be criticised as inadequate in its long-term deterrent effect when compared with other EU countries like Austria, whose landfill tax is as high as £54 per tonne (Strategy Unit, 2002), and subsequent MSW recycling rate is around 50%. Also, many waste collectors prefer paying such disposal costs since they are, overall, cheaper than devising new waste disposal methods, promoting recycling, raising waste awareness and losing time in separating waste. This also raises the question as to whether there should be a parallel incineration tax? However, the purpose of raising landfill tax is not to promote incineration at the expense of all other options, but send a clear message that landfill is placed firmly at the bottom of the waste hierarchy (Strategy Unit, 2002). A differential

[3] At the moment the rate is at £18 per tonne.

incineration tax could be considered for each material type (of household waste), with the aim of controlling different material types incinerated. A higher incineration tax could be placed on unsorted waste, recyclable materials, or materials with a high level of toxicity (Strategy Unit, 2002). Friends of the Earth (FOE) registered disappointment at the low level Landfill Tax increases, strongly criticising the 2003 budget, calling it a "wasted opportunity" (Recycling World, 2003). FOE also accused the government of providing "perverse tax breaks for incinerators" and "continuing to lavish the incineration industry with undeserved subsidies" (Recycling World, 2003).

The landfill tax also has a mechanism to allow it to fund research and local projects called the Landfill Tax Credit Scheme (LTCS). At the inception of the LTCS it funded projects to appease vociferous environmental organisations (Morris et al. 1998). Consequently, in recent years, monies from the landfill tax fund are now more difficult to obtain. The landfill tax itself has acted as a catalyst for change and there is growing awareness of sustainable waste management, and the LTCS (despite the projects for vociferous organisations) has funded numerous worthy projects (Morris et al. 2001).

2.8 WASTE MINIMISATION ACT 1998

The Waste Minimisation Act 1998 was the first piece of UK legislation to deal specifically with waste minimisation. This act is a direct result of a pressure group's lobbying in Parliament. It enables local authorities to do anything they consider necessary or expedient for minimising the quantities of controlled waste in their area. However, they are not permitted to impose any restrictions or requirements on businesses or individuals. The 1998 Act delegates powers to local authorities to *make arrangements to minimise the generation of waste in their area,* by inserting s.63A in the EPA 1990, which allows the local bodies concerned to promote schemes by arranging, advertising, or contributing to them. The new powers enable local authorities to set up initiatives, such as including waste minimisation strategies in waste plans, providing the public with information about alternatives to wasteful products, including waste reduction targets in waste contracts, and introducing repair schemes for household appliances.

Increased waste generation is linked to increased consumption of goods within society (Eurostat, 2005). Reduction in demand may occur through education and initiatives to

assist communities and their individuals to understand the imperative need to create less waste. It follows that if consumption patterns decrease, then so will waste generation. The EU's top priority at this moment in time (Commission of European Communities, 2003) is to try to decouple waste generation from economic growth. Moreover, it is thought the public need to be shown ways to re-use and recycle and be assisted to practise them. To this end, the needs of local communities should be considered and assessed, as this is something that cannot be done at a central level. The Act is designed to encourage local level cooperation and advocates exchange of information, practices and methods between local authorities. Central guidance is necessary to ensure all local efforts have the same direction. Although it seems wise to allow local authorities some freedom to act where they think fit without having to ask for central government approval, as this may prove time consuming and non-effective in the long-term.

The Act aims at minimisation of household waste in the UK. Such a legislative response to the problem is welcomed, however, it is not unfair to criticise the Act as too undefined. Some guidance to local government is considered necessary. Making primary legislation available without any instructions is not a well-constructed solution to the problem. For example, a self-assembly tool is of no use if there are no instructions. It is surprising that since the Act 1998, waste minimisation activities such as the waste minimisation clubs discussed and explained in detail by (Read, 1997), have not proliferated, perhaps because of lack of government financial support, which tends to be focused on recycling and composting initiatives. Most local authorities' only form of waste minimisation is the implementation of home composting schemes, conforming not only to legislative compliance, but also reducing collection and disposal costs (Bench et al. 2005). The fact remains that the amount of household waste in Wales is still on the increase, by an amount of 1%-3% per annum (see Chapter 3, Figure 3.5) and therefore more action needs to be taken on the waste reduction and minimisation front.

2.9 LANDFILL DIRECTIVE 1999

The Landfill Directive 1999/31/EC contains far-reaching legislation that impacts both on the management of waste and on specific waste streams. The Landfill Directive aims to improve standards of landfilling across Europe, by setting specific requirements for the

design, operation and aftercare of landfills, and for the types of waste that can be accepted at landfill sites. It seeks to steadily divert biodegradable waste away from landfill treatment by other means, including composting and anaerobic digestion.

- Article 5 (2) of the Directive requires a substantial reduction in the amount of biodegradable municipal waste (BMW) being landfilled
    - by 2010 to reduce BMW landfilled to 75% (by weight) of that produced in 1995
    - by 2013 to reduce BMW landfilled to 50% (by weight) of that produced in 1995
    - by 2020 to reduce BMW landfilled to 35% (by weight) of that produced in 1995

The significant diversion of BMW is required because as biodegradable (organic) waste decays, it gives rise to methane and CO_2, both major greenhouse gases, and a liquid leachate that can pollute ground water and surface water. Biodegradable Waste (BW) is defined in the Directive as "waste that is capable of undergoing anaerobic or aerobic decomposition, such as food and garden waste, paper and cardboard". The Directive also:

- required a plan for the reduction of all biodegradable wastes in landfill to be produced by 2003
- bans the landfilling of:
    - waste which is corrosive, oxidising, highly flammable, flammable or explosive
    - liquid hazardous waste, infectious hospital and other clinical wastes
    - whole used tyres (from 2003)
    - shredded tyres (from 2006)

The Directive classifies landfills as hazardous, non hazardous, or inert waste and prohibits the co-disposal of hazardous and non-hazardous waste after July 2004. It also requires that waste must be pre-treated before being landfilled and that landfill gas must

be collected, treated and used to produce energy. This means that if the gas cannot be used it must be flared.

The Directive applies to all sites that were accepting waste on 16th July 2001. Larger landfill sites taking wastes other than inert wastes are also subject to the Integrated Pollution Prevention and Control (IPPC) Directive (96/61/EC).

2.10 THE WASTE STRATEGY 2000 FOR ENGLAND AND WALES

An overview of the waste policy of the current Government was set out in the Waste Strategy 2000 (DETR, 2000). The Strategy set out a national framework for reducing the amount of waste going to landfill by moving towards more sustainable waste management options.

The strategy was expected to present "tough" targets to deal with the waste. Due to the strategy's nature, i.e. stemming from statutory provisions and taking the form of a statutory plan, it was expected to entail commitments that the government would be expected to fulfil.

The strategy for England and Wales included a target to reduce the amount of biodegradable waste being sent to landfill. It also specified recycling and composting rate targets for local authorities. These rates were confirmed as statutory targets in March 2001 with the release of a central government publication *Guidance on Municipal Waste Management Strategies* (Department of the Environment, Transport and the Regions, March, 2001). Targets set for 2003 and 2005 used 1998/99 as a baseline.

- The targets aimed to raise the national household recycling rate to 17% by 2003/04;
- After which, each authority had individual targets to bring the rate up to 25% by 2005/06, 30% by 2010 and 33% by 2015.

To encourage more efficient use of resources and to obtain value from waste, the Government set other targets for the recovery of waste which seem to be significant:

- To recover at least 40 per cent of household waste by 2005
- To recover at least 45 per cent of household waste by 2010

- To recover at least 67 per cent of household waste by 2015

The inclusion of recovery targets in the strategy reflected the way in which the hierarchy was altered in 1995 (DETR, 1995), and confirmed the UK Government's stance of equal priority to material recycling and energy recovery.

However, a local authority could view the strategy's targets on recycling, composting and recovery of household waste, differently, as they were not legally binding and furthermore had no direct financial penalty.

In its effort to limit the use of landfill, the government focused attention on the recovery of value from waste, to justify its then practice of increasing the number of incinerators. It could be argued that all previous efforts to promote proper material recovery, i.e. composting and recycling, appeared to be undermined by the UK's 19 MSW incinerators and proposals to build many more (Ramboll, 2006). Conclusions should, however, be drawn with care. It would appear that the switch in 1995 (DETR, 1995) from the previous hierarchy, where incineration was a disposal option at the bottom of the hierarchy, to energy recovery being placed at the same level as recycling and composting was employed to overcome the shortcomings in the UK's waste management system. It should be remembered that the government was and still is under pressure from the European Landfill Directive 1999 (Dir. 99/31/EC) to limit land-filling, but does this justify resorting to another disposal option, i.e. incineration? Again, it can be argued that energy from waste plants recovers some of the value in waste, but, without Combined Heat and Power (CHP) such plants are relatively inefficient at extracting around 22%-28% electrical efficiency from raw waste (Hardwick, 2006). Approximately 30 million tonnes of municipal solid waste is produced in the United Kingdom each year. This tonnage has the same approximate energy equivalent as 10 million tonnes of coal or 5 million tonnes of oil, representing a substantial theoretical energy potential (Hardwick, 2006). In 2001, the promotion of incineration was heavily criticised in the House of Commons: *"We do not accept energy from waste incineration is a renewable form of energy..."* and *"...incineration will never play a major role in truly sustainable waste management"* (Select Committee on Environment, Transport and Regional Affairs, 2001).

Under the Waste Strategy 2000, the Best Practicable Environmental Option (BPEO) had be taken into account when considering the merits of various waste management options (House of Commons, 2003). Therefore, unsurprisingly, individual material considerations were prioritised, in other words, where there is a well established market for recycling a material, like the reprocessing of aluminium, the chances were that the material would be 'recycled'. However, some materials, such as certain plastics, had poor markets, low bulk densities, and high calorific values, and therefore could easily be justified under BPEO for incineration or energy from waste.

At the end of 2001, the Prime Minister's Strategy Unit (SU) was tasked with carrying out a review of the Waste Strategy 2000 for England and Wales. The aim of the review was to analyse the scale of the challenge posed by the growing quantities of municipal waste and to devise cost-effective and practical measures for addressing the challenge, with particular consideration given to the implications of Article 5 of the landfill directive (which sets the targets for the reduction of biodegradable waste to landfill). The SU report entitled *Waste Not, Want Not,* published in November 2002 (Strategy Unit, 2002), was not a statement of government policy, but a contribution to the debate. It made a number of recommendations, the majority of which have been accepted by the Government. The Government published a response to the Strategy Unit's report in May 2003 and also set up the Waste Implementation Programme (WIP), managed by DEFRA. The WIP comprises eight work streams:

1. Local authority funding
2. Local authority support
3. Data
4. Research
5. New technologies
6. Waste minimisation
7. Recycling (focus on organics)
8. Waste awareness

The aim of the programme is to divert increasing volumes of biodegradable municipal waste away from landfill and move the treatment of waste up the waste hierarchy to

improve the sustainability of waste management. The WIP programme is investigating proven new technologies to deal with the problems being encountered in attempts to meet UK recycling, composting and reduction targets.

The Waste Strategy 2006 applies just to England and is currently under consultation. All indications are that the Government will start to emphasise the need for MSW to be treated to generate energy from waste. Energy from Waste (EfW) currently accounts for 9% of MSW disposal but according to DEFRA that must increase to 27% by 2020 (Letsrecycle, 2006a). Mr Speight, a member of the Commission's Sustainable Consumption and Production Unit, states that incinerators achieving a high degree of efficiency in generating energy from waste may be classed as recovery processes, and those not achieving certain levels classed as disposal processing units (Letsrecycle, 2006b). The intended incineration increase is a significant legislative development and the pressure group, Friends of the Earth (FOE) has promised "fierce opposition from local communities" if the government backs the increase in the number of incinerators used in the UK (Letsrecycle, 2006c).

2.11 THE ANIMAL BY-PRODUCTS REGULATIONS 2003 (SI 1482)

The Animal By-Products Regulations were phased in after the Foot and Mouth outbreak in 2001. The principal impact on municipal waste management is that domestic kitchen, or waste that has been in direct contact with kitchen waste, is classed as catering waste and cannot be composted in open windrow conditions. The impact on the collection and diversion of household organic waste is substantial for green waste or any waste that has been in contact with meat waste. There is a ban on open windrow for material that has come into contact with meat waste or could potentially contain meat waste. The only way this material can be processed is in closed vessels or under cover, to ensure that all pathogens are reduced to an acceptable level.

2.12 THE HOUSEHOLD WASTE RECYCLING ACT 2003

The Household Waste Recycling Act 2003 provides that where English waste collection authorities (WCAs) have a general duty to collect waste they shall ensure, except in some circumstances, that by December 31st 2010 they collect at least two types of recyclable waste separate from the rest of household waste. The circumstances where they do not

do so will be where the cost of doing so is unreasonably high or where comparable alternative arrangements are available. At present, the Act applies to England only, however, it may be applied to Wales if the National Assembly Government feels it would be appropriate.

2.13 OTHER UK WASTE LEGISLATIONS AFFECTING HOUSEHOLD WASTE

It is worth mentioning the following legislations that will have an effect on household waste. However, whether they will directly affect the diversion of household waste at kerbside has yet to be seen. The Clean Neighbourhoods and Environment Act 2005, for example, contains a range of measures to improve the quality of the local environment by giving Local Authorities and the Environment Agency additional powers to deal with:

- fly-tipped waste
- litter
- nuisance alleys
- fly-posting and graffiti
- abandoned and nuisance vehicles
- dogs
- noise,
- nuisance from artificial lighting and insects, and other issues affecting the local environment. It also puts the Commission for Architecture and the Built Environment (CABE) on a statutory basis.

It makes it an offence to drop litter anywhere, including private land and rivers, ponds and lakes. It gives local authorities new powers (litter clearing notices) to require businesses and individuals to clear litter from their land. The Act strengthens existing powers for local authorities to require local businesses to help clear up litter they generate (street litter control notices). It enables local authorities to restrict the distribution of flyers, hand-outs and pamphlets that can end up as litter. It also confirms that cigarette butts and discarded chewing gum are litter.

It amends provisions for dealing with fly-tipping by:

-removing the defence of acting under an employer's instructions

- increasing the penalties- enabling local authorities and the Environment Agency to recover their investigation and clear-up costs

- extending provisions on clear up to the landowner in the absence of the occupier.

It gives local authorities and the Environment Agency the power to issue fixed penalty notices (and, in the case of local authorities, to keep the receipts from such penalties) to:

- businesses that fail to produce waste transfer notes

- waste carriers that fail to produce their registration details or evidence they do not need to be registered

- parties leaving waste out on the streets (local authority warrant only)

The Act introduces a more effective system for stop, search and seizure of vehicles used in illegal waste disposal. It also introduces a new requirement for site waste management plans for construction and demolition projects. It repeals the divestment provisions for waste disposal functions to provide greater flexibility for local authorities to deliver waste management services in the most sustainable way.

Also the Act reforms the recycling credits scheme to provide increased local flexibility to provide incentives for more sustainable waste management. The Act enables local authorities to recover the costs of dealing with abandoned shopping trolleys from their owners. It also increases the penalty for various offences relating to pollution.

Other legislations that will have (or are having) an effect on household waste include:

- The Producer Responsibility Obligations (Packaging Waste) Regulation 1997 and Packaging (Essential Requirements) Regulations 1998 which set targets for those involved in the packaging industry chain, from raw material production to retailer selling and recovery and recycling of packaging waste. This does not apply to local authorities directly, but the industry may be encouraged to form strategic partnerships to facilitate the collection and recycling/recovery of packaging waste from the household waste stream.

- The Waste Electrical and Electronic Equipment (WEEE) Directive (2002/96/EC) has been adopted and received Royal Assent in November 2003. It places an obligation on manufacturers to collect and recycle WEEE. One outcome will probably be that local authorities may be required to provide (but not fund) facilities at household waste recycling centres to receive these items from householders. It is thought unlikely that kerbside separation of WEEE will be a desired option.
- Similarly, the Batteries Directive (Directives 91/157/EEC, 93/86/EEC, 98/101/EC) is likely to result in local authorities having to provide separate deposit facilities for batteries, again most likely at HWRCs and unlikely to occur as part of kerbside separation.
- The Biowaste Directive is no longer being moved forward (www.compost.me.uk June 2005). It is most likely that the requirements of the Directive will be promoted through other legislative instruments. The Biowaste Directive is intended to encourage the recycling of food waste to agricultural land to improve the organic quality of soil and its macro and micro-nutrients. If this Directive is implemented, local authorities will be forced to adopt separate collection schemes for food waste. The Biowaste Directive was drafted according to a mandate included in the EC Communication on the Soil Strategy in order to set quality standards for composted products to ensure safe long-term beneficial application, prevent any damage to soil resources, preserve soil properties, with particular reference to croplands, and to boost recovery of organic matter to fulfil the various goals stressed by the EC Communication itself (to fight against erosion and desertification, improve use of soils as a "sink" of carbon, enhancement of biological fertility and biodiversity, etc.).

2.14 WALES: A DISTINCT LEGISLATIVE POWER

Devolution in Wales has prompted the setting up of the National Assembly for Wales and the emergence of a more distinct Welsh legal order. There is a distinct Welsh perspective on general legal principles within the common legal system of England and Wales.

The Government of Wales Act 1998 largely defines the make-up, powers and functions of the National Assembly. It does not have the power to make primary legislation, but enjoys extensive executive powers and may make secondary legislation (i.e. orders and regulations fixing the detail of implementation). Uniquely among EU Nations, the National Assembly for Wales has a binding legal duty to pursue sustainable development in all it does. This is built into its constitution through Section 121 of the Government of Wales Act (National Assembly Government for Wales, 1998).

The notion of sustainability became established as a formal policy objective on a global scale, as a consequence of the United Nations Conference on the Environment and Development (UNCED), Earth Summit in 1992 (UNCED, 1992). The Earth Summit in Rio set out a series of objectives under Agenda 21 to works towards sustainability in general and also more specifically for waste management. The goal of sustainability lies at the heart of Wales's constitution.

2.14.1 Wales's Waste Strategy 2002

Using its powers to make secondary legalisation under the devolved administration, the Welsh Assembly Government has made an independent commitment to improving waste management in *'Wise about Waste'* its own National Waste Strategy published in June 2002 (National Assembly Government for Wales, 2002). The general aims of the strategy are intrinsically linked to and echo the European goals. These are to reduce the amount of waste that is disposed of in landfill sites and to increase quantities of recyclable materials. The Strategy contains minimum recycling and composting targets for Welsh local authorities to deliver:

- by 2003/4 a minimum of 15% of Municipal Solid Waste (MSW) must be recycled or composted, with a minimum objective for each category of 5%.
- 25% MSW by 2006/7, with a minimum objective for each category of 10%.
- 40% MSW by 2009/10, with a minimum objective for each category of 15%.

It should be noted that only source segregated materials will count for composting.

The Welsh targets go further than the English ones by including minimum objectives for the two distinct categories of recycling and composting and stating that only source segregated composting material will count towards the Waste Strategy target. The targets

are for MSW in Wales and for household waste as in England. The Welsh Strategy also includes targets for the stabilisation and reduction of household waste so that by 2009/10 (and to apply beyond) waste arisings per household should be no greater than those (for Wales) in 1997/8 and that by 2020 waste arisings per person should be less than 300 kg per annum.

2.14.2 Landfill Allowance Scheme (Wales) Regulations 2004

The Landfill Allowance Scheme (LAS) (Wales) Regulations 2004, which came into force on 1st October 2004, limit the amount of Bio-degradable Municipal Waste (BMW) going to landfill. This is a Welsh Assembly Government initiative to ensure that the EC Landfill Directive is met.

As stipulated by Article 5(2) of the Landfill Directive, the amount of BMW going to landfill has to be substantially reduced. The LAS provides a stimulus by which this will be achieved. The Waste and Emissions Trading (WET) 2003 Act established the UK framework for the Landfill Allowance Schemes in England and Wales.

2.14.3 How will LAS impact on Waste Disposal Authorities in Wales?

Section 4 of the WET 2003 Act requires "the Welsh Assembly to allocate allowances to Waste Disposal Authorities in Wales". The *Landfill Allowance Scheme* for each waste disposal authority will be based on the amount of BMW sent to landfill from the latest year of validated data (2001-02). A study commissioned by the Welsh Assembly Government on the composition of municipal solid waste in Wales was published in December 2003. The study found that overall biodegradable content of municipal solid waste in Wales was 61%.

For the year 2004/05, the scheme ran for six months, starting October 1st 2004 until 31st March 31st 2005, from which it will operate on an annual basis, i.e. April 1st 2005 – March 31st 2006. The regulations for Wales will impact on Waste Disposal Authorities (WDAs), Landfill Operators and the Environment Agency (EA), which itself is designated as the Monitoring Authority.

The WET 2003 Act sets a legal framework within which the landfill allowance scheme will operate. The National Assembly for Wales will implement the scheme in Wales. The

maximum landfill allowances currently available for allocation within Wales, in Directive target years, are as follows:

i) 2010 710, 000 tonnes of BMW

ii) 2013 470, 000 tonnes of BMW

iii) 2020 330, 000 tonnes of BMW

The Welsh Assembly Government proposes that the penalty for failing to meet landfill allowance targets, in any year, will be financially based. Currently, this is £200 for each tonne of BMW landfilled in excess of the allowance limit set for any particular disposal authority.

The Welsh Assembly Government has also decided that landfill allowance allocations for the first year of the scheme, 2004, will be based on landfill need. The landfill need for each Waste Disposal Authority will be taken to be the amount of BMW sent to landfill in the latest year for which validated data are available. The proportion of biodegradable material in municipal waste that is landfilled will be assumed to be the same across all authorities in Wales, at 61%, as previously indicated. The allocations of landfill allowances to meet the EC Landfill Directive's 2010 target are based upon the proportions of waste arising in each local authority using 2001/2 data. The allowances allocated to a local authority for each year of the scheme are based on a linear reduction from 2004 to 2010.

The Welsh Assembly Government has allocated each waste disposal authority in Wales a maximum quantity that it may landfill in each year from 2004 to 2020. In all scheme years whether target (2010, 2013 and 2020) or non-target, waste disposal authorities may not landfill more BMW than their allowance permits.

2.15 SUMMARY

The above sections have shown the evolution of household waste legislation in the UK.

The British style of waste regulation has been characterised as 'pragmatic'[4], 'informal and based on bargaining' (Harlow et al. 1997), 'secretive' (Vogel, 1996) and favouring 'voluntary compliance' (Vogel, 1996), the latter probably evolving from British

[4] See, for example, L.Hanchers's description of the British style of enforcing competition policy in the area of pharmaceuticals regulation. L.Hancher, 'Regulating Drug Prices: The West German and British Experience' in L.Hancher and M.Morgan, Capitalism, Culture and Economic Regulation (Oxford: Claerdon Press, 1989), pp.79-108.

liberalism and a society promoting the expression of individualism, even in the face of state authority, and contrasting strongly with waste regulation in, for example, Germany, that has in contrast strict application of formal rules and a tendency to avoid extensive interpretations (Lange, 1999).

With regard to diversion of household waste away from landfill, Wales has a distinct legal order different to that of England, due to the National Assembly government's ability to implement secondary legislation. Welsh legislation has taken great steps recently to commit to EU legislation and policy. Of overriding significance is the Welsh legal commitment to sustainable development as written into its defining constitution.

The most demanding piece of EU legislation for the diversion of household waste away from landfill is the Landfill Directive. This will be met by traditional household waste diversion routes of bring sites, household waste recycling centres (HWRCs) and kerbside recycling and composting collection schemes. Alternative technologies (and/or a substantial change to kerbside collection schemes) will also play a role in meeting diversion targets (see Chapter 8, Section 8.7).

The Assembly Government has implemented separate pieces of legislation in an attempt to meet the BMW diversion requirements stated in the EU Landfill Directive. The 'Wise About Waste' target for MSW recycling and/or composting of 40%, with a minimum of 15% of each category by 2010 will be a major driving force in household waste diversion, along with introduction of the Landfill Allowance Scheme (LAS). The LAS presents a more serious incentive for local authorities to divert BMW away from landfill, as non-compliance will mean a financial penalty for every tonne of BMW landfilled over the allowance.

Importantly, the Assembly Government states that only source segregated compost will count towards the Strategy target, in other words, only green waste collected at HWRCs or at kerbside will qualify, thus ruling out BMW diversion through alternative technologies to aid Strategy composting targets. The inclusion of any green waste diversion at kerbside or HWRCs towards the Strategy target is complicated by the Animal By-Product Regulations (ABPR) 2003, requiring in-vessel composting treatment of any waste potentially contaminated by meat waste (as most could potentially be).

Paper and cardboard also constitute a large fraction of household waste and are bio-degradable wastes, increasing the need for diversion prior to disposal.

In Chapter 2 the need for household waste diversion at the kerbside has been explained by the driving legislative framework. The scale of the Welsh problem will become clearer in Chapter 3.

CHAPTER 3

3 THE SCALE OF THE PROBLEM

Chapter 3 will quantify the scale of the waste problem in the European Union (EU), the United Kingdom (UK) and, in particular, Wales. An overview of waste arisings from all sectors will be looked at for the EU and UK. The focus will then turn to the difference in diversion routes for MSW away from landfill, comparing all EU countries. An analysis of present day MSW management practices in Wales will lead into a summary of the latest data on household waste generation per person in Wales, before explaining household waste's current composition. Traditional diversion routes of household waste away from landfill will then be examined, highlighting the different types and extent of kerbside recycling schemes operating in Wales.

It is important to note that this thesis will not at any point go into the environmental reasons and or potential benefits of recycling waste and living in a resource efficient society whilst the legal obligations relating to household waste have been discussed in Chapter 2.

3.1 OVERVIEW OF WASTE ARISINGS IN THE EUROPEAN UNION (EU)

It is estimated that around 2 billion tonnes per annum of waste are generated from all sectors in the EU-15 (EU-15 refers to the 15 members states of the European Union in the period prior to enlargement in 2004: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom) (Eurostat, 2005). According to Eurostat (2005), it is difficult to pinpoint the exact amount of waste arisings in the EU annually for many reasons, Figure 3 should therefore be used as an estimate of EU waste arisings per sector. As aforementioned the data available from each sector are subject to uncertainties, but Eurostat has calculated that almost a third of the total waste comes from agriculture and forestry and broadly the same amount from construction and demolition. A similar amount is contributed by the mining and quarrying and manufacturing sectors. Municipal waste comprises 6.1% of total arisings as shown in Figure 3.1.

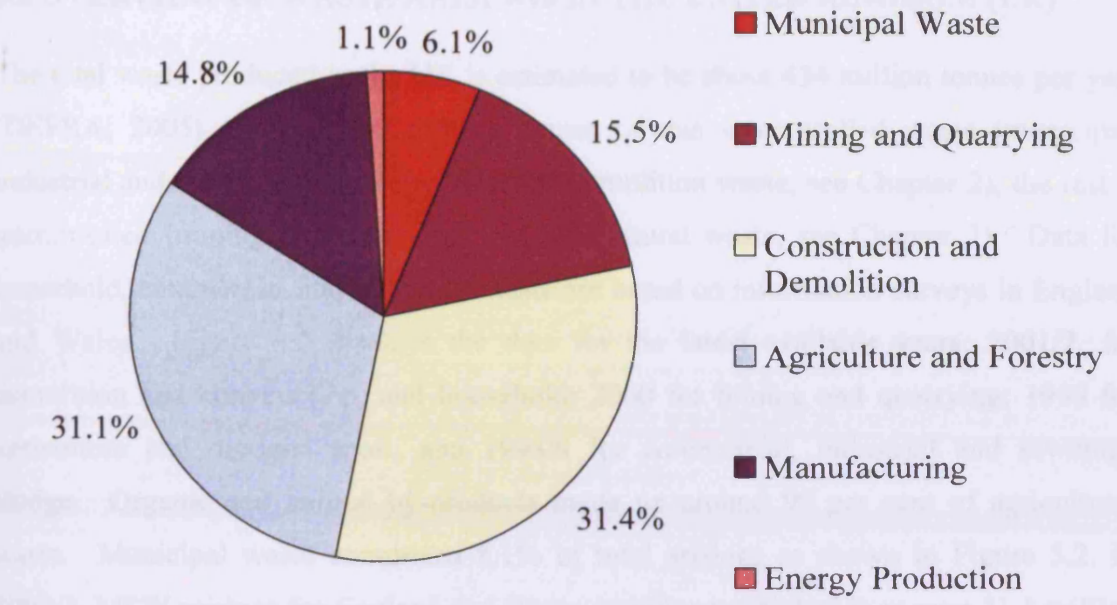

Figure 3.1 Estimated annual waste generation in the EU-15, by sector

Source: Eurostat, 2005. Figure uses latest data from 2001.

Data limitations prevent a comprehensive assessment of most waste streams in Europe. However, recent reports convey some current trends in waste generation. In its third assessment of Europe's Environment, the European Environment Agency (EEA) (2003) reports that "Total waste quantities continue to increase in most European countries. Municipal waste arisings are large and continue to grow". Indicators from a study conducted by the Organisation for Economic Co-operation and Development (OECD) in 2001 suggest increasing waste generation for some waste streams, with increases in MSW being significant. Municipal waste generation was highlighted by the OCED, (2001) as one of five 'red light' sources (needing to be addressed urgently) for pressures on the environment (ESTO, 2003). It is generally agreed that in the absence of policy measures, waste generation in the EU is likely to increase for the foreseeable future. The OECD (2001) estimated that MSW generation in the OECD region will increase by 43% between 1995 and 2020, reaching 640 kg of MSW per person.

3.2 OVERVIEW OF WASTE ARISINGS IN THE UNITED KINGDOM (UK)

The total waste produced in the UK is estimated to be about 434 million tonnes per year (DEFRA, 2005). About 250 million tonnes of this is controlled waste (municipal, industrial and commercial, construction and demolition waste, see Chapter 2), the rest is uncontrolled (mining and quarrying, and agricultural waste, see Chapter 2). Data for household, commercial and industrial waste are based on information surveys in England and Wales. Figure 3.2 displays the data for the latest available years: 2001/2, for demolition and construction, and household; 2000 for mining and quarrying; 1999 for agriculture and dredged spoil; and 1998/9 for commercial, industrial and sewerage sludge. Organic and animal by-products made up around 99 per cent of agricultural waste. Municipal waste comprised 8.1% of total arisings as shown in Figure 3.2. In 2002/3, MSW arisings for England and Wales combined, weighed in at over 31.1 million tonnes. When it is considered that data reported for the EU are comprised of some estimated arisings, MSW arisings from the UK (8.1%) are comparable to the average of 6.1% found in the EU-15.

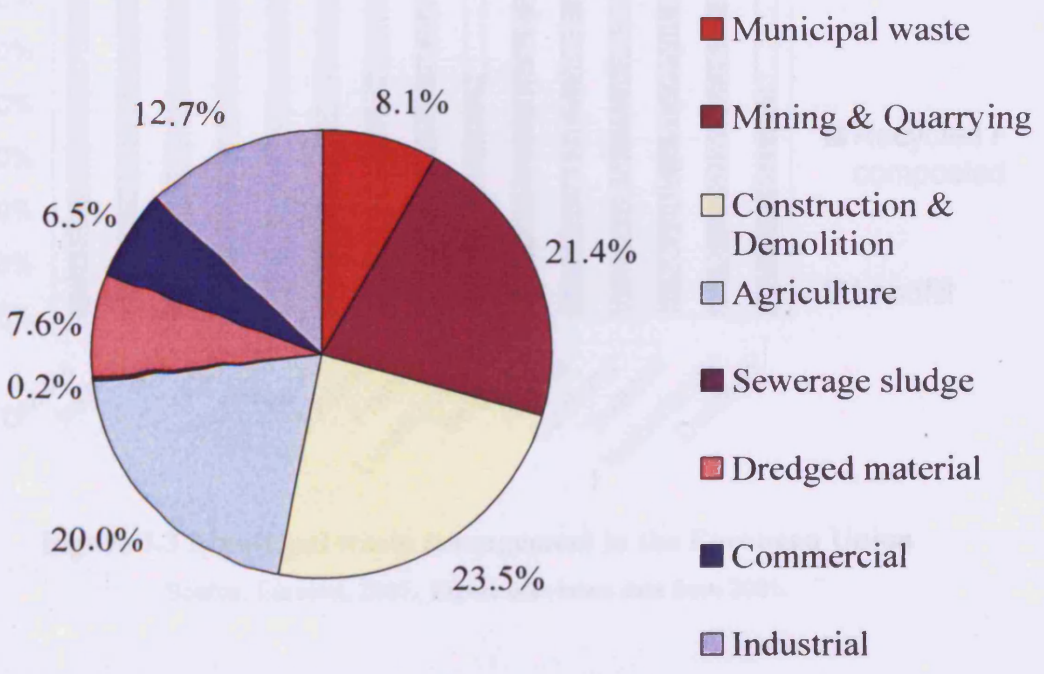

Figure 3.2 Estimated annual waste generation in the UK , by sector

Source: DEFRA, 2005.

3.3 TREATMENT ROUTE OF MSW IN THE EU

It is estimated that around 550 kilogrammes of municipal waste is produced on average by each person in the EU-15 countries (Eurostat, 2005). Figure 3.2 shows that Greece, Ireland, the United Kingdom and Italy dispose of three-quarters or more of their municipal waste to landfill while Denmark, the Netherlands, Sweden and Germany dispose of a quarter or less of their municipal waste in that way. In Denmark and Luxembourg, incineration is the single main method of disposal and over half of their municipal waste is treated in that way. Austria recycles or composts over 60 per cent of its municipal waste and Belgium and the Netherlands recycle or compost almost half of theirs. It should be noted that only broad comparisons can be made between countries because of differences in definition of Municipal Solid Waste (MSW).

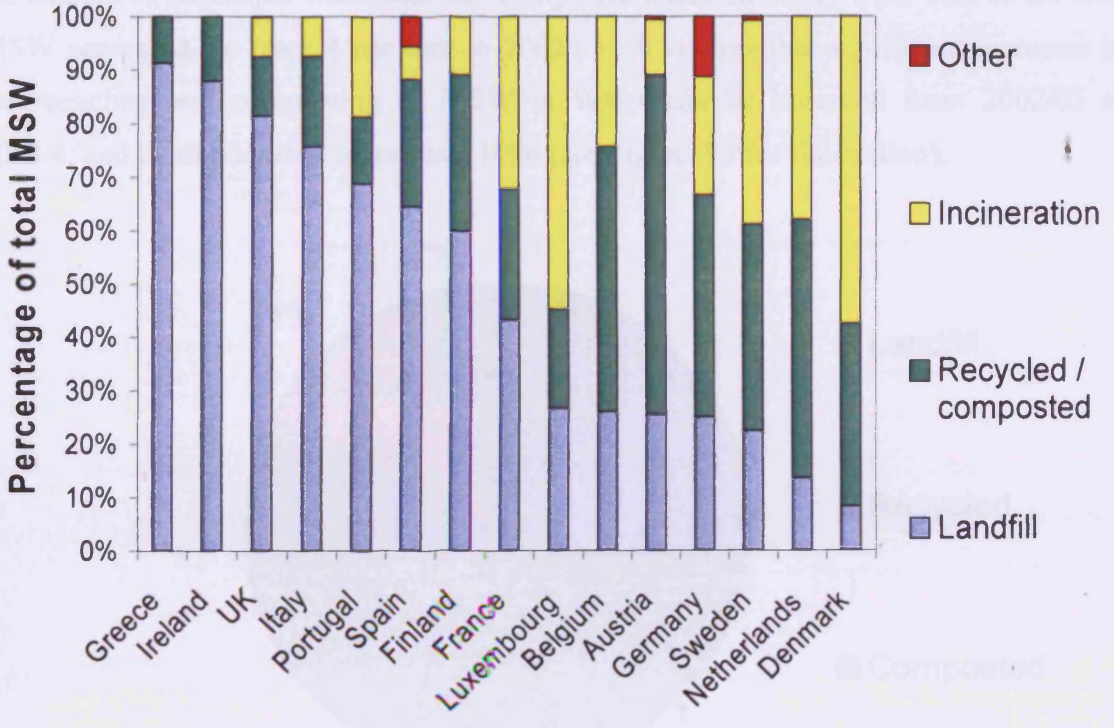

Figure 3.3 Municipal waste management in the European Union

Source: Eurostat, 2005. Figure uses latest data from 2001.

3.4 MSW DISPOSAL IN WALES

Landfill in Wales was the dominant waste disposal method in 2003/04, making up 83 per cent of the total (see Figure 3.4), this was down from 87 per cent in 2002/03. Also, for the

first time in recent years, the actual tonnage of waste being disposed of in this way decreased.

In Wales in 2003/4, about 319 thousand tonnes of waste (17.6 per cent of the total MSW) went for either recycling or composting. It should be noted that these recycling and composting figures exclude abandoned vehicles and are not National Assembly for Wales Performance Indicators (NAWPI) since some other waste items are also excluded, i.e. beach cleansing waste, incinerator residues and rubble. The 2003/4 NAWPI approved MSW recycling and composting rate for Wales was 16.5 per cent, which achieved the first target set in Wales' Waste Strategy – Wise About Waste 2002, to recycle/compost 15 per cent of MSW by 2003/4. The amount of municipal waste that was recycled made up nearly 11 per cent of the total MSW generated, up from 8.7 per cent in 2002/03. Also, the amount of municipal waste that was composted made up nearly 6 per cent of the total MSW generated, up from 4 per cent in 2002/03. It is clear that significant increases in the recycling and composting of MSW in Wales can be observed from 2002/03 to 2003/4, and in all previous years since 1996 (see Figure 3.5 for illustration).

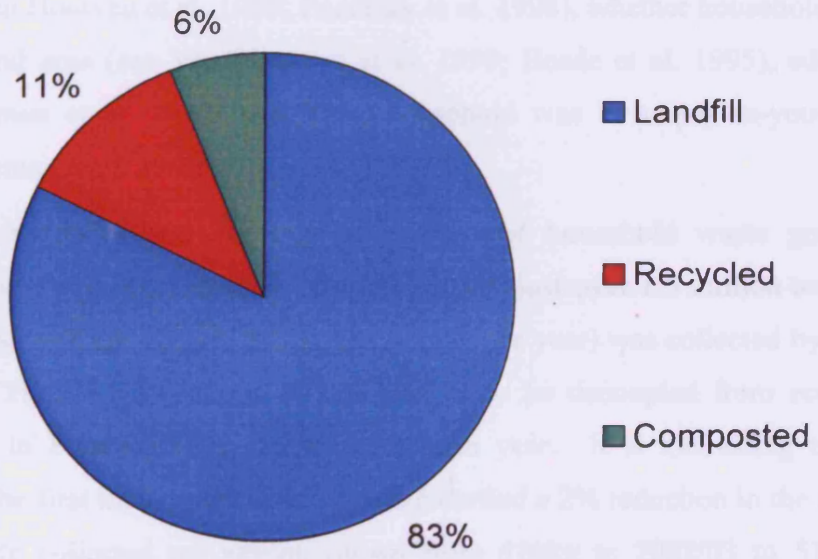

Figure 3.4 Municipal Waste Management : Wales 2003/4

Source: National Assembly for Wales, (2005).

3.5 HOUSEHOLD WASTE GENERATION IN WALES

Household waste includes household bin waste and also waste from Household Waste Recycling Centres (HWRCs), kerbside recycling schemes and bring sites. It should be noted that MSW and household waste, although similar, are not identical. It is useful to note at this stage that MSW consists of a number of different waste categories, and since there seems to be no case law ruling on its current definition, its exact legal definition is pending the UK's first dispute (see Chapter 2, Introduction).

Waste from household sources in Wales (1.52 million tonnes) accounted for 83 per cent of municipal waste in 2003/4. This compares to England where, in the same year, household sources accounted for around 87 per cent of municipal waste or 25.4 million tonnes (DEFRA, 2005).

In the 1970s, some studies examined the impact of socio-economic factors on the generation of solid waste (see Richardson, 1974, 1978; Wertz, 1976). The results showed that household income had a statistically significant but inelastic impact on household waste generation along with average household size (see Jenkins et al. 2003; Hong et al. 1999), age (see Van Houtven et al. 1999; Podolsky et al. 1998), whether households were in an urban or rural area (see Van Houtven et al. 1999; Beede et al. 1995), education levels (see Kinnaman et al. 1997) and if the household was in a 'pay-as-you-throw' scheme (see Kinnaman et al. 1996).

In Wales, between 1996/7 and 2003/4, the amount of household waste generated increased by around 19 per cent in total. During 2003/4, just over 1.5 million tonnes of household waste (an average of over 523 kg per person per year) was collected by Welsh local authorities. Household waste in Wales has yet to be decoupled from economic growth as shown in Figure 3.5 by the increase each year. It is interesting to note, however, that for the first time, in 2003/4 England recorded a 2% reduction in the amount of household waste collected per person (down from 520kg in 2002/03 to 510kg in 2003/04) (DEFRA, 2005). It remains to be seen if this is a continuing trend or a temporary reprieve for landfill.

There is a wide variation in total household waste generation rates with some countries (Poland, Finland and the Slovak Republic) having household waste generation rates less than 250 kg per annum in 2000, and others (Denmark, the Netherlands and Luxembourg) having rates in excess of 500 kg per annum (Johnstone et al. 2004).

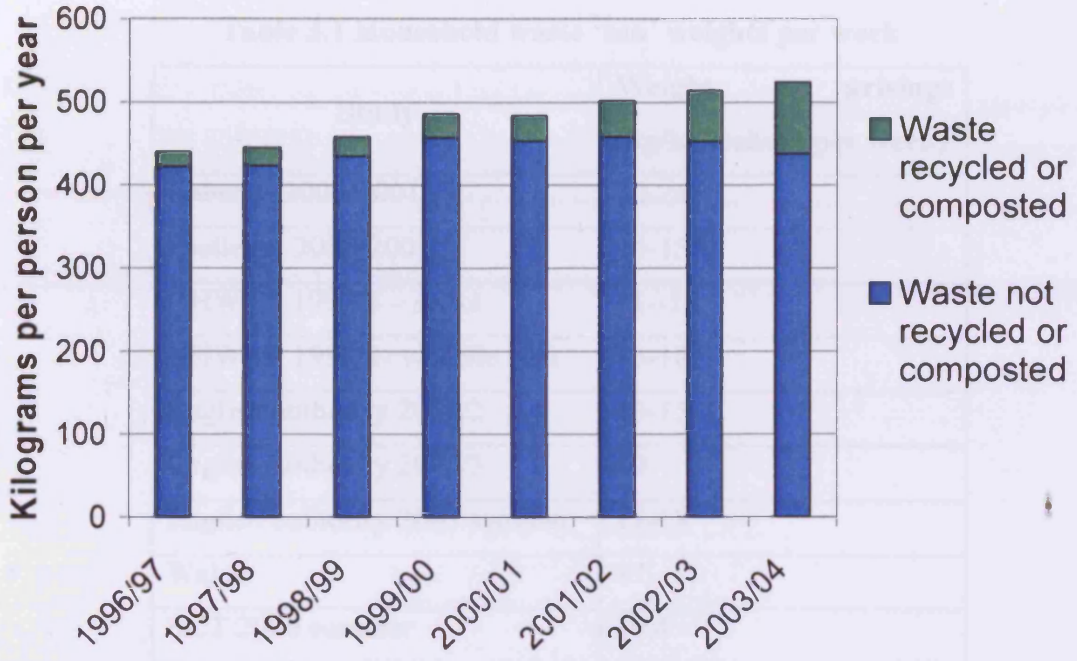

Figure 3.5 Household Waste Generation: Wales, 1996/97 to 2003/04

Source: Data collected from the National Assembly for Wales (2005). Calculation based on 2,903,085 residents in Wales - National Statistics, (2001).

3.6 Household waste composition in Wales

The most recent household waste analysis performed in Wales was conducted between 2001- 2003 by AEA Technology on behalf of the National Assembly for Wales, (2003). The study found that the average Welsh household put 17kg of 'bin' waste per week out for collection. This figure is comparable to other analyses across the UK (see Table 3.1 for further studies). Household waste generation comprises of all household waste sources and includes 'bin' waste, kerbside recycling and waste taken to household waste recycling centres and bring sites. As shown previously in Figure 3.5, the average Welsh resident generates 523 kg of household waste per annum. It is therefore possible to calculate the total household waste generated per house per week. It is known there are

1,209,048 households in Wales with residents (National Statistics, 2001), therefore, on average, 2.4 people reside per household. Therefore, multiplying 2.4 by 523 kg equals 1255.8 kg of household waste generated per average Welsh household, or 24.1kg of total household waste per week.

Table 3.1 Household waste 'bin' weights per week

Study	Weight arisings (kg/household per week)
Babergh 2000/2001	20-24
Eastleigh 2000/2001	14-15
NHWAP 1992/3 – sacks	11--13
NHWAP 1992/3- wheelie bins	15-18
English authority 2001/2	13-15
English authority 2002/3	19
English authority 2003 summer	17-18
Wales	17
RCT 2000 summer	19.4

Source: National Assembly for Wales, (2003) However not all studies relate to Wales.

In the summer of 2000, Cardiff University, (2000) conducted the first household 'bin' waste analysis in Wales, in the County Borough of Rhondda Cynon Taf (RCT). The results of that analysis indicated that the average RCT household put out 19.4 kg of 'bin' waste per week. The percentage household waste arisings per category, as reported by Cardiff University (2000) in the 2000 RCT full household waste analysis, are illustrated in Figure 3.6, which also compares these results to the more recent National Assembly for Wales, (2003) analysis. Despite different methodologies, housing stock and season, the two Welsh analyses show comparable percentages of household waste categories (see Figure 3.5).

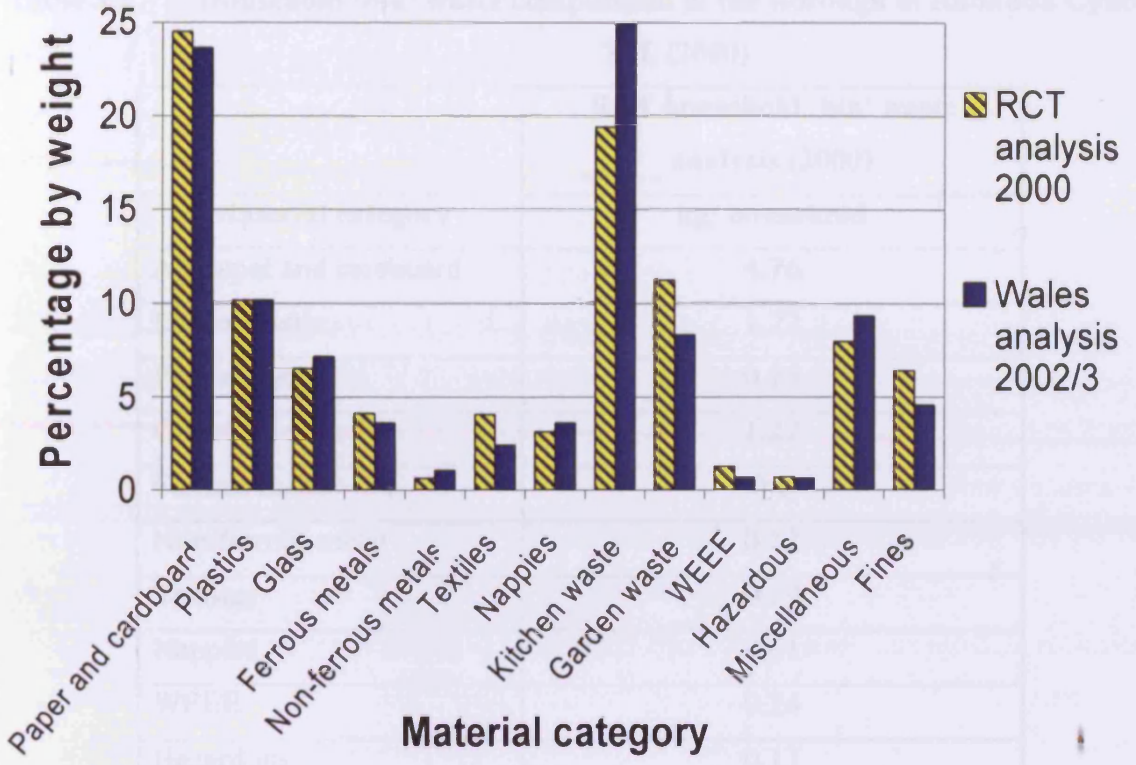

Figure 3.6 Percentage of household waste arisings based on two comparable analyses

The analysis of household waste undertaken in RCT in 2000 is used for comparative purposes with the present study's findings rather than the more recent but less geographically specific WAG 2003 analysis for the following reasons: the RCT 2000 analysis focuses on the current case study area; the RCT study reflects the typical bin of a household in RCT whereas the WAG analysis incorporates three areas: rural, valley and urban; and the results between these two analyses do not significantly differ. Therefore, each material category in the present Rhondda Cynon Taf household waste analysis is based on that used in the RCT 2000 analysis. Table 3.2 shows the average amount of each material category put in the 'bin' by households in the RCT 2000 analysis.

Table 3.2 Household 'bin' waste composition in the Borough of Rhondda Cynon Taf, (2000)

	RCT household 'bin' waste analysis (2000)
Material category	**kg/ household**
All paper and cardboard	4.76
Dense plastic	1.22
Plastic film	0.75
Glass	1.27
Ferrous metal	0.8
Non-ferrous metal	0.12
Textiles	0.79
Nappies	0.61
WEEE	0.24
Hazardous	0.13
Fines	1.24
Miscellaneous	1.55
Garden	2.18
Kitchen	3.77

3.7 HOUSEHOLD WASTE DIVERSION OF RECYCLABLES IN WALES

Local authorities throughout Wales can collect and divert recyclable household materials from the household waste stream in the three traditional ways: kerbside recycling schemes, 'supermarket' bring sites, and Household Waste Recycling Centres (HWRCs).

3.7.1 Bring sites and HWRCs in Wales

Traditionally in the UK, bring sites, commonly located at supermarkets, have been the most important routes for recycling glass and paper. Both bring sites and HWRCs are essentially drop off points and comprise large recycling containers in easily accessible places or regularly frequented locations such as supermarkets. At 'supermarket' bring sites the public simply drop off recyclable materials only, whereas HWRCs take a much

wider range of materials, including refuse. At HWRCs, the public are encouraged and sometimes made by site operatives to separate recyclables from the waste stream and deposit them into the specified containers. The containers on the site are serviced by the Waste Disposal Authority or contractors acting on their behalf (Open University, 2003).

In Wales 2003/4, there was a total of 636 bring sites and 80 HWRCs (data taken from Waste Awareness Wales, 2005). Combining bring sites with HWRCs, the density in Wales for that year equated to one 'site' for every 1689 households. It should be noted that the density of bring sites and HWRCs is very low compared to that of other northern European countries (Warmer Bulletin 77, 2001), for example one site for every 1000 households in Austria (Warmer Bulletin 77, 2001) (which has a 60% MSW recycling and composting rate, see Figure 3.3). One of the most important factors affecting the use of bring sites is thought to be their proximity to residential areas. An Italian study found that 70% of households participated in a bring scheme for dry recyclables when facilities where within 100 metres of their home, whereas participation dropped to less than 15% where distances were greater than 800 metres (Open University, 2003).

In 2003/4 all 716 Welsh sites received a total of 384,449 thousand tonnes of household waste; of which 43 per cent was recycled or composted (166,007 thousand tonnes) and the rest sent for disposal.

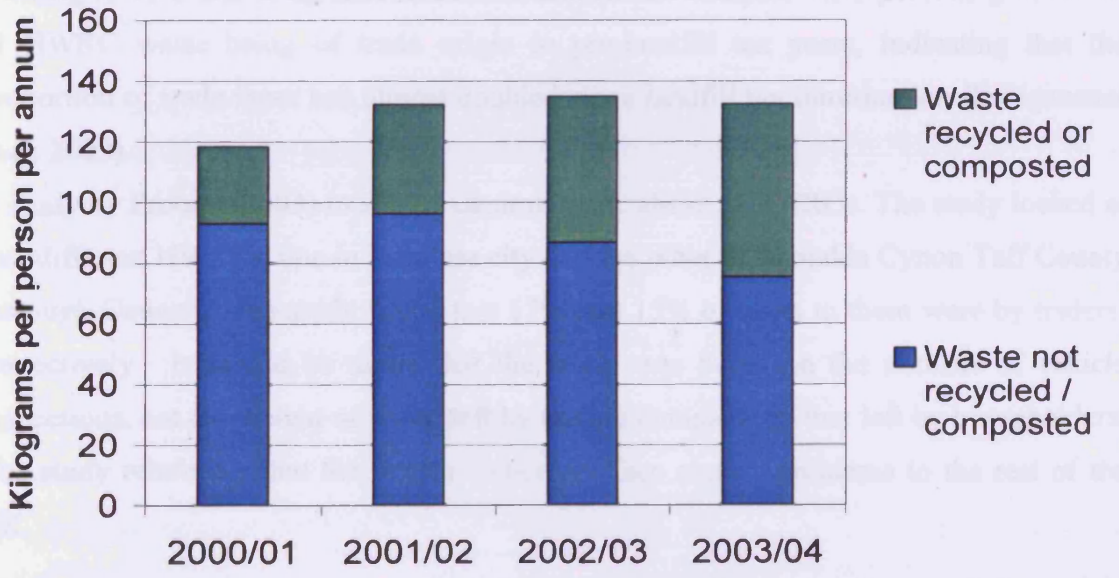

Figure 3.7 Household waste diverted through bring sites and HWRCs in Wales

The combined bring site and HWRC arisings per head of population in Wales were 132.4 kilos as indicated in Figure 3.7. The combined bring site and HWRC kilos per head, dropped from 134.9 kilos in 2002/03, to 132.4 in 2003/04, although the total percentage of diverted waste recycled and/or composted actually increased, see Figure 3.6.

3.7.2 HWRC abuse by traders

Since the introduction of the landfill tax in 1996 (see Chapter 2, Section 2.7), HWRCs' tonnage has seen a dramatic upward turn, which has been noted and commented on by local authorities across the UK (Bridgewater et al. 2003). The increase has generally been considered to be partly attributable to an increase in abuse of such sites by businesses wishing to avoid landfill tax. Other possible reasons for increased arisings at HWRCs, include growing awareness of sites and an increased popularity in DIY.

A study by Bridgewater et al. (2003) found that approximately 13% of HWRC waste by weight was brought in by traders under the guise of household waste (2001 figures by weight). Some sites were hit worse than others, with the most affected site in their study experiencing up to 17% of its waste from trade origin.

This 13% would in theory correspond to 50,000 tonnes of trade waste across Wales entering HWRC and bring sites in 2003/4, and can be compared to a percentage of 7.6% of HWRC waste being of trade origin in pre-landfill tax years, indicating that the proportion of trade input has almost doubled since landfill tax introduction (Bridgewater et al. 2003).

A study by Probert (2003) in 2003 examined trade abuse at HWRCs. The study looked at two different HWRCs, one in Swansea city and the other in Rhondda Cynon Taff County Borough Council. The study found that 17% and 15% of visits to them were by traders, respectively. It should be noted that the study was based on the number of vehicle inspections, not the weight of waste left by traders compared to that left by householders. The study reinforces that the Welsh authorities face similar problems to the rest of the UK.

3.7.3 Comparison of Welsh authority household waste diversion routes

The diversion route of household waste, either through bring sites and HWRCs combined, or through kerbside recycling schemes for recycling and or composting, is studied in detail in this thesis, by analysing annual MSW data for each Welsh authority submitted to the Welsh Assembly Government for 2003/4. Bring sites and HWRCs combined, accounted for 66.4% of total household waste recycling and composting in Wales 2003/04, a significant reduction from 78.2% in 2002/03. The reductions in percentage diversion through bring sites and HWRCs can be attributed solely in Wales to the expansion of kerbside recycling schemes. A comparison can be made to England in 2003/04, where 58% of the total household waste recycling and composting was diverted through bring sites and HRWCs (DEFRA, 2005).

Rhondda Cynon Taf County Borough Council (RCTCBC) diverted most household waste (as a percentage of total household waste diversion) for recycling and/or composting through the kerbside scheme. The percentage of household waste diverted through the kerbside scheme was higher in RCTCBC, than in any other Welsh local authority. On the other hand, Ceredigion, Conwy, Denbighshire, Isle of Anglesey and Powys diverted over 90% of their household waste (as a percentage of total household waste diversion) for recycling and/or composting through bring sites and HWRCs.

It should noted that the two authorities of Bridgend and Neath Port Talbot extracted comparatively small amounts of recyclable material from the household waste stream using the HLC plant, which is a type of Mechanical Biological Treatment (MBT) facility. Currently in Wales, the HLC plant is the only alternative technology with the ability to extract recyclables from the residual household waste stream.

3.7.4 Kerbside Schemes in Wales

Kerbside recycling schemes in the UK are voluntary, householders are encouraged in a variety of ways to segregate targeted recyclables from their general waste and put this at the kerbside in some form of separate receptacle.

In the financial year 2003/4, 61% of households in Wales had some form of kerbside recycling scheme collecting at least one material (data analysed from Waste Awareness Wales, 2005). Of the 22 authorities in Wales, only Conway (as of 01/05/2005) still had

no form of kerbside recycling scheme, although it plans to start a collection in the foreseeable future. In 2003/4, kerbside recycling schemes accounted for 42 per cent by weight of total household waste diversion into recycling and composting in Wales. This compares to 34 per cent in 2002/03. It is thought that the quantities of recyclables received at HWRCs and bring sites will continue to decrease as use of kerbside collections increases around the UK.

A wide variety of different kerbside recycling schemes operate throughout the UK. Schemes that collect only dry recyclables are currently most common in the UK, but the need for local authorities to meet targets will mean that the number of schemes which collect an organic fraction will increase (Resource Recovery Forum, 2001). In 2003/4, ten out of the 22 authorities in Wales had some kind of separate 'organic' collection at the kerbside (Waste Awareness Wales, 2005).

Kerbside recycling collection can be divided into two distinct philosophies, the first to sort recyclate at the kerbside and therefore to necessitate no or very little sorting prior to sending material to reprocessors; the second, to collect recyclate at the kerbside and sort at a local or regional Materials Recovery Facility (MRF). Each approach has different benefits and issues related to its operation, and the selection of a kerbside collection system for a particular area will depend on local considerations, such as property types and population density as well as cost and operational matters.

In Wales in 2003/4, 13 authorities sorted recyclables at the kerbside, 6 authorities collected recyclables for central sorting at a MRF, two authorities used both methodologies, and one authority had no kerbside scheme (data analysed from Waste Awareness Wales, 2005 and phone conversations with recycling officers).

3.7.5 Sorting at the kerbside

This collection system requires householders to place their recyclable materials in a box, which is then collected from the kerbside and the materials sorted into a compartmentalised vehicle. Each material is placed in a different compartment of the vehicle and materials are generally not mixed together. Boxes are the preferred containers as the materials can be retrieved easily and sorted by collection staff. Most

sorting for kerbside operations in Wales are run under the umbrella of Cylch, the Welsh community recycling network.

Benefits

- possible to collect a wide range of dry materials and of generally high quality because any materials which are not part of the collection are left in the box by the collection staff – reducing the contamination
- public can see materials being sorted and collection crews can communicate directly with them
- there is no requirement for specialist materials recovery or sorting facilities
- leads to employment opportunities through the need for more collection operatives
- most households can accommodate a recycling box and therefore suitable for most property types

Issues

- separate fleet of specialised collection vehicles required
- balancing compartment volumes is important to avoid one 'filling up' more quickly than others
- collection rates are slower so labour requirements and hence costs are higher
- collection vehicles can cause traffic congestion in built up areas
- depending on the vehicle design it can be difficult to increase the range of materials collected as markets improve or requirements change
- one box may not provide households with sufficient capacity to store all their dry recyclables if collections are less frequent than weekly

3.7.6 Sorting Co-mingled Collections at a MRF

Co-mingled collections involve the separate collection of a range of dry recyclable materials, which must then be sorted at a materials recovery facility (MRF). Materials tend to be collected in one container, typically a wheeled bin or a plastic sack. In the UK, glass tends not to be collected as part of a co-mingled collection for health and safety reasons, and because if paper and glass are collected together then glass fragments can 'contaminate' the paper and cause problems during reprocessing. In some schemes,

paper is collected as one stream with containers (glass, plastics, cans) collected as a second stream.

Benefits

- simple and easy for the public to use
- paper-only collections can be developed into multi material schemes
- collections are faster and more efficient as materials are tipped unsorted into the collection vehicle
- existing collection vehicles may be used depending on collection arrangements and frequencies
- lower capital investment in collection
- some flexibility on container types
- wheelie bins provide greater capacity which can enable a less than weekly collection

Issues

- contents of container are not checked before collection therefore level of reject materials can be higher
- if existing collection vehicles used then collection of recyclables on the same day as refuse may not be possible
- recyclables need to be sorted at a MRF which requires capital investment and means sorting costs are incurred post collection
- the MRF must be designed in conjunction with the collection system

3.7.7 Sorting Co-collections at the MRF

Co-collection generally refers to schemes where refuse and recyclable materials are collected at the same time and in the same vehicle. Householders are provided with a plastic sack (usually brightly coloured) in which to place their recyclables. The sack containing the recyclables is put out for collection at the same time as the refuse and is either put in the back of the collection vehicle with the refuse – the 'survival' bag system – or a split vehicle is used, with one compartment for recyclables and one for refuse. These systems require the refuse and recyclables to be off loaded at the same facility to avoid additional transportation. For the 'survival' bag system, the bags of recyclables can

be separated from the refuse automatically or they can be removed manually. The recyclable materials then require further sorting at a MRF.

Irrespective of the collection method, the collection of high quality source segregated recyclable materials requires commitment from the householders and short term storage of these materials prior to collection.

Costs for the introduction of source separation collections can be high, since they involve capital and operating expenditure for recycling containers, collection vehicles, and sorting facilities. Collection costs are higher for kerbside sort systems, but lower for co-mingled systems.

3.8 SUMMARY

The above sections have shown the scale of the waste problem in the EU, the UK and in Wales. It is clear that management of our resources is marked by inefficiency, a lack of understanding of mechanisms and drivers for change, and a scarcity of either hard data or relevant indicators of progress (Eurostat, 2001). The lack of data can be seen on an EU level with not all member states having up-to-date figures on waste arisings (Eurostat, 2005). The varying definitions of different 'sectors' across member states also affects comparison of data at an EU level (Eurostat, 2005). Wales and England seem to have reliable figures for controlled waste, but, like other EU member states, make estimates on non-controlled waste, particularly from the agricultural sector. Additionally, agricultural waste is changing definition and becoming a controlled waste, adding more EU uncertainty to the data. The recent Waste Data Flow model (WAG, 2005) is an interesting development designed for local authorities to facilitate faster, more regular, efficient and accurate data collection of municipal waste statistics to enhance local data management for reporting and strategic planning purposes, potentially streamlining access to performance benchmarking with other authorities. The Waste Data Flow model will obviously allow the government to more closely monitor progress towards national and local targets. If it is successful, then all waste streams should be monitored in this fashion.

Certain EU member states, in particular the UK, are more historically reliant on a linear flow of raw materials into consumer products then waste into landfill than other high

recycling and composting nations like Austria, that recycle and compost over 60% of MSW (see Figure 3.3). In recent years, Wales in particular has taken great steps to shake itself free of linear resource inefficiencies, and is moving towards higher levels of sustainability.

Diversion of MSW, in particular household waste relies predominately on the public to voluntary separate (to a certain degree) recyclables and green waste from the remaining residual waste fraction. Chapter 4 will look at a case study authority's household waste diversion infrastructure.

CHAPTER 4

4 THE CASE STUDY AREA

This chapter will describe the infrastructure for diverting household waste into recycling and composting systems within the case study authority. The chapter explains the case study authority's location and demographics. The diversion routes of household waste for recycling and/or composting in Rhondda Cynon Taf County Borough Council (RCTCBC) are elaborated upon, and the ways in which household and MSW recycling and composting rates are calculated are also detailed. The main focus of the study, kerbside diversion, can be limited by a number of factors. These factors are the number and type of materials requested in the kerbside recycling scheme; the scheme's collection frequency from households; the storage receptacle(s); number of households served by the scheme compared to the number actually taking part; the amount of recyclable material from those taking part actually put out for collection; and the efficiency of the Materials Recovery Facility (MRF).

Bring schemes and kerbside collection schemes are two main collection methods for source segregated recyclables and compostables (Atkinson and New, 1993). Woodard et al. 2001 state that during the mid-1980s and early 1990s kerbside schemes began to be introduced in the UK, and Leeds, Cardiff, Milton Keynes, Sheffield and Bath were the most prominent ones. In the UK, by 1993, Coggins (1994) notes 40 different kerbside schemes in operation. As detailed in Chapter 3, Section 3.7.4, kerbside schemes are now widespread throughout Wales. The literature examining kerbside recycling scheme infrastructural is extensive with various authors noting infra-structure parameters that affect recycling performance (see Woodard et al. 2005 for a comprehensive overview). Hummel (2003), Noehammer and Byer (1997), Everett and Peirce (1993), and Platt et al. (1991) identify the storage container; Tucker (2000), Everett and Peirce (1993), and Platt et al. (1991) highlight collection frequency; Hummel (2003), Thomas (2001), and the Open University (2003) note the number of materials collected; and Noehammer and Byer (1997), Everett and Peirce (1993), Folz and Hazlett (1991) examine collection day. Perrin et al. (2001) and Read (1999) emphasise that it is the responsibility of the service provider to make the scheme as convenient for the householder as possible.

4.1 RESEARCH LOCATION AND DEMOGRAPHICS OF THE CASE STUDY AREA

In January 2002, Cardiff University Waste Research Team began a project concerned with maximising the recovery of the recyclable elements of household waste. The team was based in a research station at Bryn Pica Landfill site, operated by a Local Authority Waste Disposal Company (LAWDC) called Amgen Cymru Ltd. RCTCBC, a typical South Wales unitary authority, was chosen as a case study area shown in Figure 4.1. After Cardiff, RCTCBC is the second largest unitary authority in Wales in terms of population. The case study area comprises three valleys: the Rhondda, the Cynon and the Taf. Figure 4.1 shows the location of the Waste Research Station towards the northern end of the case study authority and the local authority pilot Materials Recovery Facility (MRF) towards the southern end. The most severe deprivation in RCTCBC occurs in those areas furthest from Cardiff (IWA, 2003), particularly in the more northern Cynon area (the area around Aberdare in Figure 4.1), although there are wards near main conurbations in the Rhondda area (the area between Porth and Treherbet in Figure 4.1) where acute social and economic problems are apparent (IWA, 2003). RCTCBC possesses a range of socio-economic and cultural characteristics. Some of the highest levels of socio-economic deprivation in the UK are observed, particularly in the northern end of the authority. In the borough, there is a mixture of housing types, including terraced, council owned and private/modern housing. Terraced housing accounts for around 52 per cent of total dwellings within it (National Statistics, 2001). The overall population of the Valleys is declining slowly with a small natural increase in most areas being countered by outward migration, particularly from the northern wards (IWA, 2003). In RCTCBC economic activity rates are lower than in the rest of Wales and much of the economic inactivity is expressed as permanent sickness or disability (IWA, 2003).
The Waste Research Team worked in partnership with RCTCBC Sorting Out Recycling Together (SORT) team, who were employed to influence and help increase participation, material recovery, and general waste awareness of the public. Together they worked on a number of aspects associated with the kerbside recycling scheme.

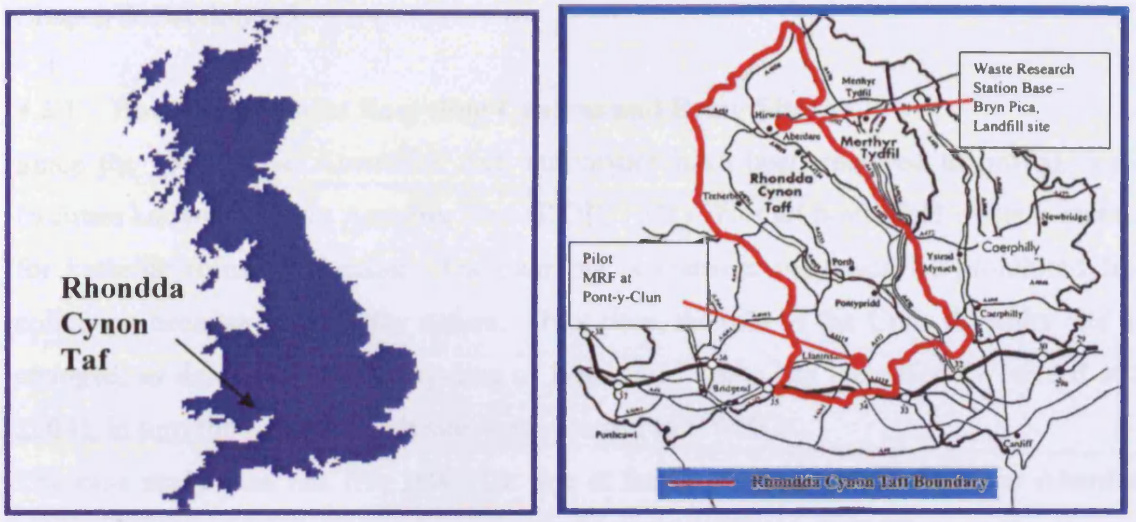

Figure 4.1 The case study area location and boundary, including the location of the research station base and recycling centre

4.2 HOUSEHOLD WASTE DIVERSION IN THE CASE STUDY AREA

For the year 2003/04, household waste arisings in RCTCBC were 109,000 tonnes and MSW arisings were 121,300 tonnes (National Assembly for Wales, 2005). In RCTCBC, the household waste recycling and / or composting rate was 10.9 per cent, and the National Assembly for Wales Performance Indicator (NAWPI) MSW recycling and/or composting rate was 11.2 per cent (National Assembly for Wales, 2005).

A local authority's MSW recycling rate can be calculated by adding together the diversion from the following sources:

(a) Household Waste Recycling Centres (HWRCs), (b) Bring sites, (c) Kerbside recycling schemes, and, (d) Any diversion of non-household waste for recycling and/or composting.

All the MSW diversion sources (a+b+c+d) are then divided by the total MSW arisings, giving a percentage MSW recycling and/or composting rate. The calculation of a local authority household waste recycling and/or composting rate is very similar, omitting part (d) in the initial addition of diversion sources and then dividing by the total household waste arisings (instead of MSW arisings), to give the percentage of household waste

recycled and/or composted. The composition of household waste was discussed in Chapter 3, Section 3.5.

4.2.1 Household Waste Recycling Centres and Bring Sites

Since the 1967 Civic Amenities Act, authorities have been required to provide waste facilities known as Civic Amenity sites (DOE, 1975). Not all household waste is suitable for kerbside refuse collection. For example, a mattress may well be prohibited from collection because of its bulky nature. Over time, the role of the Civic Amenity site has changed, as demand for the recycling of household waste has increased (Woodard et al. 2004); in turn the name of such sites has changed to HWRCs.

The case study area has five HWRCs: one at the Bryn Pica landfill site near Aberdare, one at Dinas, one at Ferndale, one at Treorci and one at Gelli near the recently decommissioned Nant-y-Gwyddon Landfill site. There are 46 bring sites spread throughout the case study area (see Appendix 4.1 for list). Bottle banks and can disposal units are run by the unitary authority, a local mill owns the paper banks, and textiles are sent to charity shops. The total amount of waste collected from HWRCs and bring sites in the case study area and subsequently taken to be recycled or composted in 2003/2004 was 2,021 tonnes (National Assembly for Wales, 2005). Combining bring sites with HWRCs, the density in RCTCBC for 2003/4 equated to one site for every 1851 households, compared to the Welsh average of one for every 1689 households. It has already been remarked that the density of bring sites and HWRCs per household in Wales is very low compared to other northern European countries (see Chapter 3, Section 3.7.1).

4.2.2 Case Study Area - Kerbside Collection Schemes

In January 2002, RCTCBC launched a kerbside collection scheme. Aspects of the kerbside recycling scheme have evolved since its inception. The scheme as of May 20065currently requests the following materials for collection: all paper, cardboard, plastics (HDPE and PET bottles and carrier bags), metal packaging (beverage and food cans), glass, and green 'plus' waste (including uncooked fruit and vegetable peelings, tea bags and garden waste). The council asks residents to separate recyclables into three separate clear bags: one containing paper and cardboard, one containing all other requested dry recyclables, and a third containing green waste. It should be noted that

clear bags are provided free of charge and recyclable waste collections are weekly and mostly on the same day as general refuse collection. Residents are instructed to put a sticker (also supplied by the Council) on the last clear bag they put out and the collection crew will leave a roll of new clear bags. The number of households in May 2005 served by the kerbside collection totalled around 66,000. Households with the service are within 33 different electoral wards of the 52 in total in RCTCBC. Wards served by the scheme are coloured red in Figure 4.2. The number of households served by the kerbside recycling scheme has increased in 3 distinct 'roll out' phases. The final fourth phase at the time of writing will provide all households in RCTCBC with a kerbside recycling collection.

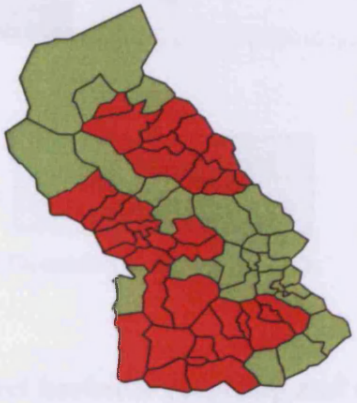

Figure 4.2 Wards of the case study authority in September 2005 served by the kerbside recycling scheme (coloured red)

The amount of household waste material that could potentially be recycled and composted through the kerbside recycling scheme in the case study authority is dependent upon a number of factors, as illustrated in Figure 4.3. The first factor is the number and type of household waste materials requested by the case study authority, for kerbside recycling and composting collection (see Chapter 4, section 4.2.3.). A second factor is the number of households served by the weekly collection scheme and the average number of served households that actually set out recyclate for weekly collection. Third, the amount of potential material requested by the Council that the average household puts out for collection will understandably limit the overall diversion. Finally, the materials in the case study authority are then sorted at a MRF, and the efficiency of

that facility to recover material will play a part together with all the other factors mentioned above in affecting the overall recycling and composting rate of the household waste diverted at the kerbside.

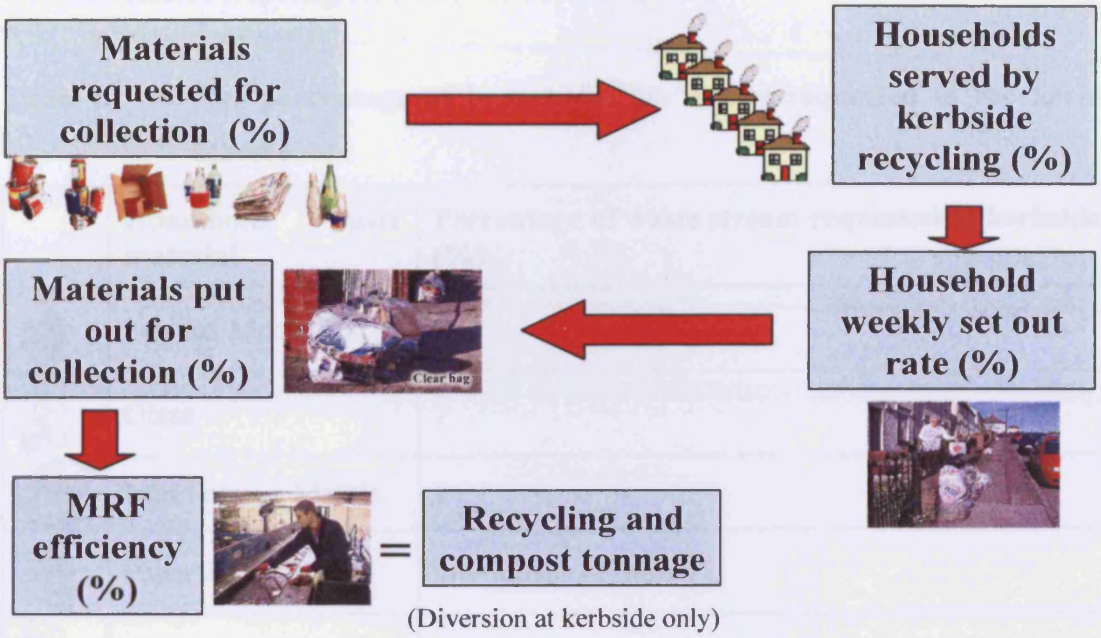

Figure 4.3 Factors that affect kerbside recycling and composting diversion in the case study authority

4.2.3 Materials requested for collection

Materials requested in the kerbside recycling scheme have changed during its development. For current requested materials in the kerbside recycling scheme, see section 4.2.2. Residents have been informed of the service by three consecutive letters, explaining they were being included in the kerbside recycling scheme, detailing when it would collect from their street, and also the type of recyclable materials collected in the scheme (see Appendix 4.2 for sample leaflets).

No material has been discontinued from the collection scheme, but it has expanded to include all paper. Originally only newspapers, magazines and cardboard were accepted, now all paper (not including Tetra-pak, paper with plastic windows, tissues or small fragments of un-classifiable paper) is requested for kerbside recycling collection.

Prior to the change in requested material it was calculated from the 2000 RCT full household waste analysis (Cardiff University, 2000) that, on average, 10.2 kg per household or 52 per cent of a household's full 'bin' waste could potentially be diverted into the kerbside recycling scheme (See Table 4.1).

Table 4.1 The percentage of household 'bin' waste requested in the kerbside scheme

	Household waste material	**Percentage of waste stream requested in kerbside scheme (%)**
	Ferrous Metals	4
	Glass	7
	Non Ferrous Metals	1
	Paper - Recyclable	Previously 12, now 17
	Plastic Dense	6
	Green 'plus'	22
	Total % of average bin waste requested for kerbside	**Previously 52%*, now 57%****

*Equates to an average potential of 10.2 kg per household per week

** Equates to an average potential of 11.1kg per household per week

After the scheme changed to accept all paper (not including Tetra-pak, paper with plastic windows, tissues or small fragments of un-classifiable paper), the average amount of household 'bin' waste that could potentially be diverted into the kerbside recycling scheme increased to 11.1 kg per household, or 57 per cent of the full weekly bin (as shown in Table 4.1).

4.2.4 Monitoring of household set out

The set out rate is considered to be the proportion of households within a street that put out a storage receptacle of recyclable material on the day of the kerbside recycling collection (see Section 4.3.1 for more details about household set out rate). The monitoring system devised by Cardiff University for RCTCBC enabled the collection team to monitor individual household set out, by converting the council's pre-existing tick sheets from counting the total number of bags put out, to counting the individual households setting out recyclate for collection (see Appendix 4.3 for example of set out rate survey tick sheet). All households in RCTCBC served by the kerbside recycling scheme were monitored weekly for set out. The collection vehicle driver was responsible for recording the houses in a particular street that had participated on the collection day. As part of quality assurance of data, on occasions the set out rate was measured independently of the drivers (see Section 4.3.1).

4.3 EXPERIMENTS

A quality assurance study examining the accuracy of monitoring household set out rate was performed to explore any risk of driver recording error. In the case study area, the recyclable material was collected weekly from residents and the collection drivers monitored individual household set out in the scheme at the same time. A difference between driver and SORT team monitoring data, instigated a study to find out why?

4.3.1 Purpose of quality assurance study

A study examining the accuracy of monitoring household set out rate was conducted to quantify the accuracy of the set out rate data generated by drivers and the SORT team.

Local authorities can monitor the number of households taking part in their kerbside recycling schemes. The term 'set out' rate used in the present report means the fraction of households from which collection is taken, during a given week. The term 'participation rate' was defined by the DETR in 1999 and means those using the scheme at least once in a four week period divided by those with access to the scheme over that period. The two terms 'set out rate' and 'participation rate' are sometimes used

interchangeably by local authorities, but there is a clear difference. It follows that participation rates are never lower than those for set out (UEA, 2003).

Guidelines for conducting observational surveys of household recycling behaviour in kerbside collection schemes were first published by the European Recovery and Recycling Association (ERRA, 1994). The Department of the Environment, Transport and Regions (DETR, 1999) published its own similar surveying criteria. Due to the fact that the case study authority recorded the participation of households in the scheme as often as it collected the recyclate, i.e. on a weekly basis, it was thought inappropriate to use the 'participation ratio' (those using the scheme at least once in a four week period divided by those with access to the scheme over that period) put forward by the DETR in 1999, as an indicator of how many households were using the scheme.

4.3.2 Methodology – Set out quality assurance

Set out rate surveys were conducted in three different ways. The first method was monitoring by the driver of the collection vehicle (see Section 4.3.3.2), the second by the SORT Team (see Section 4.3.3.3), and the third by the University (see Section 4.3.3.4). The primary source of set out data used for analysis was derived from collection vehicle driver surveys. However, to ensure data quality, it was thought that cross-correlating recordings of the same rounds by the SORT team and University would minimise any inaccuracies in data. All households' weekly set out rate in the kerbside recycling scheme have been monitored since the scheme's inception in 2002, making it the largest continually monitored kerbside scheme in the UK (Woollam et al. 2005). In addition to ascertaining how many households in a given area put out recyclates for collection in the scheme each week, it was also possible to analyse recycling behaviour in more depth, by observing how frequently an individual household 'set out' (see Section 4.3.3.1). The frequency at which an individual household took part in the scheme would be directly related to the length of time a household was monitored. There would likely be an increasing variation in participation frequency over time, because of more opportunities for the household to 'set out' or miss a collection. For this reason different participation frequencies were defined (see Section 4.3.3.1).

4.3.3.1 Participation frequency

When analysing the participation frequency of a household over time the definitions used by (Woollam et al. 2003) were followed. 'Weekly participation' was defined as an individual household taking part in the collection scheme more than 75 per cent of the time (e.g. six times over an eight week period). 'Fortnightly participation' was defined as participation every other week, allowing for either two consecutive weeks' set out or no set out (making allowance for those, for example, that might have forgotten or were absent from the property) over an eight week period. 'Random participation' was defined as those that participated less than 75 per cent of the time and not in the previously defined fortnightly pattern. 'Infrequent participation' was defined as households that set out less than 25 per cent of the time. (See Table 4.2 for worked examples of participation frequencies).

Table 4.2 Examples of participation frequencies

	Week Number									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Frequency of individual household set out (as percentage)**	**Participation frequency**
Weekly household set out of individual households (1=Yes)	1		1		1		1		50	Fortnightly
		1		1		1			37.5	Fortnightly
	1	1		1		1		1	62.5	Fortnightly
	1		1		1	1	1	1	75	Weekly
	1	1	1	1	1	1	1		87.5	Weekly
	1	1	1	1	1	1	1	1	100	Weekly
	1	1		1	1		1		62.5	Random
		1	1		1	1		1	62.5	Random
	1		1				1		37.5	Random
						1			12.5	Infrequent

4.3.3.2 Driver set out surveys

The monitoring system devised by Cardiff University for RCTCBC enabled collection vehicle drivers to monitor the set out rate of individual households (see Appendices 4.3 and 4.4 for an example of a driver form and set out rate tick sheet). Data for households setting out in the recycling scheme were input into the spreadsheet system on a weekly basis by the S.O.R.T team. The weekly household set out rate could then be calculated

for each street, each collection round, and consequently each of the 33 electoral wards served by the kerbside recycling scheme (see Figure 4.2). To ensure quality data, the set out rate was measured independently of that of drivers' recording.

4.3.3.3 SORT team set out surveys

As part of the process to ensure quality of the driver data, on occasions the SORT Team surveyed the five trial areas (see Appendix 4.5). This took place between 7.00am and 9.00am before the collection teams collected the clear bags. The SORT team covered the entire daily collection round of each trial area, but it was not practical for the team to record set out rate at the same time as drivers, as this would have been too time consuming. Therefore an early morning survey approach was adopted. During this study, on fifteen separate occasions the set out rate was measured independently of that of drivers (see Appendix 4.5).

It should be noted that early morning set out rates did not always accurately reflect actual set out rates on a day as they were sometimes found to be lower than actual. Some households did not put their clear bags out overnight, but would put them out just before the time the collection crew was expected.

4.3.3.4 University set out surveys

The University recorded set out at the same time as the collection drivers. Differentiated collection and surveying times by the SORT team, collection drivers and the University would obtain a more accurate picture of recycling behaviour. Therefore, all parties independently recorded set out rate.

4.3.3.5 Consistency

All three groups, the SORT team, university and collection drivers used the same tick sheets to record household set rate. Households with a clear bag outside their property were ticked on the sheet as having set out recyclate. The SORT team always monitored the scheme set out between the hours of 7am -9am. The University always monitored the

scheme set out at the same time as the drivers. All three recordings of round set out were analysed by inputting the result into a spreadsheet.

4.3.3.6 Interpreting household set out rate

Each of the three methodologies recording set out rate data was subject to its own inaccuracies. Driver set out surveys were slightly inaccurate, despite attempts to make it as easy as possible for drivers to input data on forms provided. This was due to over reporting on the part of certain drivers. The SORT Team set out surveys, although not inaccurate, were recorded before the collection team arrived and, therefore, missed data on households that put out recyclables as the collection crew arrived. The University set out surveys, which were recorded at the time of collection, were, for this reason the most accurate of the three survey types. However, it was only possible to conduct University set out surveys twice, due to time constraints. When analysing individual household set out rates, driver surveys were used as they were completed on a weekly basis.

4.3.3.7 Results - Difference in recorded set out

Set out rate error is discussed according to actual percentage error and the effect the error had on the average percentage round set out rate. The following observations were made:

- There was an average 15 per cent 'real error' difference between the SORT team recorded set out and that of the University team. This suggested that 15 per cent of households put out their recyclables after 7am-9am.
- The significance of this behaviour meant that the 15 per cent 'actual error' difference could alter the overall set out percentage per round by approximately 6 per cent.
- The 'actual error' between driver over reporting and monitoring conducted by University staff on the same day at the same time was 9 per cent.
- If University recorded set out is taken to be the actual set out rate then, based on drivers' average past reported set out, drivers normally over-reported by 17 per cent. The fact that University staff were following and monitoring them changed the normal recording behaviour of drivers.

4.3.3.8 Results- Driver Recording Error

On an average street of 50 households, if the household kerbside recycling behaviour reflected the Borough 'norm', i.e. 40% set out on a weekly basis, the following could be expected:

- 20 households (40% of the total) in the street would actually be setting out on a particular week.
- 17 households would put out recyclables for collection before 9 am.
- A further 3 households would put out clear bags after 9 am.
- The drivers would claim 22 households put out clear bags for collection, if University staff were following them.
- The drivers would claim 24 households set out in that street, if the University staff were not following them.

4.3.3.9 Conclusions - Quality Assurance

Drivers over-reported set out rate on their collection rounds. This over reporting was not as high as first thought when comparing SORT team data with drivers' data (see Appendix 4.5). Some of the discrepancy in error that affected round set out rate was likely due to households setting out after 7am-9am (see Appendix 4.6). Drivers still over-reported household set out rate. Consequently, any day's actual set out rate for a round was likely to be approximately 7% less in absolute terms than reported by drivers. Driver error varied from driver to driver. Findings show most drivers had a low error in recorded set out rate, however, one in particular had a high recording error (see Appendix 4.5).

4.4 SUMMARY

Chapter 4 has detailed the infrastructure for diverting household waste into recycling and composting systems within the case study authority.

It is clear that local authorities have the power to control a large aspect of the kerbside recycling scheme diversion, and consequently household recycling and/or composting rate. Local authorities, for example the case study authority could choose the number and type of materials requested in the kerbside recycling scheme; the scheme's collection

frequency from households; the storage receptacle(s); number of households served by the scheme; and the design of the Materials Recovery Facility (MRF) that inevitably affects the efficiency.

The Chapter also found that when monitoring the kerbside scheme, drivers over reported set out rate on their collection rounds. Their reporting was not as inaccurate as first assumed when comparing SORT team data with drivers' data. Some of the discrepancy in error that affected round set out rate was the likely due to households putting out after 9am. A typical set out rate for a round was approximately 7 per cent less in absolute terms than reported by the driver.

It is important to note that the kerbside recycling scheme in the case study area was in its infancy during the research conducted in this thesis.

CHAPTER 5

5 ATTITUDES AND BEHAVIOUR TOWARDS RECYCLING

Chapter 5 will look at the attitudes and behaviour of residents in RCTCBC towards waste disposal, recycling, and composting. Of all the factors that make up kerbside diversion, attitude and behaviour towards recycling and composting, in particular the household set out rate and the amount of materials put out for collection by residents (see Chapter 4, Figure 4.3), are not within the local authorities' direct control. If a household is served by a kerbside recycling collection it is the householder's choice whether s(he) puts out material for collection. The scheme therefore relies on voluntary participation (although it is acknowledged that some local authorities in reality put pressure on residents to recycle by providing a fortnightly collection of residual waste, see Chapter 8, Section 8.6). Chapter 4 explained the main aspects of the kerbside recycling collection, the number of households served by the kerbside recycling scheme, and the MRF's efficiency. All of these contribute to kerbside diversion in the case study area and are all under the direct control of the local authority.

Tonglet et al. 2004 (a) note that much of the recent UK research on MSW management has focused on household recycling behaviour. Many social psychology studies have focused on the measurement of public attitudes and the relationship between attitudes and behaviour, or intended/claimed and actual behaviour (Steel, 1996; Corral-Verdugo, 1997; Tucker et al. 1997 and 1998; Resource Recovery Forum, 2002 and 2004; Barr et al. 2003 and 2005; Robinson et al. 2005; Collins et al. 2006; also see earlier studies Rokeach and Kliejunas, 1972; Sample and Warland, 1973; Liska, 1975; Ajzen and Fishbein, 1977). Self reported or claimed behaviour is widely employed in research on recycling practices (De Young, 1986 and 1991; Ebreo and Vinning, 1994; Goldernhar and Connell, 1993; Barr et al. 2005); more recently Perrin et al. 2001, Williams et al. (2003) and Woollam et al. 2003 (see Section 5.6.1) have shown claimed recycling behaviour shows no correlation to actual. Studies have tried to find the barriers and influences which discourage households from recycling (Wang et al. 1997; Read, 1999; Thomas, 2001; McDonald and Oates, 2003), however, these have been based predominately on claimed behaviour, so are potentially flawed from the offset. The British government has acknowledged the role that changes in attitudes and behaviour could play in its waste

strategy (DETR, 2000). Much has been attempted to change household recycling behaviour at both the national and local level. In 2002, the government launched a national campaign called the Rethink Rubbish campaign, which specifically focused on getting the public to change their attitude towards waste and recycling. This campaign was recently superseded by the Waste and Resources Action Programme (WRAP) and the Recycle-Now Campaign (WRAP, 2006). Many local authorities have also tried to change recycling behaviour (see, for example, Poulter, 2003, and Read, 1999). However, few academic studies have been directed towards examining the true effectiveness of stimuli (Read, 1999; Evison et al. 2001; Perrin et al. 2001; Mee 2005; also see Chapters 6 and 7 of this thesis). Recently, there has been a resurgence in the use of models from social psychology in particular, the Theory of Planned Behaviour (TPB) (see Figure 5.1 and also Cheung et al., 1999; Davies et al., 2002; Tonglet et al., 2004 b and Davis, 2006) to provide a theoretical framework for understanding householders' recycling behaviour. The TPB hypotheses that the pre-determinant of behaviour is intention (Tonglet et al. 2004 b). Intentions are influenced by the three boxed factors shown in section a of Figure 5.1. An additional box in section (c) in Figure 5.1 shows the influence of a stimulus to change recycling behaviour, such as a waste awareness campaign or schools' waste education programme (see Chapters 6 and 7, respectively).

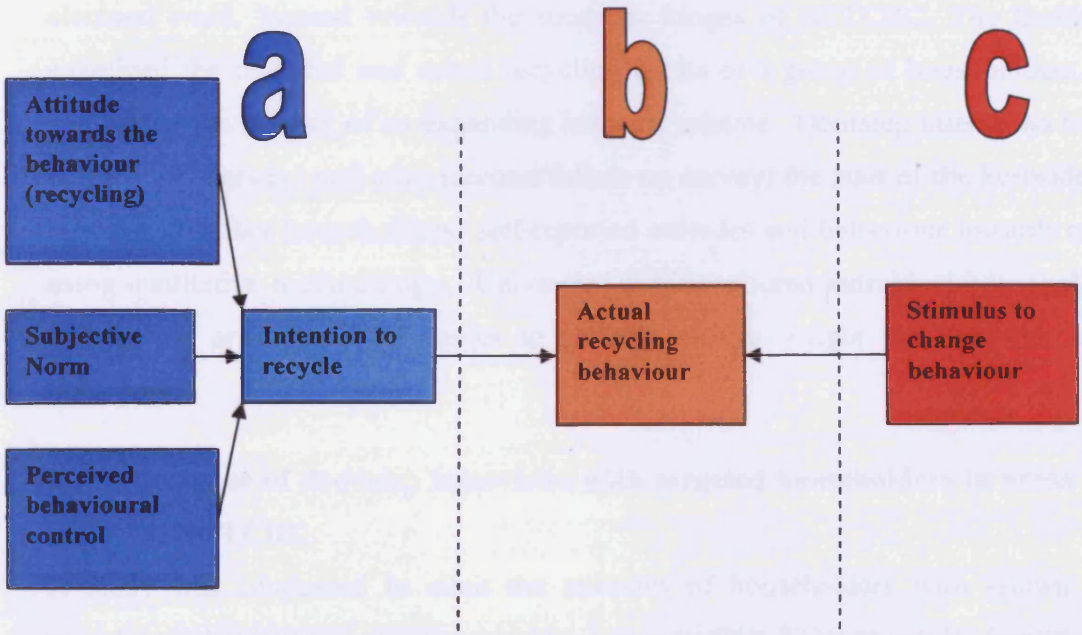

Figure 5.1 The Theory of Planned Behaviour (adapted from Ajzen, 1991).

In the following section, experiments to discern attitudes towards recycling and households' actual recycling behaviour (sections (a) and (b), respectively, in Figure 5.1) in the case study area will be introduced.

5.1 EXPERIMENTS TO ESTABLISH ATTITUDES AND BEHAVIOUR TOWARDS RECYCLING

A number of studies were performed to establish attitudes and behaviour towards recycling, including a study to establish intended, claimed and actual recycling and composting behaviour; a study to elicit targeted households' attitudes towards kerbside recycling and composting; a study of known recycling behaviour; and a comparison of actual monitored kerbside recycling behaviour in RCTCBC with that of household recycling behaviour in a neighbouring local authority. With all the UK legislative pressures in mind, the need to understand household behaviour in order to increase household participation in kerbside recycling schemes is a useful and worthwhile exercise.

5.1.1 Purpose of kerbside scheme expansion doorstep interviews with householders in Beddau, RCTCBC

3306 residents live in Beddau (RCTCBC, 2005), which is both a small town and also an electoral ward, located towards the southern fringes of RCTCBC. The Beddau study examined the intended and actual recycling habits of a group of householders, prior to and during the infancy of an expanding kerbside scheme. Doorstep interviews took place before (first survey) and after (second/follow-up survey) the start of the kerbside scheme in order to gather householders' self-reported attitudes and behaviour towards recycling, using qualitative methodology. University staff monitored individual household set out rate in the area for eight weeks to provide clearer insight into kerbside recycling behaviour.

5.1.2 Purpose of doorstep interviews with targeted householders in areas 1, 2 and 3, RCTCBC

A study was conducted to elicit the attitudes of householders with known kerbside recycling behaviour towards household waste recycling, because results from the follow-

up kerbside expansion survey (see Section 5.1.1 for purpose of follow-up survey) showed that the general public had exaggerated their claimed recycling behaviour. Accurate conclusions could therefore not be drawn from the information gathered due to its unreliability. In an effort to gain a better understanding of attitudes towards households recycling, this third study was undertaken. Interviews were conducted as part of an awareness campaign (see Chapter 6).

5.1.3 Purpose of the analysis of actual kerbside recycling behaviour

In an attempt to understand actual kerbside recycling behaviour, household set out rates in kerbside recycling schemes of two Welsh authorities, namely, Rhondda Cynon Taf County Borough Council and Caerphilly County Borough Council, were compared. Data derived from the monitoring of approximately 114,000 households' set out rates in the two separate kerbside recycling schemes were analysed, making this the largest analysis of monitored kerbside recycling behaviour in the UK (2003). The comparison examined the average household set out rate of individual households per ward, and per street, in both schemes. Average household set out rate at a particular demographic level (ward and street) was then correlated with appropriate socio-economic indicators. The research was performed using the 'ArcView' Geographical Information Systems (GIS) package.

5.2 STUDY METHODOLOGY

The following sections detail the way in which each experiment was conducted, providing, where necessary, background information.

5.2.1 Methodology of kerbside scheme expansion door step interviews in Beddau

The first doorstep interviews were performed a week prior to the kerbside recycling scheme starting in the area. It assessed the recycling habits of householders. Door-to-door surveys were conducted through questionnaires completed by interviewers. A second follow up survey was conducted six months after the kerbside scheme had become operational. A sample of prior and post (follow-up) doorstep surveys can be found in Appendix 5.1. Both surveys took less than five minutes per household to complete. The canvassing team comprised between two to eight canvassers who worked over three evenings during the working week, knocking doors between the hours of 4pm

and 8pm (a photograph of the canvassing team is shown in Figure 5.2). After the kerbside scheme had started it was monitored intensely for a period of eight weeks. A full list of streets chosen for the survey can be found in Appendix 5.2. The area in Beddau selected for study of the kerbside scheme's expansion was part of a former Council estate.

Figure 5.2 Survey team wearing easily identifiable insignia

5.2.2 Methodology for doorstep interviews with targeted households in areas 1,2, and 3, RCTCBC

Interviews using questionnaires were conducted on the door step between October and November 2003 in the trial areas. A sample of the doorstep survey can be found in Appendix 5.3. Overall, 694 householders were interviewed from Areas 1, 2 and 3. In Area 1, all households in the area were targeted, and 438 interviews were conducted. In Area 2, only those households that were known to have previously set out in the kerbside recycling scheme were targeted, and 148 interviews were conducted. In Area 3, only those households known to have not previously set out were targeted, and 108 interviews were conducted.

Whether or not a household was taking part in the scheme was judged by looking at the household's prior kerbside recycling behaviour, attained from collection drivers' set out survey forms. To establish non-participation in the kerbside recycling scheme, individual households' set out data were analysed. If a household had not set out for 3 months prior to the interview, then that household was classed as a known non-participant.

Door-to-door interview team members followed a protocol (see Chapter 6, Section 6.2.6 for more details) and conducted interviews in a consistent manner, which gave

householders the opportunity to choose whether to participate in the survey or not. Only 1% of householders were unwilling to be questioned on the doorstep. The doorstep interview was designed to be short and concise. Questions took no longer than a few minutes to answer on the doorstep. Householders' responses invariably led to further raising of recycling awareness through the dissemination of additional information about the recycling scheme and recycling in general (for more details on what verbal information was given to householders, see Chapter 6). Interviewed households in Areas 1,2 and 3 all received engaging awareness raising methods (see Chapter 6, Table 6.1).

Interview results presented in this Chapter combine those elicited from households in areas 1,2 and 3. The results are not representative of RCTCBC as a whole. Results obtained from the individual targeted areas will only be discussed. For more information about why and how the areas were selected and information about each area's socio-economic characteristics, see Chapter 6, Section 6.2.2.

In the statistical analysis of interviews, missing values were accounted for and recorded. The following nomenclatures were used:

- 99= Question was 'Not relevant' to the householder;
- 98= The householder had 'No time to answer the question' in the judgement of the interviewer; and
- 97= Question 'Not answered'.

See Appendix 5.4 for full interview analysis. Doorstep interview results were input into the Statistical Package for Social Sciences (SPSS) and can be found in Appendix 5.5.

5.2.3 Methodology for analysing actual kerbside recycling behaviour in RCTBCB and CCBC

Caerphilly County Borough Council (CCBC) (see Figure 5.3 for location map of the authority) provides a fortnightly kerbside recycling collection for all residents. This corresponds to 48,000 households (www.nationalstatistics.gov.uk). The scheme was introduced in stages from February 2002 onwards, when households were provided with a 55 litre capacity 'Green Box' to be filled with recyclable material, including paper, magazines, junk mail, cans, glass, textiles, plastic bottles, and engine oil. If households were not participating in the kerbside recycling scheme, it was the responsibility of the

collection team to leaflet them. It should be noted that green boxes were free of charge, and recyclable collections were mostly on the same day as general refuse collection. The recycling rate in this local authority was 19.3% in 2003/2004 (National Assembly for Wales 2004).

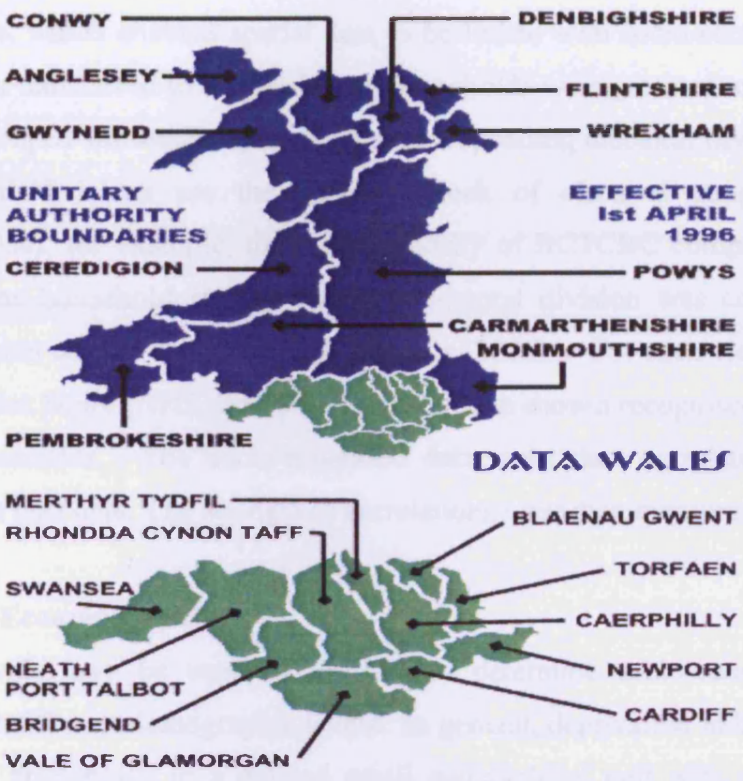

Figure 5.3 Location map of case study local authorities

A set-out survey is a simple count of households setting out their container for a kerbside recyclable collection. This figure can be divided by the total number of households monitored to give a set out rate (ERRA, 1994 and DETR, 1999). A set out rate monitoring system was designed. The monitoring system devised by Cardiff University for RCTCBC enabled the collection team to monitor individual household set out, by converting the council's pre-existing tick sheets counting the total number of bags put out, to counting individual households setting out recyclate for collection. This was achieved by designing driver survey forms (see Appendix 4.3 and 4.4), and the driver ticked a box on the sheet to indicate if a household had set out. The monitoring system in

RCTCBC was almost identical to the one used by CCBC and thought comparable. In both case study areas, the driver was responsible for recording the houses in a particular street that had set out on the collection day. To confirm the reliability of data, on fifteen occasions in RCTCBC, the set out rate was recorded independently of drivers recording. The research was performed using the 'ArcView' Geographical Information Systems (GIS) package, which enabled spatial data to be linked with socio-economic data. The data were then transferred to a spreadsheet, households were grouped under street names and streets grouped subsequently under the corresponding electoral division. In the UK, electoral wards/divisions are the building block of electoral geography (National Statistics, 2005a), for example, the local authority of RCTCBC comprises 52 electoral divisions. The household set out rate per electoral division was compared to 2001 electoral division census data (National Statistics, 2005b). For each electoral division, a Townsend Index Score (NHS, 2005) was calculated to show a recognised socio-economic deprivation indicator. The socio-economic data were then correlated to the spatial (household set out) data. The strength of correlations were then measured using SPSS.

5.2.4 Socio-Economic Indicators

Several methods may be used in the UK to determine socio-economic status for populations at different demographic levels. In general, deprivation indices "measure the proportion of households in a defined small geographical unit with a combination of circumstances indicating low living standards or a high need for services, or both" (Bartley et al. 1994). Importantly, regarding all ecological measures of deprivation (i.e. measures based on geographic areas, rather than individual circumstances), "not all deprived people live in deprived wards, just as not everybody in a ward ranked as deprived are themselves deprived" (Townsend et al. 1998). This point is reiterated by Sloggett and Joshi (1994). In interpreting deprivation scores it is important to remember that many deprivation scores are relative measures, i.e. the score for any one area is standardised by reference to the mean for the total of all areas included in the calculation. For example, scores derived for all the wards in one Local Authority (LA) cannot be compared to scores derived separately for all the wards in another LA, because the scores for each set of wards are relative to the mean for the respective LA. There are many

different measures of deprivation that are in common use (Hurst, 2004). In the past, the most commonly used have been the Jarman Underprivileged Area Score, The Carstairs Index, and the Department of the Environment's (DoE) Index of Local Conditions. More recently, the Townsend Index, the Indices of Deprivation 2000 (ID2000) published by the Department of the Environment, Transport and the Regions (DETR) and its 2004 revision (ID2004) published by the Office of the Deputy Prime Minister (ODPM), have come into widespread use. In a study comparing how the use of different measures of deprivation may influence resource allocation decisions, Mackenzie et al. 1998 highlighted that different organisations have preferences for different measures.

This study used the Townsend 'z' Score for electoral division level and the A Classification Of Residential Neighbourhoods (ACORN Score) (CACI, 2005) for street level. The more positive the 'z' score, the more socially deprived the electoral division, and the higher the ACORN score the more socially deprived the street.

The Townsend Index Score (NHS, 2005) is used by social scientists to derive a score for socio-economic status. To calculate this index, four UK 2001 census variables are combined, namely, unemployment (lack of material resources and insecurity), overcrowding (material living conditions), lack of owner occupied accommodation (a proxy indicator of wealth), and lack of car ownership (a proxy indicator of income). The Townsend Score (z) is a summation of the standardised scores for each variable (scores greater than zero indicate greater levels of deprivation), thus, the more negative the 'z' score the more affluent the area, and the more positive the 'z' score, the more socially deprived the area. The method for calculating the Townsend Score is as follows:

Step 1: The following variables are extracted from the 1991 Census:

V1 = % economically active residents aged 16-59/64 who are unemployed

V2 = % private households which do not possess a car

V3 = % private households which are not owner-occupied

V4 = % private households with more than one person per room

Step 2: The distributions of the extracted variables are 'normalised' using the following transformations;

N1 = LN(V1+1) N2 = LN(V2+1) N3 = SQRT(V3) N4 = LN(V4+1)

Step 3: The variables are standardised by subtracting the mean and dividing by the standard deviation:

S1 = (N1 - mean of N1)/ S.D. of N1 S2 = (N2 - mean of N2)/ S.D. of N2

S3 = (N3 - mean of N3)/ S.D. of N3 S4 = (N4 - mean of N4)/ S.D. of N4

Step 4: The Townsend Score is calculated by summing the standardised variables, i.e. the Townsend Score = S1 + S2 + S3 + S4.

The ACORN classification system was developed by CACI (CACI, 2005) from a range of data analysed from the UK 2001 census. The ACORN acronym means 'A Classification Of Residential Neighbourhoods'. The CACI organisation produced the ACORN classifications to include every street in the country, comprising 18 groups, containing 57 ACORN neighbourhood types (CACI, 2005). It is a geodemographic (combining geographical and demographics analysis) classification of British social classes using key factors such as home ownership, health, employment and lifestage (for more details about ACORN Score, see Appendix 5.6).

5.2.5 Geographical Information Systems (GIS)

In this study, Arc View was essentially used to draw maps of Rhondda Cynon Taf County Borough, one containing the set out rate data and the other containing the Townsend Index Score. Shading was used to distinguish zones within certain ranges of relevant values. This allowed for a convenient visual association between the two data sets. The percentage ranges were 25-28, 29-32, 33-35, 36-38, 39-44, 45-54, and 55-65. Further, the package was utilised to examine correlations existing between the data sets by drawing scatter diagrams and performing linear regression analysis.

5.3 RESULTS OF KERBSIDE SCHEME EXPANSION DOOR STEP INTERVIEWS WITH HOUSEHOLDERS IN BEDDAU, RCTCBC

The following sections will present the results derived from pre-kerbside collection and follow-up surveys conducted on the doorstep with householders in the Beddau kerbside scheme expansion area.

Forty-six per cent of the 506 household samples were interviewed by the team. Five per cent did not have time to participate in the survey and the remaining 49 per cent were not at home at the time of the survey. A statistical Bernouli test validated that the interviewed sample population was representative of the total sample area surveyed (see Appendix 5.7).

The survey was well received by the majority of interviewees, with most showing an interest in the proposed kerbside collection scheme. Findings revealed that 68 per cent of interviewed householders had not recycled at all prior to the scheme starting. Of the 32 per cent of householders that had recycled, half (16 per cent) of these recycled clothes only. The remaining 16 per cent of householders who claimed to recycle more than clothes, took their recyclable materials to a supermarket bring site. Traditionally in the UK, bring sites, commonly located at supermarkets, have been the most common routes for recycling glass and paper. Most of the surveyed households who claimed to recycle were habitually taking their glass and paper to these sites.

Although only 16 per cent of householders recycled more than clothes, when householders were asked to rank the importance of household recycling on a sliding scale of 1 to 10, 90 per cent viewed recycling as important (a score of 5 or over). This result is shown in Figure 5.4.

5.3.1 Choice of receptacle

In October 2002, the Council, which had previously been trialling three different receptacles for recyclable material storage, converted all areas to the clear bag scheme, selected on its broad base appeal, with most households (58 per cent) surveyed prior to the scheme commencing showing preference for the clear bag storage method. The box receptacle was the second most popular method (27 per cent) and the re-use of supermarket carrier bags was the least preferred method of storage (11 per cent). Of the 4 per cent of householders who expressed a preference for another type of receptacle, most wanted an extra wheeled bin, to store recyclables. In the Beddau area, residents currently store general refuse in a wheeled bin.

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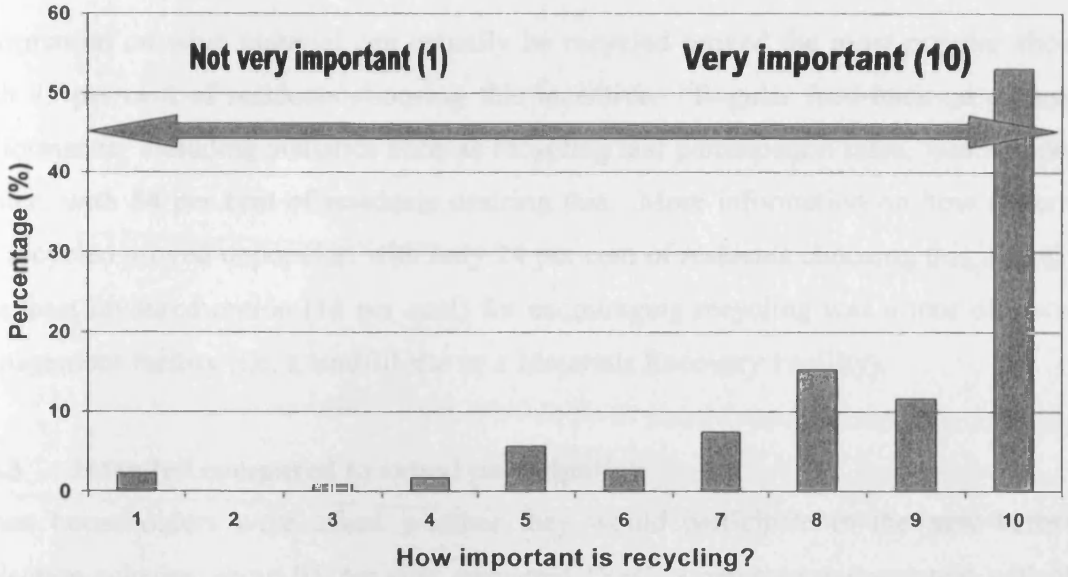


Figure 5.4 Distribution of the 'importance of recycling to the householder'-the Beddau area

5.3.2 Incentives for households to recycle

Residents were offered a number of hypothetical incentives and asked to state which would encourage or help them to recycle their household waste. There was no restriction on the number of categories they could choose. Results are shown in Figure 5.5.

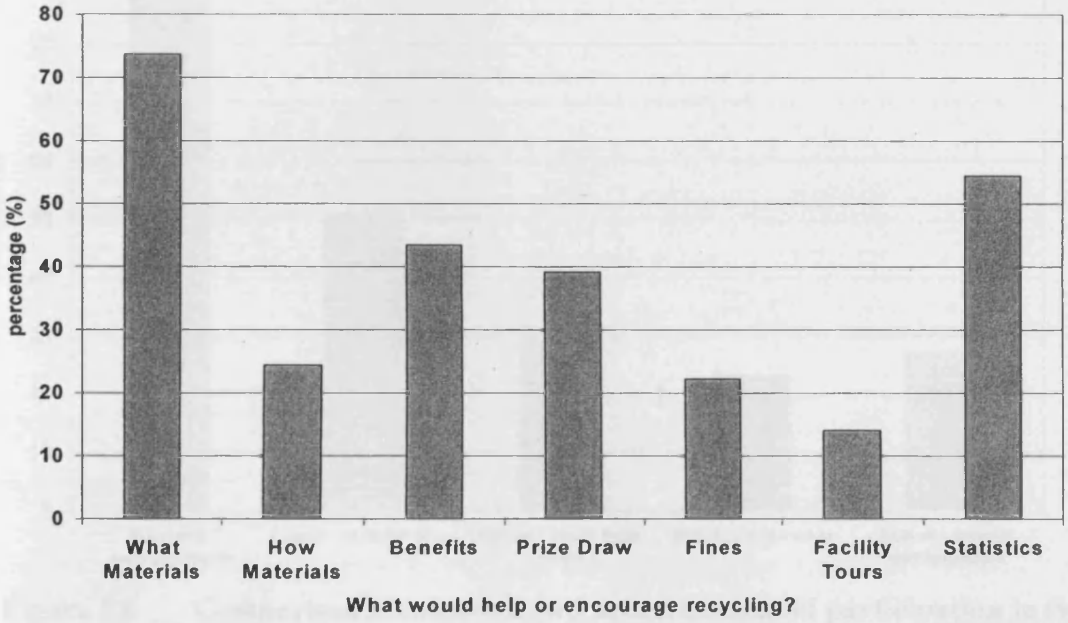


Figure 5.5 Methods for encouraging or improving recycling rates – Beddau area

Information on what material can actually be recycled proved the most popular choice, with 73 per cent of residents choosing this incentive. Regular feed-back on an area's performance, including statistics such as recycling and participation rates, was a popular choice, with 54 per cent of residents desiring this. More information on how materials are recycled proved unpopular, with only 24 per cent of residents choosing this incentive. The least favoured option (14 per cent) for encouraging recycling was a tour of a waste management facility (i.e. a landfill site or a Materials Recovery Facility).

5.3.3 Intended compared to actual participation

When householders were asked whether they would participate in the new kerbside collection scheme, about 95 per cent answered 'Yes', a percentage consistent with that derived from a nationwide survey conducted by the Environment Agency, which predicted a pre-scheme participation rate of about 90 per cent (Environment Agency, 2002).

However, quantifying the intended participation rate is of little significance compared to the observed actual participation rate as shown in Figure 5.6.

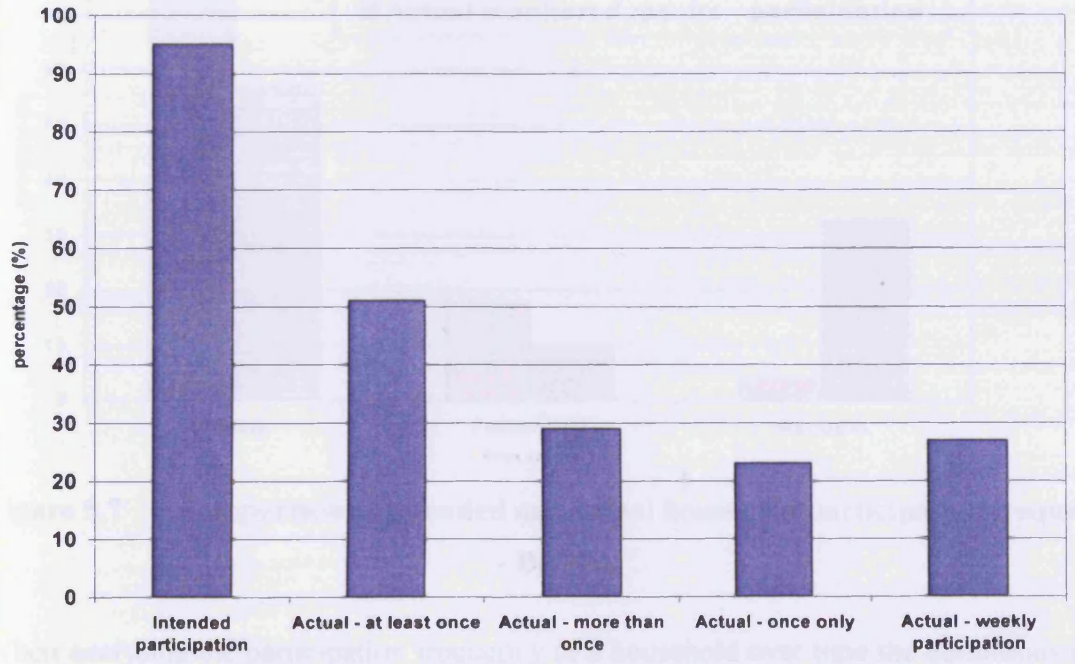


Figure 5.6 Comparison of intended and actual household participation in the new scheme – Beddau area

During the eight week monitoring of the surveyed area, the average weekly participation rate was 27 per cent. Interestingly throughout the eight week monitoring period, more than 50 per cent of households participated at least once.

5.3.4 Intended compared to actual participation frequency

One of the most important behavioural choices available to those participating or not in a kerbside recycling scheme is how often they put out their recyclable material. With the Council collecting weekly, the option to recycle is as convenient as putting out general refuse. The survey examined the intended frequency of recyclable waste being put out for collection. This 'intention' was compared to 'actual' monitored behaviour as shown in Figure 5.7. Actual participation frequencies were calculated from those that participated more than once, as shown in Figure 5.6.

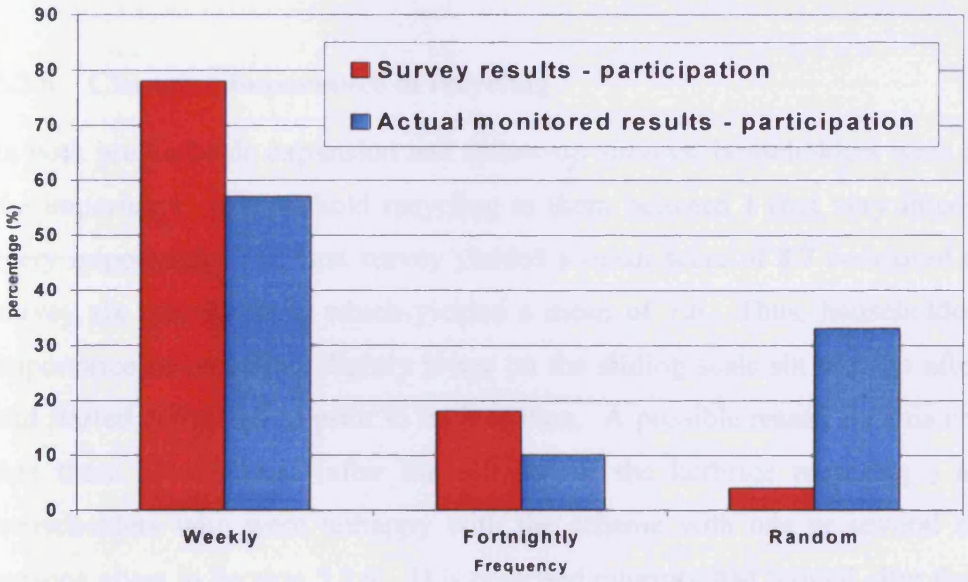


Figure 5.7 Comparison of intended and actual household participation frequency - Beddau

When analysing the participation frequency of a household over time the definitions used in Chapter 4, Section 4.4.1 were followed (see also Woollam et al. 2003). More than half of householders (58 per cent) actually setting out in the scheme put out recyclables for

collection on a weekly basis. Pre kerbside collection scheme survey results showed that three-quarters of residents (78 per cent) initially intended to put out recyclables on a weekly basis, while about 18 per cent intended to put out recyclables on a fortnightly basis. However, findings revealed a third of households (32 per cent) actually put out recyclables for collection on a random/infrequent basis.

5.3.5 Follow-up kerbside survey results

Six months after the kerbside collection scheme's inception, households in Beddau were re-surveyed to identify reasons as to why the majority were not participating in the scheme. Fifty per cent of the 506 households samples participated in the doorstep interviews conducted by the team for the follow-up (second) survey. Four per cent did not have time to participate in the survey, while the remaining 46 per cent were not at home at the time of calling. In the second survey, 92 per cent of those questioned were satisfied with the clear bag scheme.

5.3.6 Changing importance of recycling

In both pre kerbside expansion and follow-up surveys, householders were asked to rank the importance of household recycling to them between 1 (not very important) and 10 (very important). The first survey yielded a mean score of 8.7 compared to the second survey six months later, which yielded a mean of 7.6. Thus, householders ranked the importance of recycling slightly lower on the sliding scale six months after the scheme had started compared to prior to its inception. A possible reason for this change may be that there now existed (after the roll out of the kerbside recycling) a minority of householders who were unhappy with the scheme with one or several of the several reasons given in Section 5.3.9. This polarised minority had formed after the pre-kerbside collection survey, therefore may have been responsible for the decrease in mean score.

5.3.7 Claimed compared to actual participation

The follow-up survey indicated that 80 per cent of householders claimed to be participating in the scheme. Of those claiming to be participating, 77 per cent said they

put out recyclables weekly, 18 per cent fortnightly, and 5 per cent randomly or infrequently. If such levels of participation and frequency were correct, then a 60 per cent average weekly set out rate would have been expected. A comparison of claimed participation in the kerbside collection scheme in the follow-up survey with 'actual' observed participation, revealed 29 per cent of householders claiming they were participating in the scheme who had never actually participated in it. This was discovered by cross correlating surveyed house numbers with individual household participation data. Thus, findings seem to suggest that most householders were overstating their commitment to the kerbside scheme, and even those actually participating were claiming to be doing so more frequently than actually observed. As shown in Figure 5.6, over 50 per cent of householders in the area under study had participated at least once in the collection scheme.

5.3.8 Householders' perception of recyclable refuse

Potentially, RCTCBC can divert 57 per cent of bin waste through the kerbside recycling scheme (see Chapter 4, Table 4.1). When householders were asked how much of their refuse was recyclable by RCTCBC in the kerbside recycling scheme, 35 per cent thought under half of their refuse could be recycled, and 19 per cent thought between 75 per cent - 100 per cent of household waste could be recycled in the scheme. Thus, 54 per cent of households wrongly perceived the amount of general household refuse that could be recycled, indicating that more than half were unaware of how much general refuse could actually be recycled from their door step.

5.3.9 Reasons for non-participation

In the follow up survey, only 20 per cent of households surveyed admitted to not participating in the kerbside collection scheme. Reasons for householders not participating in the scheme are shown in Figure 5.8. The main reason for not participating in the scheme was lack of time. Other reasons included being disabled, living on one's own, and people perceiving they did not produce enough waste to warrant participation.

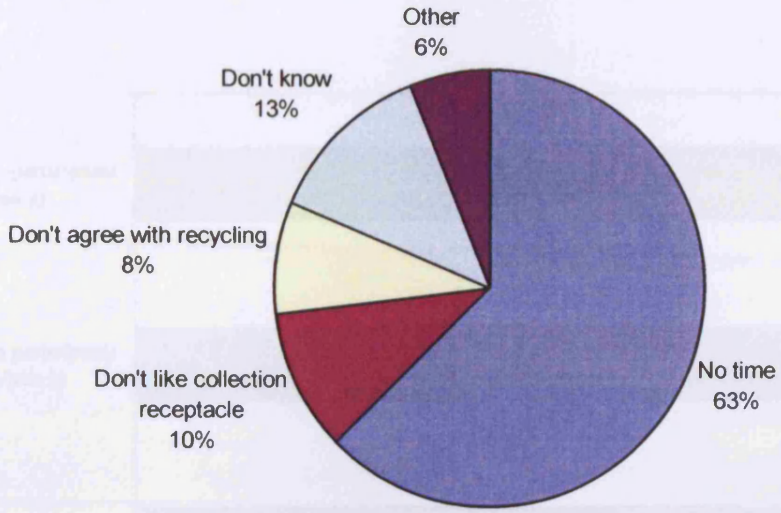


Figure 5.8 Results of survey "Reasons given by householders for not participating in the kerbside collection scheme"

5.4 RESULTS OF DOOR STEP INTERVIEWS WITH TARGETED HOUSEHOLDERS IN AREAS 1, 2 AND 3

The following sections will present the results of 694 interviews conducted with householders in Areas 1, 2 and 3.

5.4.1 Claimed scheme participation

The first survey question asked if households had ever participated in the kerbside recycling scheme. Figure 5.9 shows the percentage of householders claiming past participation in the scheme. Seventy-three per cent of all households, 504, claimed to have participated at some point in time since the scheme's inception. It is important to note that the interview results being discussed here are from Areas 1, 2 and 3 combined. In Areas 2 and 3, households were specifically targeted as being those with and without prior recycling behaviour, respectively. Of households known not to have participated in the recycling scheme, 63 per cent claimed to have participated in it. Not surprisingly, all known participants in the scheme claimed to be taking part in it.

Figure 5.9 Results of survey question "Claimed participation in scheme?"

The findings reiterate that claimed participation (as discussed in section 5.3) was much greater than actual participation.

5.4.2 Present participation

In order to compare high alleged participation with actual participation, those interviewed were asked to indicate whether they were currently participating in the scheme. This would also help to distinguish current activity from past participation. Of householders interviewed, 481 (70 per cent) claimed to be currently participating in the scheme, whereas 23 (4.6 per cent) households claimed to have participated in the past and to have subsequently stopped their kerbside recycling activity (see Appendix 5.5). Therefore, 4.6 per cent of households had dropped out from participating in the scheme. The most common reasons given for ceasing particpation in the scheme were 'too busy to continue' or 'simply lack the time'. Other reasons, in no particular order, included:

- difficulty obtaining more bags,
- ill health,

- vermin ripping open the bags,
- storage problems with too many bags in the house,
- one householder could not give a reason why s(he) had stopped.

5.4.3 Influence of someone aged under 16 on a household's claimed 'present' participation in the scheme

To see if the presence of a young person in the household affected a household's claimed present participation in the kerbside recycling scheme, these two variables were compared. It was found (see Appendix 5.5) that 72 per cent of households claiming to be presently participating in the kerbside scheme included a household member under 16 years of age. This percentage did not significantly differ from that of households that did not have a member aged under 16 (70 per cent). Therefore, there seemed to be no relationship between the presence of someone under the age of 16 in a household and claimed participation in the kerbside recycling scheme.

5.4.4 Alternative locations for recyclate diversion

Households were asked if they diverted recyclable material anywhere else. It was found (see Appendix 5.5) that approximately one-third (157) of the 467 households claiming to presently participate in the kerbside scheme also took recyclables to locations elsewhere, such as a HWRC, or bring sites at supermarkets, or charities. Further analysis revealed that a small number of households claiming not to recycle under the kerbside scheme were taking recyclables elsewhere. Eight of thirty-five households claiming not to participate in the scheme, claimed to be taking recyclables to a HWRC, bring sites at supermarkets, or charities.

5.4.5 Home composting

It was considered pertinent to ask how many households actually had gardens and how many presently home composted. It was found (see Appendix 5.5) that approximately 18.2 per cent of households that claimed to have a garden, also claimed to home compost regularly.

5.4.6 Claimed non-participation

Four justifications for non-participation to the scheme were offered. These were:

- No time to recycle
- Storage of recyclables a problem
- Disagree with recycling
- No incentive to recycle

A fifth option allowed the householder to state 'other' non listed reasons for not participating (see section 5.4.11).

5.4.7 No time

Figure 5.10 shows the percentage of households who stated they could not spare the time to separate household waste for recycling. Among known non-participants claiming not to recycle, just over half (56 per cent) indicated that time was a reason for their non-participation. Of claimed non-participants, just over half stated (54.6 per cent) also that time was a reason for their non-participation.

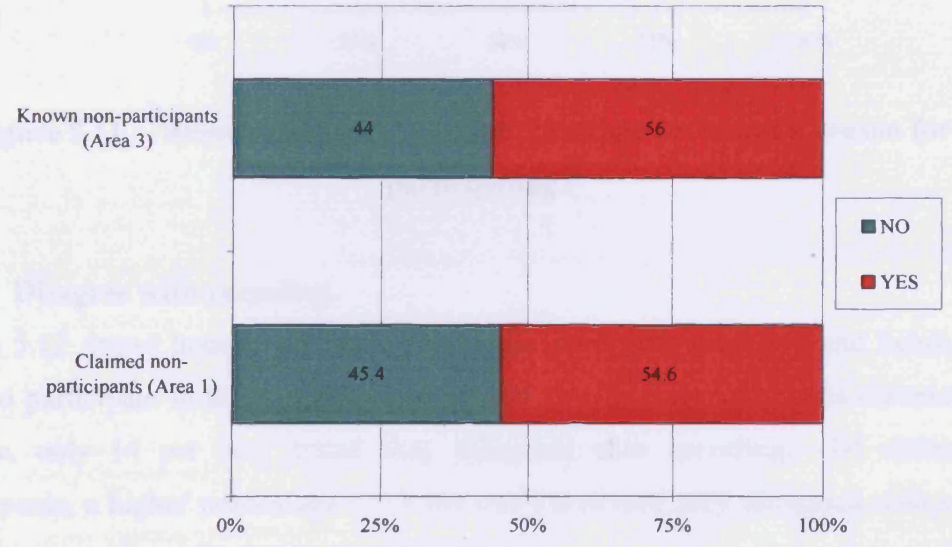


Figure 5.10 Results of survey question "No time a reason for not participating?"

5.4.8 No storage space

Figure 5.11 presents the percentage of households stating that storage of bags was a problem and an issue impacting on their participation in the kerbside scheme. Among known non-participants claiming not to recycle, just over half (56 per cent) indicated that lack of time was a reason for their non participation. Of claimed non-participants, a different result emerged, since 67.6 per cent stated that lack of storage space was not the reason for their non-participation.

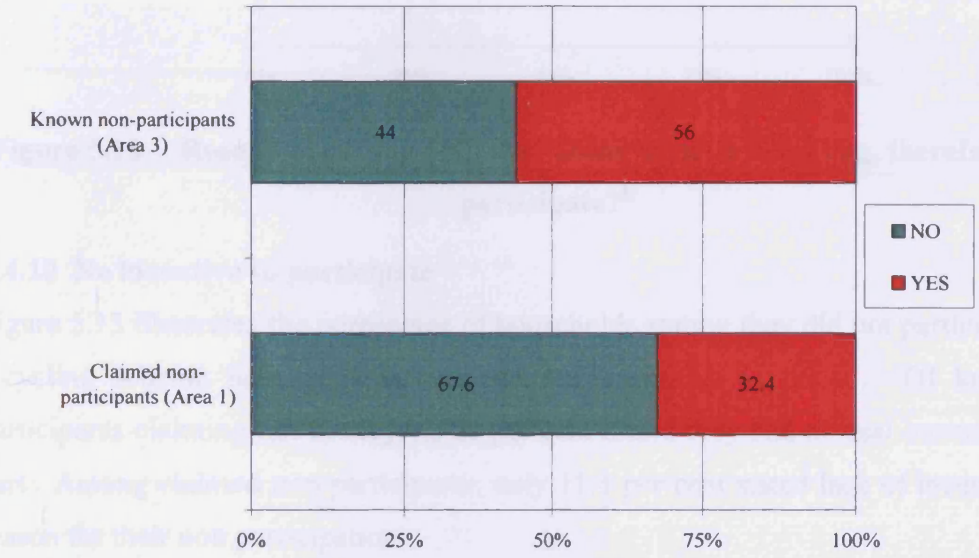


Figure 5.11 Results of survey question "Storage problems a reason for not participating?"

5.4.9 Disagree with recycling

Figure 5.12 shows households stating they disagreed with recycling and hence did not wish to participate in the kerbside scheme. Of known non-participants claiming not to recycle, only 14 per cent stated they disagreed with recycling. Of claimed non-participants, a higher percentage (29.4 per cent) indicated they disagreed with recycling and this was a reason for their non participation.

Figure 5.12 Results of survey question "Disagree with recycling, therefore do not participate?"

5.4.10 No incentive to participate

Figure 5.13 illustrates the percentage of households stating they did not participate in the recycling scheme because there was no real incentive to do so. Of known non-participants claiming not to recycle, 26 per cent stated they had no real incentive to take part. Among claimed non-participants, only 11.4 per cent stated lack of incentive was a reason for their non participation.

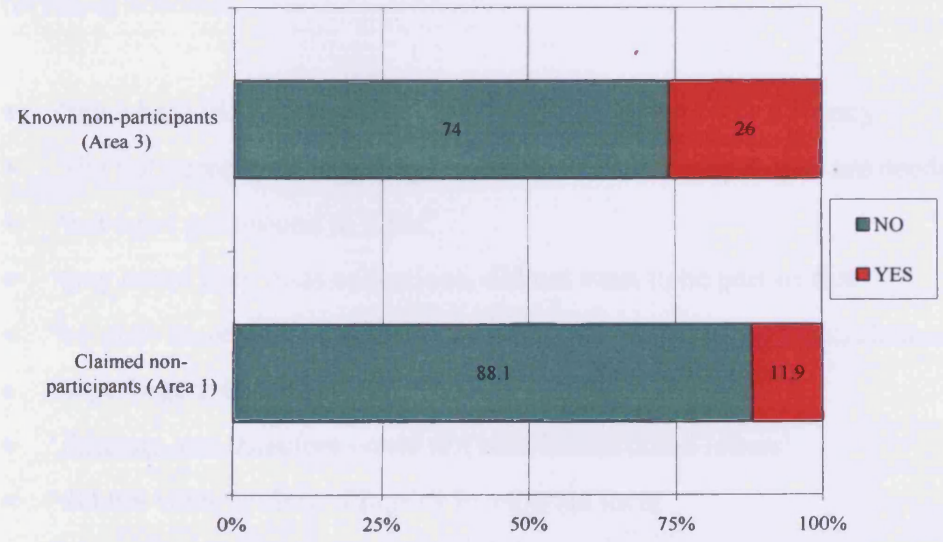


Figure 5.13 Results of survey question "No incentive a reason for not participating?"

5.4.11 Other reasons

Many households gave other reasons apart from those discussed above for their non-participation in the recycling scheme. Households could provide as many reasons as they wished. Of the 97 households that responded to this question, most stated they 'couldn't be bothered', 'were too lazy', 'not interested' or viewed it as 'too much hassle'. 'Other reasons' for non-participation in recycling are presented in order of the number of respondents offering them given in brackets:

- 'could not be bothered, too lazy, too much hassle, not interested' (21)
- 'no details of scheme or bags' (14)
- 'ill health, or too old/elderly to take bags to kerbside' (9)
- 'they did not produce enough waste to recycle' (8)
- 'it was too much trouble getting bags' (3)
- 'reason of no time' (5)
- 'storage problems' (4)
- 'animals rip open bags and make a mess/litter' (2)
- 'they had not thought about it, or did not know' (2)

Some 'one-off' comments are listed below, in an attempt to consider all attitudes towards the recycling scheme:

- 'the whole idea of recycling was thought to be a waste of money'
- 'did not agree with recycling - because twice as many trucks are needed'
- 'have not got around to it yet'
- 'they heard they miss collections, did not want to be part of that'
- 'because there was no wheelie style bin, did not want bags outside the house'
- 'kept forgetting to take part'
- 'illiterate and therefore could not read instructional letters'
- 'did not want to clean things or to separate them'
- 'when it's compulsory I will recycle'
- 'the scheme is just too complicated'

- 'A lady stated she was a widow and that's why she could not do it'

5.4.12 What would help or encourage recycling?

Householders were asked what would help or encourage them to start participating in kerbside recycling or, if they were participating, what would help them recycle more. The question was addressed to all households, whether they claimed to participate or not. They were given seven (1-7) suggestions and asked to assess them as good incentives by answering Yes or No to each.

5.4.13 More information

In survey results presented in section 5.1, 30 per cent of households indicated that more information would not help or encourage them to recycle. All the households in this study had received an informative scheme leaflet (see Chapter 6). This possibly explains why of all households that responded to the question, 60.1 per cent indicated that more information would not help or encourage them to recycle (see Figure 5.14).

Of known non-participants claiming not to recycle, more than half (54.1 per cent) stated that more information would not help or encourage them to take part. Among known participants, two-thirds (66.3 per cent) stated more information would not make them recycle more.

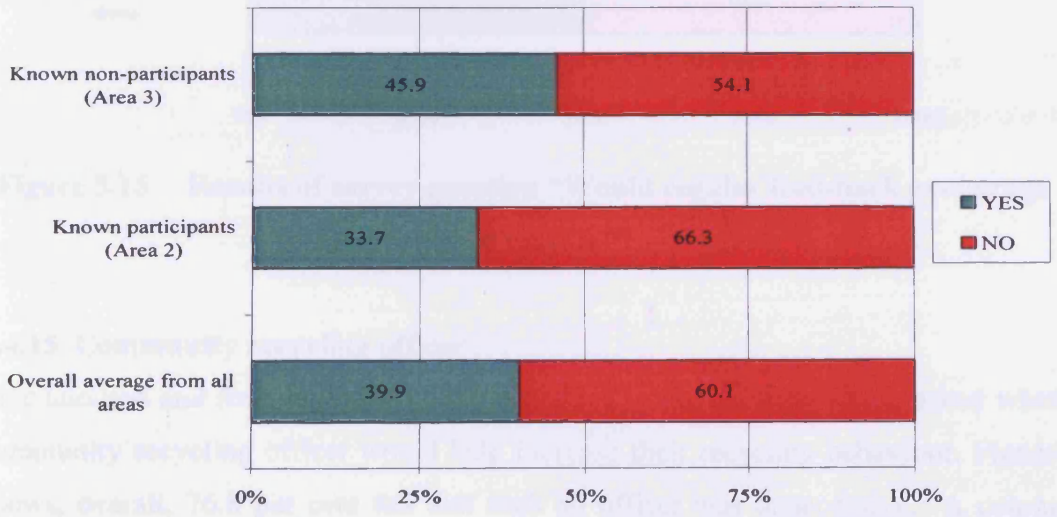


Figure 5.14 Results of survey question "Would more information help you to recycle?"

5.4.14 Regular feed-back

Figure 5.15 presents the percentage of households that thought feed-back on recycling would/ would not encourage them to recycle. Of the 514 householders who responded, 258 indicated that regular feed-back on their voluntary recycling efforts would encourage them to recycle, while 256 indicated that feed-back would not encourage them. Of known non-participants claiming not to recycle, 57 per cent stated that feed-back would help or encourage them to take part.

Known participants most liked the idea of being given feed-back about their recycling performance, with 60.6 per cent stating it would help or encourage them to recycle more. It should be stated that after interviews, householders were offered a feed-back leaflet (see Chapter 6).

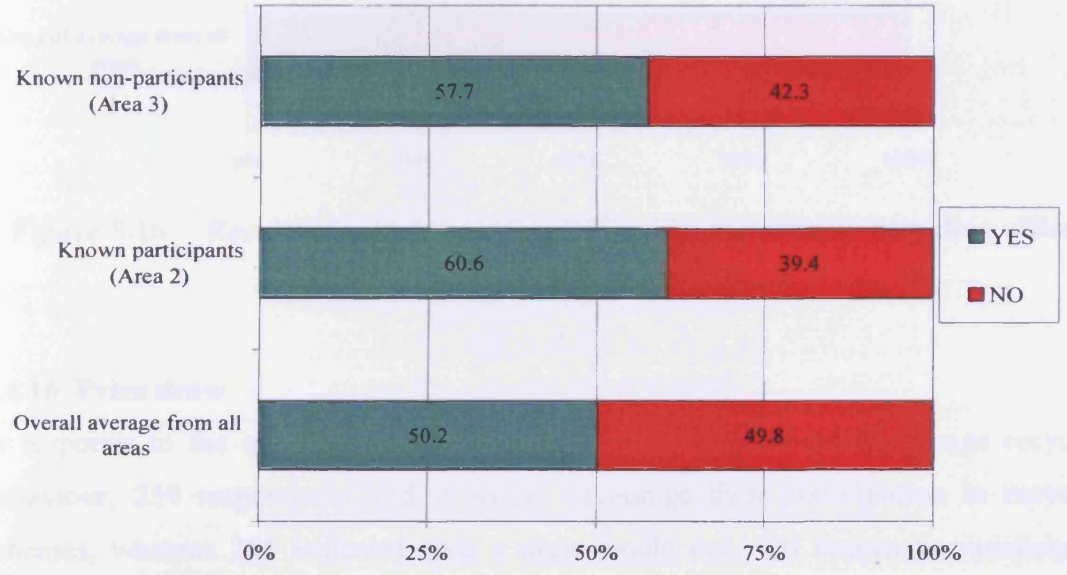


Figure 5.15 Results of survey question "Would regular feed-back encourage you to recycle?"

5.4.15 Community recycling officer

Five hundred and fourteen households responded to the question which asked whether a community recycling officer would help increase their recycling behaviour. Figure 5.16 shows, overall, 76.8 per cent felt that such an officer was unnecessary. A community recycling officer was defined as someone based in the local community (a friendly recognisable face) who would visit every month or so to solve any problems households

were experiencing with the recycling scheme. Among known non-participants claiming not to recycle, just over a quarter (26.1 per cent) stated that a community recycling officer would help or encourage them to take part. Known participants least liked the idea of a community recycling officer, with 78.8 per cent opposing the suggestion.

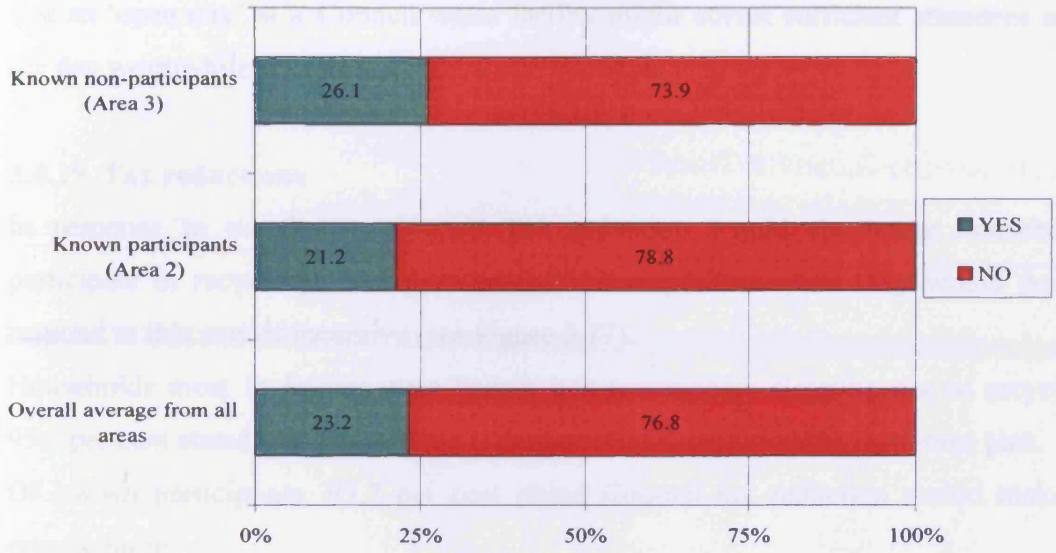


Figure 5.16 Results of survey question " Would a community recycling officer help you recycle?"

5.4.16 Prize draw

In response to the question asking whether a prize draw would encourage recycling behaviour, 259 respondents said it would encourage their participation in recycling schemes, whereas 255 indicated such a draw would not. Of known non-participants claiming not to recycle, just over half (52.3 per cent) stated that a prize draw would help or encourage them to take part. Known participants least liked the idea of a prize draw, with 57.7 per cent opposing such an incentive.

5.4.17 Financial penalties

As regards fines and the imposition of charges as an incentive to encourage recycling behaviour, 77 per cent of the 514 respondent households indicated that such an incentive would not encourage them to participate in recycling.

5.4.18 Waste facility tours

As for tours of waste facilities as an incentive, 80 per cent of the 514 respondent households disagreed with this as a form of positive encouragement. Therefore, 1 in 5 households inferred they would be interested in tours of waste facilities. This suggests that an 'open day' at a Council waste facility might attract sufficient attendees to make the day worthwhile if offered to the whole Borough.

5.4.19 Tax reductions

In response to whether a Council Tax reduction would encourage households to participate in recycling, 90.3 per cent of 513 respondents said they would positively respond to this sort of incentive (see Figure 5.17).

Households most in favour were known non-participants claiming not to recycle, and 95.2 per cent stated that Council tax reduction would encourage them to take part.

Of known participants, 93.7 per cent stated Council tax reduction would make them recycle more.

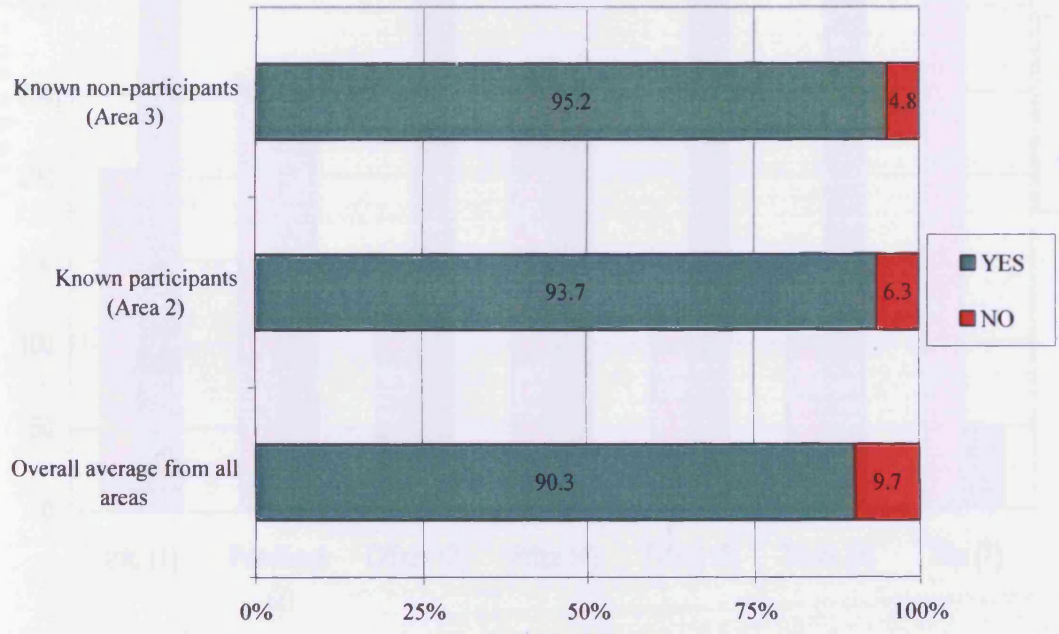


Figure 5.17 Results of survey question "Would tax reductions encourage you to recycle?"

5.4.20 Incentives to help or encourage recycling

Overall responses to the recycling incentives question are compared in Figure 5.18. It is clear that four of the incentives discussed above stand out from the others. Householders clearly disagreed with the idea of a community recycling officer, fines for non-participants, and tours of local waste facilities as encouraging or helping recycling. However, they were overwhelmingly in favour of Council tax reduction as a method to encourage participation in the scheme.

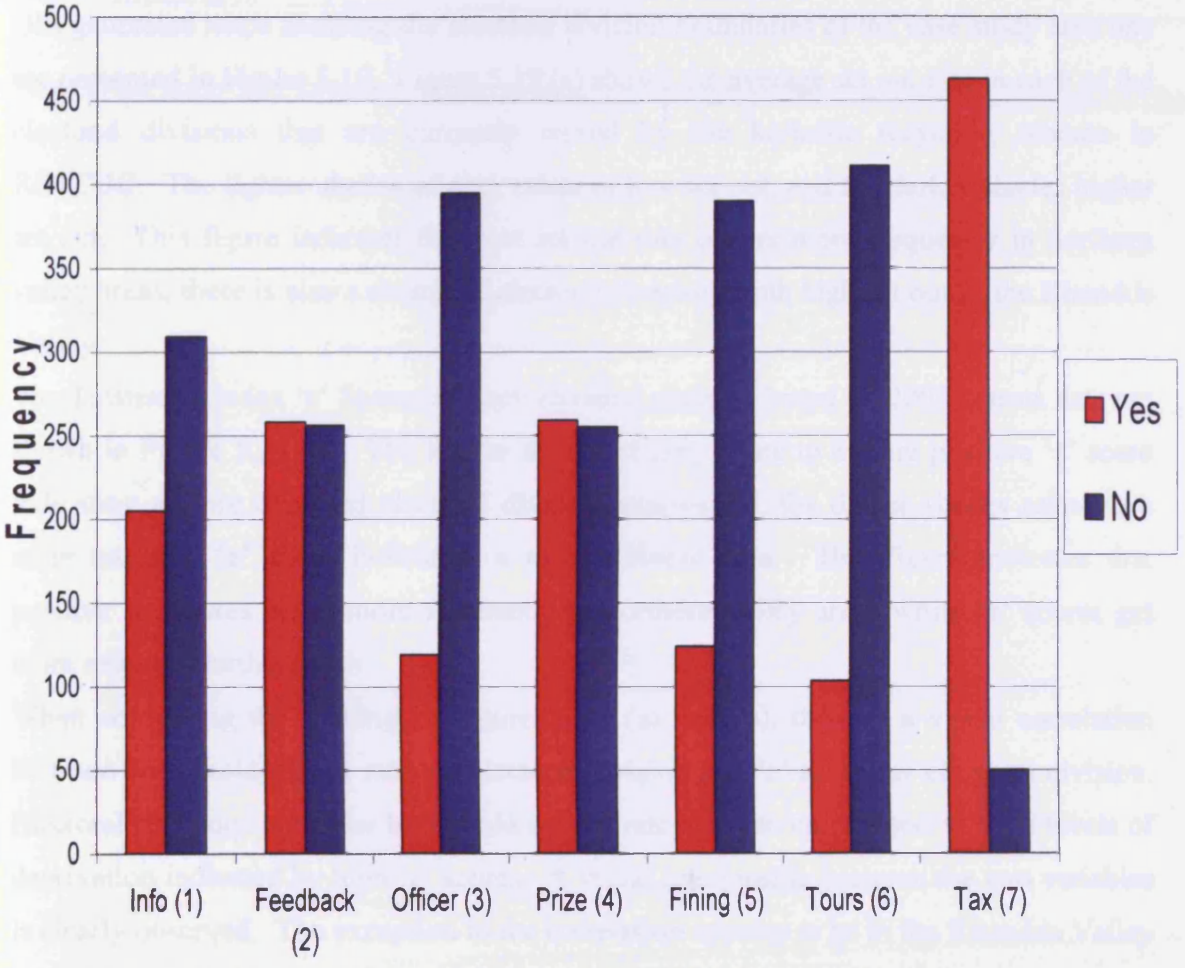


Figure 5.18 Results of all survey questions about incentives

5.5 RESULTS OF THE ANALYSIS OF ACTUAL KERBSIDE RECYCLING BEHAVIOUR

The following sections will present the results of the analysis of actual kerbside recycling behaviour. The set out rate was considered to be the proportion of households within a street that put out recyclable materials on the day of kerbside collection. The data analysed were derived from both areas, RCTCBC and CCBC.

5.5.1 Ward level examination of case study one

GIS generated maps showing the electoral division boundaries of the case study area one are presented in Figure 5.19. Figure 5.19 (a) shows the average set out rate in each of the electoral divisions that are currently served by the kerbside recycling scheme in RCTCBC. The lighter shades of grey relate to low set out, and the darker shades higher set out. This figure indicates that low set out rate occurs more frequently in northern valley areas, there is also a cluster of electoral divisions with high set out in the Rhondda Valley.

The Townsend Index 'z' Scores of each electoral division based on 2001 census data are shown in Figure 5.19 (b). The lighter shades of grey relate to a more positive 'z' score indicating a more deprived electoral division, conversely, the darker shades relate to a more negative 'z' score indicating a more affluent area. This figure indicates that positive 'z' scores occur more frequently in northern valley areas while 'z' scores get more negative further south.

When comparing the shading in Figures 5.19 (a) and (b), there is a visual correlation between household set out rate per electoral division and 'z' score per electoral division. Electoral divisions with low household set out rate seem to correspond to high levels of deprivation indicated by high 'z' scores. A visual relationship between the two variables is clearly observed. The exception to the correlation appears to be in the Rhondda Valley where there is a cluster of electoral divisions with a high household set out rate and also a high 'z' score. The cluster seems to be around the closed Nant-y-Gwyddon landfill site.

The average set out rate for each electoral division, correlated to the Townsend Index 'z' Score for that division are shown in Figure 5.20. A similar spread of data along the

regression line provides evidence that there is a weak correlation between the two variables. The regression co-efficient R^2 is 0.19.

The electoral divisions of Cwm, Clydach and Llwyn-y-pia directly neighbour the landfill and have the highest electoral division set out rate in the Borough, and also 'z' scores of around +4.

The regression co-efficient increases over twofold (R^2=0.48) when the cluster of data from electoral divisions in close proximity to Nant-y-Gwyddon landfill is omitted, shown in Figure 5.20. The electoral divisions eliminated from this data set are shown in Figure 5.19 (a), namely, Cwm Clydach, Llwynypia, Tonypandy, Ystrad and Pentre.

The R^2 value of 0.48 (see Figure 5.21) suggests a moderate link between the variables, which led to further analysis using the SPSS statistical package to explore possible significance in the strength of the relationship. A Pearson correlation coefficient value of -0.69 indicated that the two data sets, Household Set out rate and Townsend Index Score, were moderately to strongly related at the 0.01 (1%) significance level. The findings thus suggested that household set out rate in the kerbside recycling scheme was moderately to strongly related to the socio-economic characteristics of case study one (if the data from the 5 electoral divisions surrounding Nant-y-Gwyddon are omitted).

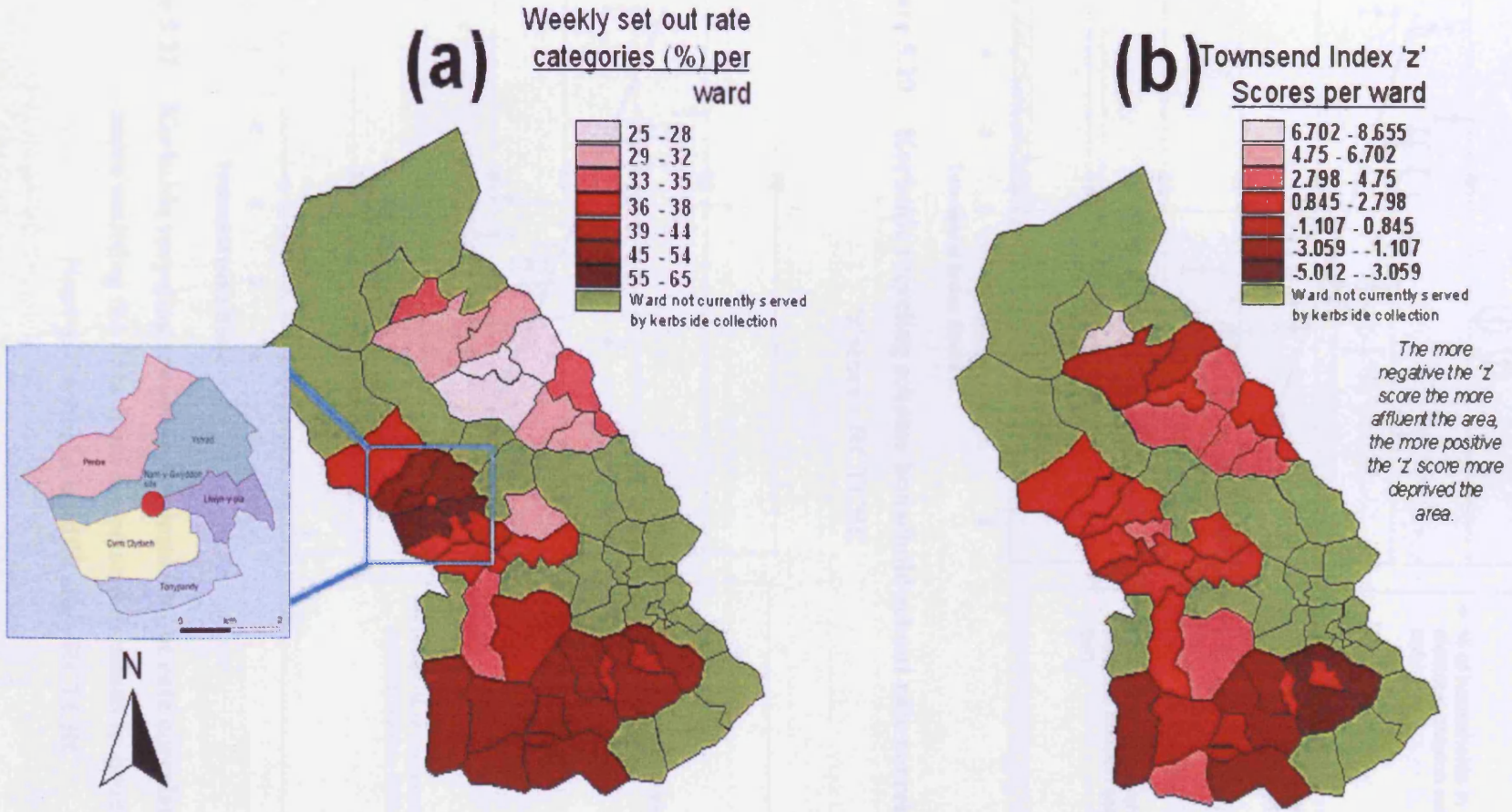


Figure 5.19 GIS generated maps showing the electoral divisions of the case study area.

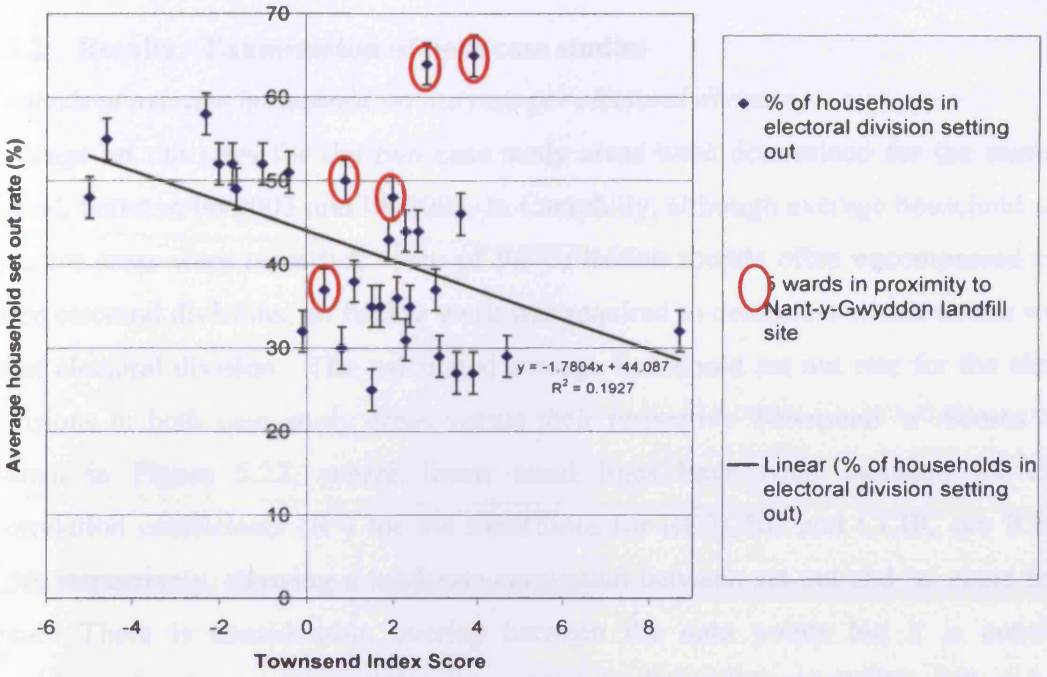


Figure 5.20 Kerbside recycling scheme household set out rate correlated to 'z'score - RCTCBC

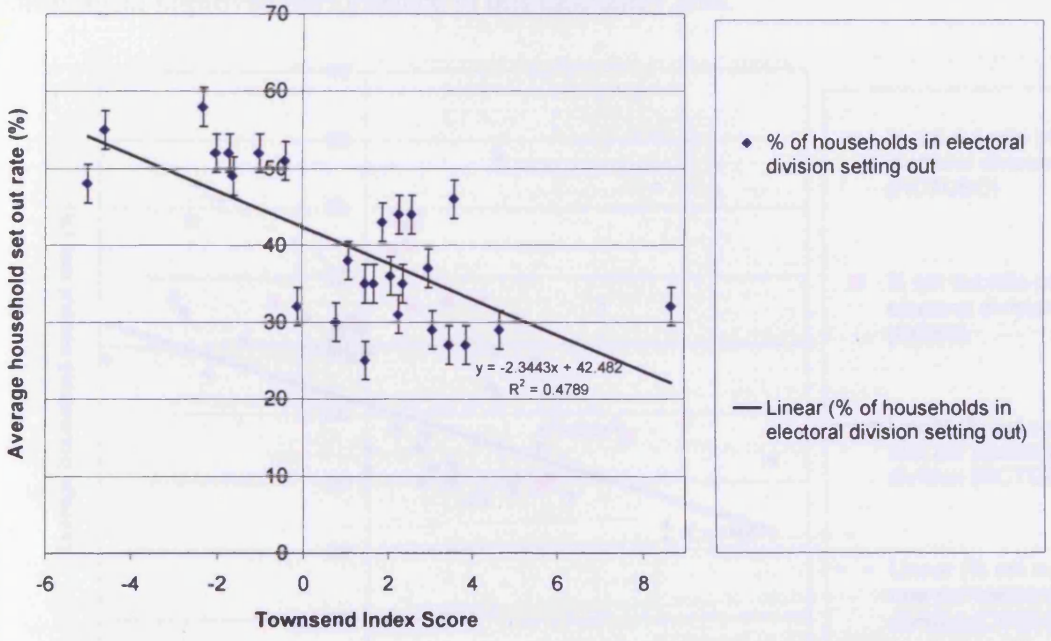


Figure 5.21 Kerbside recycling scheme household set out rate correlated to 'z' score omitting the data from 5 electoral divisions in proximity to Nant-y-Gwyddon landfill site - RCTCBC

5.5.2 Results – Examination of both case studies

Analysis of average household set out rate per electoral division

Average set out rates for the two case study areas were determined for the same time period, between 06/2003 and 08/2003. In Caerphilly, although average household set out data for areas were recorded, some of the collection rounds often encompassed two to three electoral divisions, so further work was required to determine which streets were in what electoral division. The calculated average household set out rate for the electoral divisions in both case study areas versus their respective Townsend 'z' Scores are as shown in Figure 5.22, where linear trend lines have been included for clarity. Correlation coefficients (R^2) for the trend lines for RCTCBC and CCBC are 0.46 and 0.30, respectively, showing a moderate correlation between set out and 'z' score in each area. There is considerable overlap between the data points but it is considered significant that there exists a different trend line for RCTCBC and CCBC. Observing the lines individually it is seen that electoral divisions with a 'z' score of zero had a set out of 42 per cent in RCTCBC whilst the corresponding rate in CCBC was 60 per cent, indicating an improved performance in this case study area.

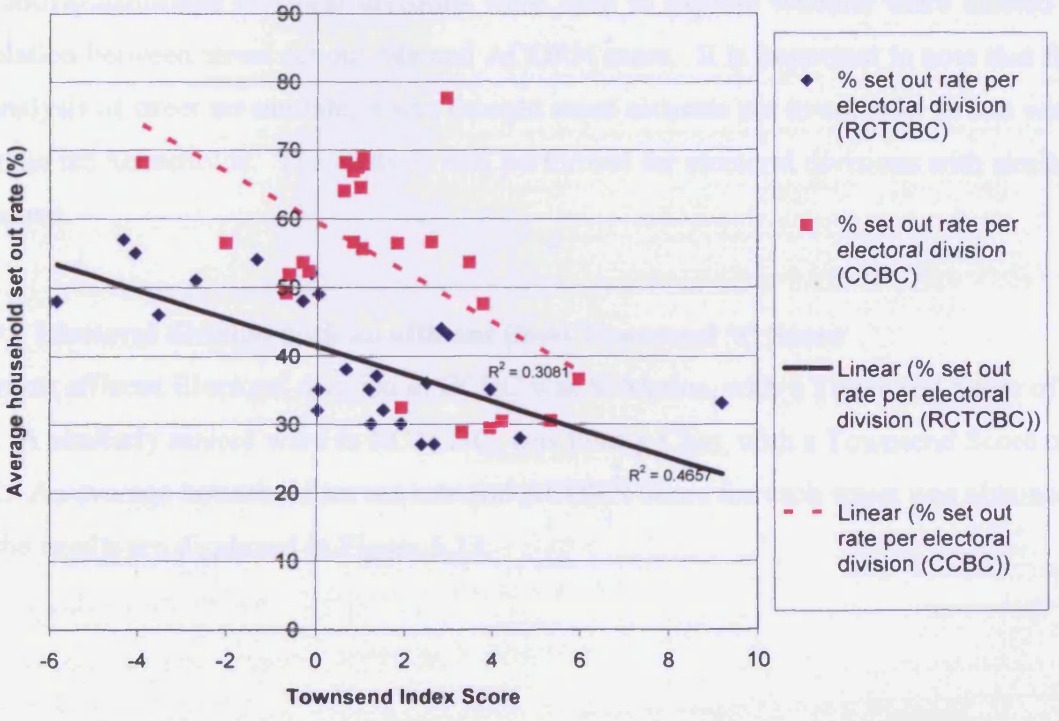


Figure 5.22 Relationship between set out rates and Townsend 'z' Score

Table 5.1 identifies electoral divisions in the two case study areas with Townsend 'z' scores at the two extremes and at the mid point. It is interesting to note that electoral divisions with similar 'z' scores can exhibit very different set out rates, for example, the affluent electoral divisions of Pontyclun and St Matins, both with a 'z' score of about -4 but with set out rates of 55 per cent and 68 per cent, respectively.

Table 5.1 - Electoral divisions selected for in-depth street analysis

Rhondda Cynon Taf County Borough Council		**Caerphilly County Borough Council**	
Electoral division	**Townsend Score**	**Electoral division**	**Townsend Score**
Pont-y-Clun	-4.32	St Matins	-3.90
Aberdare East	1.23	Machen	1.08
Penrhiwceiber	4.65	Aberbargoed	5.99

The above-mentioned electoral divisions were used to explore whether there existed a correlation between street set out rate and ACORN score. It is important to note that for the analysis of street set out rate, it was thought more accurate not to consider streets with less than ten households. The analysis was performed for electoral divisions with similar 'z' scores.

5.5.3 Electoral division with an affluent (low) Townsend 'z' Score

The most affluent Electoral division in CCBC was St Matins, with a Townsend Score of -3.90. A similarly ranked ward in RCTCBC, was Pont-y-Clun, with a Townsend Score of -4.32. An average household set out rate and ACORN Score for each street was obtained and the results are displayed in Figure 5.23.

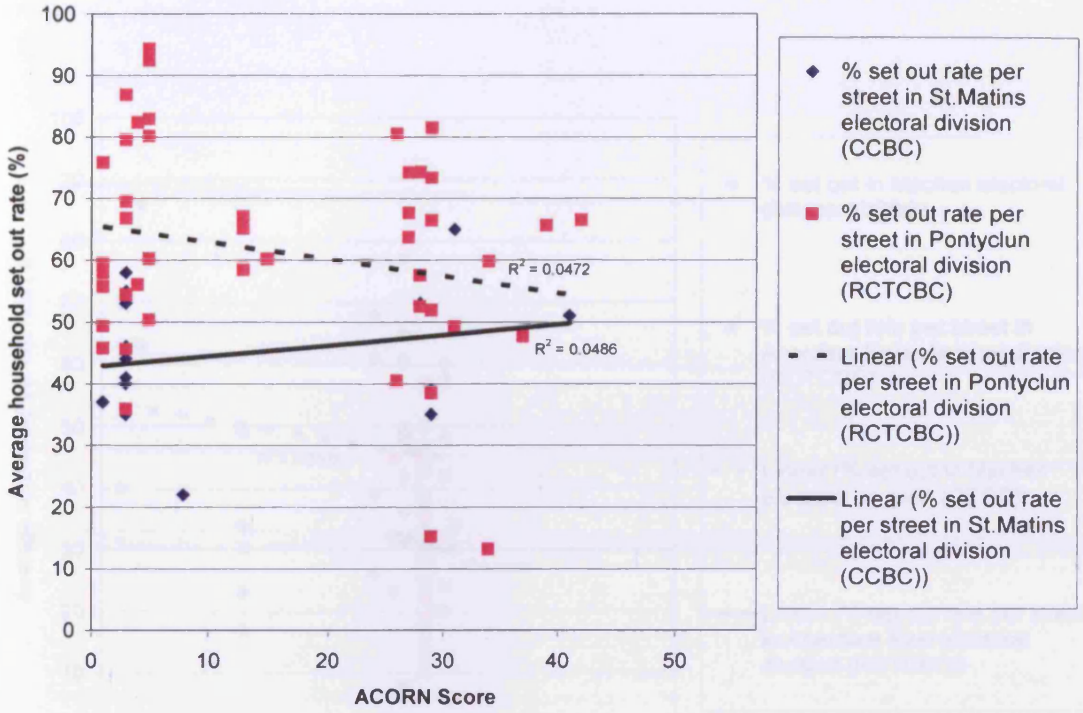


Figure 5.23 ACORN Score and set out rate for streets in St Matins electoral division (CCBC) and Pont-y-Clun electoral division (RCTCBC)

As can be seen in Figure 5.23, the streets in both areas contain a similar spread of ACORN scores, but the correlation between average household set out per street and ACORN Score is weak, with the two trend lines exhibiting correlation coefficients of 0.015 and 0.049 for RCTCBC and CCBC, respectively.

5.5.4 Electoral divisions with a near zero Townsend 'z' Score

The electoral division selected for CCBC was Machen, with a Townsend Score of 1.08, and for RCTCBC the selected division was Aberdare East, with a Townsend Score of 1.23. Average household set out rate and ACORN Score for each street are displayed in Figure 5.24. In Aberdare East, the majority of streets obtained an ACORN Score of 32, implying their residents were retired home owners. The electoral division of Machen in CCBC had far more streets with different ACORN Scores. The correlation between average household set out per street and ACORN Scores is weak for both electoral divisions with R^2 values of only 0.003 and 0.032 in RCTCBC and CCBC, respectively.

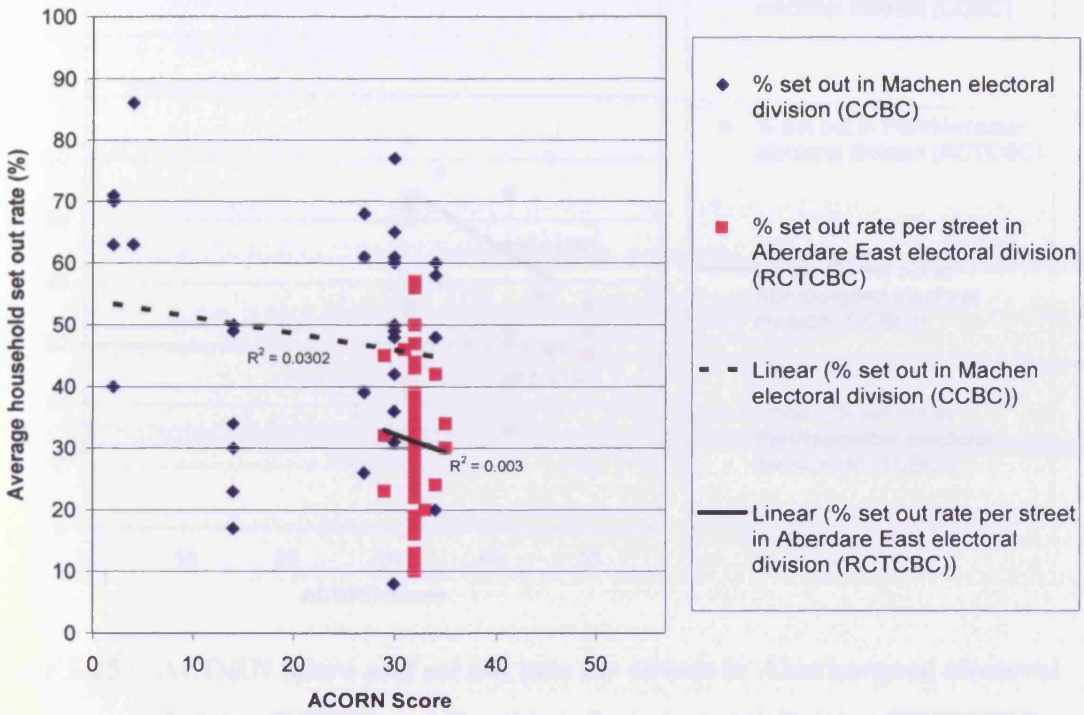


Figure 5.24 ACORN Score and set out rate for streets in Machen electoral division (CBBC) and Aberdare East electoral division (RCTCBC)

5.5.5 Electoral divisions with a deprived (high) Townsend Score

Penrhiwceiber from RCTCBC and Aberbargoed from CCBC, with Townsend 'Z' Scores of 4.65, and 5.99, respectively, were the selected electoral divisions and data are presented in Figure 5.25. Very low values for the correlation coefficients were obtained again (R^2=0.05 for RCTCBC and R^2=0.18 for CCBC), indicating little or no correlation between set out and ACORN Score for these electoral divisions.

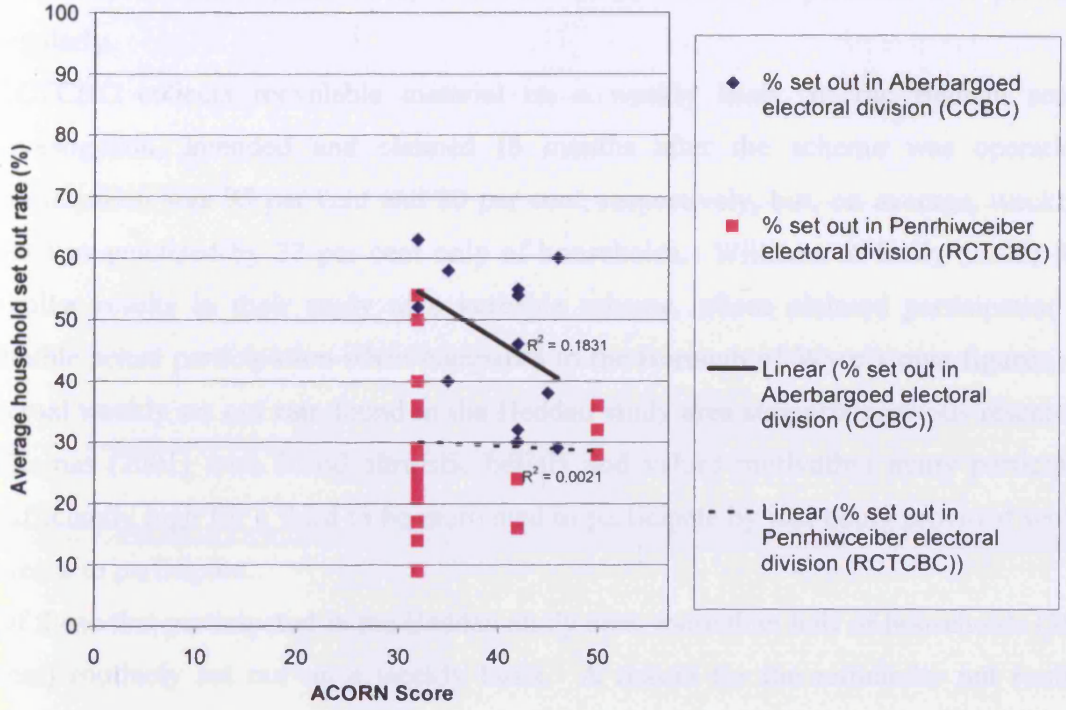


Figure 5.25 ACORN Score and set out rate for streets in Aberbargoed electoral division (CBBC) and Penrhiwceiber electoral division (RCTCBC)

5.6 OVERALL DISCUSSION

The following sections will discuss the results of the experiments.

5.6.1 Intended, claimed and actual recycling behaviour

Intended participation in the kerbside recycling scheme and actual participation were shown to be very different. Waste disposal is a normal 'habitual' task made easy because there are systems in place to remove generated general refuse on a weekly basis. The 'habitual' task of putting household rubbish in a bin is a decision that employs the minimal amount of mental and physical effort the part of the householder (Davies et al . 2002). The same 'habitual' task of recycling seems not yet to have formed part of the householder's routine. With only 23 per cent of households participating just once in the Beddau kerbside scheme expansion, it would seem householders may need more encouragement to participate more frequently. De Young (1996) suggests that intrinsic reasons that lead to voluntary participation can be nurtured and developed. Thus, if a

household has participated once, it will not be as difficult to persuade it to participate regularly.

RCTCBC collects recyclable material on a weekly basis. In the Beddau area of investigation, intended and claimed (6 months after the scheme was operational) participation was 95 per cent and 80 per cent, respectively, but, on average, weekly set out was practised by 27 per cent only of households. Williams & Kelly (2003) found similar results in their study of a kerbside scheme, where claimed participation was double actual participation when compared to the Borough of Wyre's own figures. The actual weekly set out rate found in the Beddau study area supports previous research by Thomas (2001) who found altruistic beliefs and values motivating many participants, sufficiently high for a third to be motivated to participate by just being provided with the means to participate.

Of those that participated in the Beddau study area, more than half of households (58 per cent) routinely set out on a weekly basis. A reason for the remainder not routinely participating on this basis may be their failure to generate sufficient dry recyclate to fill one of the three clear bags. However, at the time of the study, the Council could have potentially collected an average 10.2kg of recyclable material by weight from each household (see Chapter 4, Section 4.2.3) therefore, it is difficult to see material generation as a barrier. Further, 54 per cent of householders wrongly perceived the amount of refuse that could be recycled (see Section 5.3.8), and this misperception may have been one of several reasons influencing participation frequency. Research at Oxford Brookes (1999) indicated that a third of households could not identify what proportion of their household waste could be recycled. Both that and the present study thus highlight a recurring theme, namely, there is a lack of waste awareness education given to the public.

Present study findings reveal households over exaggerated their intention to recycle, probably endeavouring to convey a positive intention to please the interviewer or to be perceived as morally good. The UK Resource Recovery Forum (2002) reported that people consistently over-report environmental attitudes and behaviour in surveys when compared to the actions they actually take. Tucker (2003) commented that self-reported behaviours are more likely to reflect attitudes rather than behaviours, for example, "what

I should do" rather than "what I actually do". The present survey results and subsequent monitoring suggest householders in the area under investigation were reflecting recycling attitudes rather than actual recycling behaviour. The poor correlation of intended and claimed participation with actual weekly set out should be of great concern to the waste management industry. Since 29 per cent of those that claimed to be participating in the kerbside scheme had never actually done so, such communicated over-commitment on the door step calls into question the validity of door to door surveys.

Both the pre- and follow-up kerbside collection surveys found the householder wanting more information on what materials could be recycled, similar findings were found in a survey conducted in Kensington (Read, 1999).

Since the late 1980s, kerbside recycling schemes have been the focus of a great deal research, with public participation shown to be an important element for their success. Studies around the world suggest that participation is encouraged through convenience of collection, however, there is little consensus on major determinants of recycling behaviour (Tucker, 1997). Perhaps the most prominent worldwide factor for participation in kerbside recycling schemes is whether the scheme is voluntary or mandatory. Unlike the UK, many European and North American states have the power to set legally enforceable requirements to separate recyclables and/or organics in the household at a municipal/federal level. For example, mandatory household recycling (see Chapter 8, Section 8.4.3 for more discussion) exists in parts of Canada, the USA, Germany, Denmark, Austria, and The Netherlands (Open University, 2003). It has been shown that in these areas, and also in areas using direct and variable charging or PAY-T (pay as you throw) schemes (Ernst and Young, 2002), higher levels of participation and material recovery are achieved (Everett, 1993), although well planned and designed voluntary schemes may achieve comparable levels of participation and similar recovery levels (Noehammer, 1997).

Price (2001) contended that there is little incentive for the typical UK householder to divert waste from disposal in landfill if there is no penalty for non-participation in recycling schemes. One method available to encourage householders to recycle is to make disposal the least convenient option and to try to educate the public about waste issues, reinforcing the argument that kerbside schemes can become better supported with

more effective communication and educational awareness campaigns. Evison & Read (2001) showed that waste awareness campaigns and publicity on a regular basis can produce better recycling performance. Many feel the level of participation is heavily influenced by the manner in which the authority publicises its kerbside collection and encourages householders to participate (Moloney, 2002).

5.6.2 Socio-economic factors and recycling behaviour

Many research studies have investigated the relationship between socio-economic factors and recycling behaviour. Affluence in terms of size of residence, area and income, and education have been found to be positively linked to recycling behaviour (Watts, 1999; Berger, 1997; Coggins, 1994; Tucker, 1998). On the other hand, there are studies that have found no strong link between housing type, income, and education and recycling participation (Vinning, 1992).

Oversimplified analysis using single one-dimensional variables, such as housing type or educational level, for comparison against recycling participation, may mask other dependencies and simplify a complex set of factors influencing participation.

In the aforementioned studies, it is important to note how the authors derive and quantify household recycling behaviour, as large differences have been found between actual, claimed, and intended recycling activity (Woollam et al. 2003). Additionally, more meaningful correlations can be drawn from socio-economic factors if the variables chosen are multi-dimensional, for example, the Townsend Index and ACORN score. Standalone single dimensional socio-economic indicators, like housing type, house size, income and educational levels can mask true socio-economic status and misinform the reader as to the significance of any potential relationships.

Parfitt et al. (2001) suggest more meaningful analysis of participation can be achieved using a combination of key waste management design variables, such as storage method, collection frequency, and density of bring sites. In the TPB shown in Figure 5.1, factors such as socio-economic characteristics and receptacle type are argued to be indirect, mediated through components of the model (Ajzen, 1991). Although many support the model, there are some who think it does not adequately explain recycling behaviour, and

additional variables (such as section C, shown in Figure 5.1) should be included within it (Davies et al. 2002).

It is thought that because of the 114,000 household sample size combined from RCTCBC and CCBC and the regular monitoring of individual household set out in the kerbside scheme, the case study areas provide useful examples for looking at the relationship between recycling set out rate (household set out rate per ward and per street) and socio-economic factors (Townsend Index score per ward and ACORN score per street).

It is, however, acknowledged here that there is a risk of 'ecological fallacy' (Langbein, 1978) in such comparisons [i.e. inferring from average statistical characteristics (census data) individuals' behaviour]. Ecological fallacy assumes that individual-level correlations are the same as aggregate-level correlations. However, Langbein (1978) showed that individual level correlations may be larger, smaller, or even reverse in sign when compared to aggregate level correlations. For instance, in the United States at the 'state' level there is a strong correlation between race and illiteracy, but this largely disappears at the individual level. The risk of ecological fallacy in the current study is nonetheless minimised by comparison of datasets of the same 'demographic level', i.e. using a socio-economic indicator for ward level set out data and a street level socio economic indicator for street level set out data.

Public information and education campaigns have proven to be an additional factor affecting recycling schemes. Feed-back on performance and re-enforcing positive elements of the scheme are also important (Open University, 2003). Many successful schemes report door knocking and road shows are invaluable for getting the recycling message across to the householder (Read, 1999).

In the present scheme, it may in fact have been a 'negative' waste awareness message that was responsible for a cluster of increased participants in the RCTCBC case study area. The Nant-y-Gwyddon landfill site in the Rhondda Valley had been a source of public attention for several years, with a concerted campaign mounted for its closure. It was on the top of a mountain, about 400m from villages surrounding it below. For the past 12 years, residents had been concerned about the possible effects of landfill on their health and on the health of unborn babies and the surrounding environment in general. Increasing public opposition in wards in close proximity to the landfill, spearheaded by

the local action group called RANT (Residents Against Nant-y-Gwyddon Tip), is thought to be the reason for the significantly higher household participation in the kerbside recycling scheme in that area. RANT had written numerous articles, held hundreds of public meetings, and enlisted the assistance of the local media to raise public awareness of the landfill problem. As a consequence, Nant-y-Gwyddon landfill site was closed in 2002.

The study results also suggest there is a limit to the likely set out rate that will be achieved in certain wards, and this depends moderately to strongly on the Townsend Index score. Factors such as the Nant-y-Gwyddon effect can also alter the expected limit. The connotations of these findings are important. Local authority targets for Wales are identical for every authority. Provided that a suitable infrastructure is in place, more households are likely to voluntarily participate in the kerbside recycling scheme in affluent areas. It is likely, therefore, that Welsh Assembly Government targets will be more easily met in more affluent areas, because participation will likely be higher. There is also evidence that the amount of recyclate will be higher in affluent areas (Cardiff University, 2003).

The results presented in Figures 5.22 to 5.25 for "set out rates" determined from data generated from 114,000 houses across two boroughs, represent, one of the largest sample sizes for this type of investigation.

Figure 5.22 demonstrates the relationship between average household set out rate and Townsend 'z' Scores, i.e. a link between recycling behaviour and socio-economic status. The linear regression analysis produced R^2 values of 0.47 and 0.31 for wards in RCTCB and CCBC, respectively. These values demonstrate a reasonable level of correlation between recycling behaviour and socio-economic factors in the two case study areas, and Within RCTCBC a moderate to strong link identified from the Pearson coefficient value of -0.69. Interestingly where both on Figure 5.22 intersect at a Townsend 'z' score of zero, CCBC and RCTCBC had average set out rates of 60 per cent and 43 per cent, respectively. The difference between the two percentages was significant and suggests set out rate not only depends on socio economic factors but also on other factors such as the collection infrastructure and frequency as indicated by Parfitt et al. (2001) and Woollam et al. (2004).

All attempts at use the ACORN scoring system to correlate set out rate with socio-economic status at street level proved unsuccessful, as illustrated in Figures 5.23 to 5.25. This is attributed to the large degree of clustering of ACORN scores within a given electoral ward. It is interesting to note the wide range of set out rates achieved in different streets, from a low of about 10 per cent to over 90 per cent, and streets with the highest ACORN scores (most deprived) exhibiting the lowest maximum set out rates. Maximum rates were 95 per cent in affluent 'ACORN scoring' streets, 85 per cent in average 'ACORN scoring' streets, and 65 per cent in deprived 'ACORN scoring' streets.

5.6.3 Summary

Every local authority in England (and probably in Wales) has a duty by 2010 under the Household Waste Recycling Act 2003 to provide a kerbside recycling scheme (collecting at least two recyclable materials) which current study findings suggest the majority of households will not take full advantage of. This should be of great concern to the waste industry, since, with households having the choice to opt in or out of a kerbside recycling scheme, this effectively provides them with the power to determine whether local authorities meet their mandatory targets (Perrin et al. 2001).

The results of this study suggest that if the waste management industry bases performance in kerbside schemes on self-reported or intended recycling behaviours, predictions will be inaccurate. ENCAMS (Environmental Campaigns, www.encams.org) has developed an analytical tool using MOSAIC (Geographical Information System, GIS) software to produce maps of local authority areas identifying geo-demographic segmentation patterns. ENCAMS research suggests that the responses and motivations of various groups differ and that waste awareness campaigns should take these differences into account. Designers of the model claim it can identify a street's socio-economic status and suggest an appropriate awareness raising technique. ENCAMS research results are based on 'claimed' and 'intended' recycling behaviour not actual, the results presented in this chapter suggest that this will lead to inaccurate assumptions about household recycling behaviour.

MOSAIC software (which is based on 'street level' socio-economic indicators) is also likely to be inaccurate as no correlation between socio-economic factors and recycling

behaviour was found in this study at the demographic level of the street (see Sections 5.5.3, 5.5.4 and 5.5.5).

The main finding shows that detailed 'actual' data collection and scheme monitoring is essential for potential kerbside service improvement. Recycling attitudes need to crystallise into actual kerbside recycling behaviour if kerbside diversion targets are to be attained.

5.7 CONCLUSIONS

The following sections will present an overview of main findings reported in the three primary research stages detailed in Chapter 5.

5.7.1 Main findings from kerbside scheme expansion doorstep interviews with householders in Beddau, RCTCBC

- Intended and claimed participation showed no correlation with actual participation.
- Almost three-quarters of respondents (73 per cent) stated that information on what material can actually be recycled would help them recycle and compost more material.
- Of those who claimed to be participating in the scheme, 29 per cent had never actually taken part in the scheme.
- More than half of householders (58 per cent) who were actually setting out in the scheme put out recyclables for collection on a weekly basis.
- The follow-up (second) survey revealed 54 per cent of householders wrongly perceived the amount of general household refuse that could be recycled.
- The main reason for not participating in the scheme was lack of time.

5.7.2 Conclusions of doorstep interviews with targeted householders in areas 1,2 and 3, RCTCBC

- Findings presented in section 5.3.1 indicated claimed recycling behaviour differed from actual behaviour. Therefore, claimed attitudes and behaviour towards waste disposal and recycling should not be used for decision making purposes. The

only reliable claimed data came from those households known to be already participating in the kerbside scheme.

- No relationship was found between the presence of someone under the age of 16 in a household and claimed participation in the kerbside recycling scheme, suggesting that young people have no effect on claimed scheme participation.
- Approximately one-third of households that claimed to presently participate in the kerbside scheme also took recyclables to locations elsewhere, such as a HWRC, or bring sites at supermarkets, or charities.
- Analysis revealed that just under a quarter (22 per cent) of households claiming not to recycle under the kerbside scheme were taking recyclables elsewhere.
- Approximately one-fifth of households that claimed to have a garden, also claimed to home compost regularly.

5.7.3 Conclusions of the analysis of actual kerbside recycling behaviour

- The GIS model indicated a moderate to strong link between household set out rate (%) and socio-economic ('z' score) in case study area one.
- An additional factor affecting set out rate in the kerbside scheme of case study area one was identified, namely, the 'Nant-y-Gwyddon effect'.
- The 'Nant-y-Gwyddon effect' was thought to be the result of the presence of an active, highly vocal anti-landfill group called RANT. It is thought that the awareness raised by the group was responsible for the significantly increased set out rate in areas surrounding the landfill site.
- The correlation between average set out rate and Townsend 'z' Score at electoral ward level was confirmed in the RCTCBC and CCBC case study areas.
- The aforementioned correlation depended on factors such as collection infrastructure and frequency.
- There was no correlation between ACORN score and set out rate at street level. This finding has wider connotations since it implies that actual kerbside recycling behaviour cannot be linked with socio-economics at the street level. Many conclusions drawn from waste analyses may therefore be inaccurate if related to ACORN Score.

- Householders clearly rejected a community recycling officer, fines for non-participants, and tours of local waste facilities as incentives for encouraging or promoting recycling.
- Only Council tax reduction had wide support as a method to encourage participation in the recycling scheme.

CHAPTER 6

6 A TARGETED WASTE AWARENESS CAMPAIGN

Waste awareness messages surfaced on a significant scale in the UK in the late 1990s (IWM, 1995). The former Department of the Environment, Transport and Regions launched the *"Are you doing your bit?"* campaign in 1998 – one of the first environmental initiatives from the then new Labour Government in the UK. It included in its environmental remit messages to the public about waste and recycling, among other environmental issues. Anti-litter campaigns had been launched since the 1950s through 'Keep Britain Tidy' (www.encams.org.uk), but it was not until 2002 that the government launched a national campaign called the Rethink Rubbish campaign, which was specifically focused on getting the public to change their attitude towards waste and recycling. This campaign has been recently superseded by the Waste and Resources Action Programme (WRAP) and the Recycle-Now campaign (www.recyclenow.com). The current campaign involves TV adverts and other professionally designed services such as websites, leaflets and posters. Such national campaigns are the result of thorough market research and consumer testing and convey a more general, awareness-raising message than the more specific local authority campaigns. In the past, the public have broadly been subjected to two recycling campaigns of an entirely different nature, one telling them why they should recycle (the national campaign) and the other telling them how they can recycle (the local authority campaign, of which there have been numerous ones). They appear to complement each other but, in practice, the two campaigns are very different and the public have never made a connection between the two. One of the main aims of the Recycle-Now campaign is to attempt to integrate the two different types of campaign. The Recycle-Now campaign allows local authorities to use the same logo and artwork and provides guidelines for an effective communication campaign enabling a more consistent message to be delivered to the public. Communicating coherent recycling messages will be one of the key success factors for local authorities over the next decade (Mee, 2005). But whether or not such campaigns are effective depends partly on the indicators used to judge their success. An analysis of waste awareness campaigns that demonstrate good practice suggested their success should be judged by soft and hard indicators (Rethink Rubbish, 2004). Soft and hard indicators are integrally

linked. Soft indicators examine change in attitudes towards waste, whilst hard indicators measure change in recycling rate. Change in recycling rate is what local authorities really need to know in order to meet landfill diversion targets. Monitoring the success of waste awareness campaigns by change in hard indicators is surprisingly scarce. Read, (1999) was the first in the UK to prove their effectiveness.

In Wales, local authorities were consulted by Waste Awareness Wales on their support for the development of various awareness techniques, from 'road-shows' to 'websites' (WAW, 2004). The decision process to identify the best form of waste awareness technique for the national campaign was therefore reliant on opinion rather than the scientific verification of the effectiveness of each individual technique. As highlighted in the introduction to Chapter 5, numerous studies have been conducted on household attitudes towards waste and recycling. However, few comprehensive studies have been directed towards examining the true effectiveness of a waste awareness technique (see Read, 1999; Evison et al. 2001; Perrin et al. 2001; Bailey et al. 2003; Lyas et al. 2004; Mee, 2005).

The literature divides how effective the waste awareness campaign is into two social dilemmas (Lyas et al. 2004): to improve recycling performance either through collective (structural) or individual (psychological) approaches (Van Vugt, 2001). The specific awareness techniques described in this Chapter seek to improve recycling performance through the individual. Strategies are interventions that increase awareness about the problem (Van Vugt, 1998) for example, through information provision by means of door knocking (Read, 1999; Bailey, 2003), the use of feedback leaflets (Perrin et al. 2001) and also the effect of varying the message in the feedback leaflets (Lyas et al. 2004; Nigbur et al. 2005). Such strategies have had varying success to-date in changing recycling behaviour. Mee identified a weakness that no suitable toolkit existed for assisting the majority of local authorities to adopt best practise in communications (Mee, 2005). A word of caution, however, a definitive guide to the best awareness techniques for householders can only evolve out of studies that differentiate between each technique, as attempted in this thesis. Accordingly, a targeted waste awareness campaign was undertaken to change household recycling behaviour. This chapter explains its purpose and the aim of accompanying experiments. The waste awareness campaign's structure is

outlined and the methodologies of each experiment to monitor the campaign's effectiveness are detailed. Five areas were targeted, all with the same recycling infrastructure, and within each area a different waste awareness raising technique was implemented to attempt to change recycling behaviour. The purpose of the experiments was to quantify the effect of any change in recycling behaviour in each area solely due to a specific awareness raising technique. The results identify any change in kerbside recycling behaviour in each of the areas.

6.1 EXPERIMENTS TO MONITOR THE EFFECTIVENESS OF A TARGETED WASTE AWARENESS CAMPAIGN

A number of experiments were conducted to quantify the effect of any change in recycling behaviour solely due to a specific awareness technique. Recycling behaviour was assessed using the performance indicators of: material capture, the quality of recyclate, and average weekly set out rate in five different areas of Rhondda Cynon Taf County Borough (RCTCB). These indicators were used in an analysis of recycling performance both pre and post the awareness campaign in order to judge which awareness raising method had been the most effective.

6.1.1 Purpose of studying the quality of recyclate

It was thought beneficial to devise an indicator that reflected the quality of recyclate, as it might change after a waste awareness campaign. The Recyclate Awareness Index Score (RAI Score) provides a tool for the quantification of material quality. The material quality or RAI Score was calculated in the study from both the pre and post awareness recyclable waste analysis.

6.1.2 Purpose of studying household set out in scheme

Prior to the awareness campaign, set out rate data were analysed in depth to establish which households were already taking part in the kerbside recycling scheme. After the awareness campaign, set out rate data were analysed in depth again, this time to establish any new recruits to the kerbside recycling scheme. Not only was it thought useful to identify new recruits to the scheme, but also to establish whether individual households

that had previously participated in the scheme, participated more frequently after the awareness campaign.

6.1.3 Purpose of studying material capture per household

It was thought relevant to observe if there had been any increase in dry recyclate (non green waste) per participating household in each area after the awareness campaign. Green waste diversion was also recorded, but any change in this category was not thought to be a fair reflection of the effectiveness of the awareness campaign itself because not all households had a garden and the amount of green waste diverted is affected by seasonal and weekly weather patterns. Average household diversion was analysed by means of two recyclable waste analyses conducted pre and post the awareness campaign in each of the five areas.

6.2 THE AWARENESS RAISING METHODS

The aim of the waste awareness campaign was to change households' kerbside recycling behaviour. Kerbside recycling scheme performance indicators were used to monitor any change in the recycling behaviour of targeted households. Different households were targeted with different types of awareness raising techniques (see Section 6.2.2). It was important that the media and messages used could be easily replicated by other local authorities, therefore, awareness techniques were kept simple. To keep the trials fair and to ensure targeted householders had all been subjected to the same stimuli, trans-boundary awareness methods, such as radio, TV, and supermarket promotions were not used, because it would have been impossible to know which householders were exposed to what message.

6.2.1 Types of waste awareness raising techniques

Two categories of waste awareness raising technique were used: 'passive' and 'engaging'. 'Engaging' techniques involved verbally discussing recycling with households, for example, in a door step interview, and 'passive' methods involved giving residents forms of communication that did not involve verbal interaction, for example, a leaflet.

When planning service promotion of any kind, there are numerous principles that need to be adhered to. Community based social marketing techniques have been popular in the USA since the early 1990s (Lura Consulting, 2003). Many techniques have been implemented in order to try and change recycling behaviour, including leaflets, celebrity launches, promotional videos, and many more (Read, 1999; The Environment Council, 2003). A combination of various methods has been proven to raise scheme participation, material capture, and the overall recycling rate of certain areas (Read, 1999; Perrin et al. 2001). Wolfe (1993) and Evison and Read (2001) have shown that public information about recycling remains fundamental to its success. However, a combination of all such awareness raising techniques is time consuming and costly. With limited resources, these 'road show' style promotions remain out of the reach of most local authorities.

For this reason, it was considered necessary to separate the different forms of awareness raising techniques, so that the effect of each technique on recycling behaviour could be assessed for its individual benefit.

This research differentiated between passive and engaging forms of awareness raising. Passive forms of awareness raising used in this research included informative leaflets about the scheme, newspaper articles in the local council paper *Rapidly Changing Times* distributed to all households, reminder cards, and feedback leaflets. A more extensive list of passive forms of awareness raising can be found in Read (1999). The engaging forms (called interactive forms of awareness by Read, 1999) used in this project were door-to-door interviews coupled with extensive on the doorstep recycling advice.

The different waste awareness raising techniques employed in this study are shown below:

- Scheme leaflet (passive)
- Feedback leaflets (passive)
- Advertisement in *Rapidly Changing Times,* a Council paper distributed to every household (passive)
- Interviews and doorstep advice (engaging/interactive)
- Recycling receptacle provision.

All techniques were designed to be easily replicated by any other local authority attempting to change kerbside recycling behaviour. An explanation of what was involved in each activity is provided below.

6.2.2 Targeted households

Five different trial areas were selected in the case study area. Each of the five trial areas had a kerbside recyclate collection round. Rounds were chosen in conjunction with RCTCBC and based on two factors: they had similar set out rates and comprised a similar number of households (see Appendix 6.1 for each area's socio-economic status).
Table 6.1 shows the waste awareness raising techniques used in each of the five targeted areas, numbered 1 to 5. Area 5 was a control area that received no awareness raising technique (except the unavoidable *Rapidly Changing Times* insert); Area 4 was the only area to receive a 'passive' waste awareness raising technique; and the three other areas received 'engaging' waste awareness techniques. Thus, there were three areas (1, 2 and 3) that received 'engaging' waste awareness techniques. All households in Area 1 were targeted with the specified technique whereas households in Areas 2 and 3 were selectively targeted based on prior recycling behaviour. In Area 2, only those households previously participating in the scheme were targeted, whereas in Area 3 only those households not previously participating in the scheme were targeted.

Table 6.1 Waste Awareness Raising Techniques Received in Targeted Areas

Target Area	Number of households on round in area	Selective targeting of households	Awareness technique
Area 1	1388	All 1388 households	Engaging + Passive
Area 2	707	108 households with prior recycling behaviour	Engaging + Passive
Area 3	1159	148 households with no prior recycling behaviour	Engaging + Passive
Area 4	971	All 971 households	Passive
Area 5	1086	All 1086 households received no waste awareness raising technique	Control group

The research went one step beyond simply differentiating between awareness raising techniques. It sought to establish the effect of the awareness raising techniques on targeted households with previously known, not claimed recycling behaviour. This was necessary as it has been proven that there is a substantial difference between claimed and actual recycling behaviour (Woollam et al. 2003).

The types of households targeted were:

- those that (based on set out surveys) were already taking part in the kerbside scheme.
- those that (based on set out surveys) had not participated previously in the kerbside scheme.

6.2.3 Scheme leaflet design

It was intended that the scheme leaflet should be easy to understand, visually appealing, and it should:

- provide an explanation of what should be placed in Rhondda Cynon Taf's clear bags;
- address some frequently asked questions (highlighted in previous research by Cardiff University 2002, 2003);
- provide contact information for further questions;
- promote sustainable development in its broadest sense;
- and be bilingual (English and Welsh).

The design was based upon a similar leaflet used by Daventry District Council, the local authority with the highest household recycling rate at the time of the campaign design in 2003. A smaller version of the leaflet can be seen in Figure 6.1. The contents of the leaflet were designed to fit on one reversible A4 sheet of paper, one side in English, the other in Welsh. At every stage in the leaflet's construction, people not in the 'waste industry' were consulted to see if they understood what was being explained or portrayed. The wording on the leaflet was considered very important. The title line "Your Council's Recycling Scheme" was so worded to give ownership of the scheme to the householder. Also, up with the title were the logos of the two project partners, RCT and Cardiff University, to give the leaflet a recognisable and familiar image. Publicising the

University/Council partnership was thought to give the recycling scheme added prestige. Subsequent lines described the Borough's Sorting Out Recycling Together (SORT) campaign, explained to householders how to separate their recyclables into one of three clear bags, and emphasised that by taking part in the scheme householders could maximise the amount of rubbish recycled and help protect the environment. Pictures were used of different recyclable materials to add colour and to show the householder which materials were requested in the scheme. A table described the RCT clear bag system and use of ticks and crosses showed what should and should not be placed in each clear bag. Instructions were highlighted to draw attention to them, for example, households were asked to flatten cardboard, remove bottle tops, and squash bottles.

The last few lines presented information to provide answers to some frequently asked questions. Useful contact numbers, a description of how to obtain more clear bags, and an explanation of what time to put out recyclables for collection were given. As the kerbside recycling scheme is voluntary, a 'Many thanks for your help' was added at the bottom of the leaflet.

The final leaflet design and contents were approved by SORT Team members, recycling officers, and Council members.

All stakeholders liked the leaflet and it met the project's objectives. During door-to door interviews many members of the general public commented on the usefulness of the leaflet.

The leaflet was delivered to all properties (4225) in Areas 1-4 chosen to participate in the study, but not to those in Area 5, the control area. In order to ensure the leaflets were received, members from the University's waste research team delivered them by hand within one week (see Figure 6.3). Even though leaflets were known to have been delivered to the targeted households, during door to door interviews just a month later, some households requested another one, stating they had never received the original leaflet.

Figure 6.1 Scheme leaflet

6.2.4 Feedback leaflets

Past University research (Woollam et al. 2003) reported a high percentage of householders asking for feedback on how they were doing in the scheme. Due to the fact that kerbside recycling is a voluntary scheme, feedback leaflets were designed to thank householders for participating in it. It also explained the common goal of the University/Council partnership to increase recycling activity.

It reminded participants to wash and squash recyclable materials. It told the householder what percentage of the Borough (those with access to the kerbside recycling scheme) were using the scheme on a weekly basis. Details for contacting the Council were also included.

Householders were reminded of why they should recycle and the potential benefits of doing so. Localised facts made this Section more interesting and the statement "What you do makes a difference" reinforced the community engagement principle of transferring ownership of the scheme to the community (see Figure 6.2).

Figure 6.2 Feedback leaflets

Figure 6.2 Feedback leaflets

6.2.5 *Rapidly Changing Times*

Rapidly Changing Times is a paper that is produced by RCTCBC every month and sent to every household in the Borough. Unfortunately, this awareness material was also received by the control area. For political reasons it could not be stopped. It was thought a useful medium to use in the awareness campaign to reinforce the recycling message in Areas 1 to 4.

6.2.6 The interview protocol

Engaging people and householders in the community is an ongoing dialogue. By knocking at the doors of households, the campaign wanted to transfer part of the ownership of the scheme to them, for example, the campaign tried to make sure householders knew who to call or email, if they wanted more information about recycling.

The aim of the interview and advice was to assess householders' claimed recycling activity and attitudes towards recycling. Just as important, too, was verbally reminding the householder of the scheme and explaining the "why," "who," "what," "when," "where," and "how" about recycling. Householders' commitment to the scheme was elicited – whether this was their first participation in the scheme or whether they were already participating but not putting out all the materials requested by the Council, and were washing and squashing certain materials.

The role and use of doorstepping had been researched by Read (drawing on North American literature). The waste awareness campaign tried to mimic Northern American community-based social marketing techniques (Lura, 2003) whereby an informal verbal contract is made with the householder to recycle in the scheme as often as possible.
In an attempt to eliminate barriers to participation, clear recycling bags were offered to the householder, and given if asked for by any member of the public. Interview questions asked in each trial area were identical to ensure that the data generated from each targeted group could be cross-referenced and used to develop a more detailed understanding of the views of that particular group. Any differences in responses between the different trial areas could also be observed. A total of 694 interviews were conducted. For a copy of the protocol for the interview, including the survey questionnaire, see Appendix 6.2.

6.2.7 Door step interview team

The interview team consisted mainly of SORT Team personnel and a few University staff. The same people who conducted the collection round survey undertook the doorstep survey, to ensure continuity and avoid the need to explain again the geography of the area to interviewers.
The team were briefed to ensure everyone would ask the same questions and give the same answers. All 6 members of the SORT team were able to deal with any questions relating to waste or recycling because they had been Waste Awareness Officers for a year (prior to their present positions, 5 of the 6 SORT team members had previously worked in the waste industry). The four University staff employed to door knock were also familiar with the RCT scheme and recycling in general. Consistency of answers given to

the public was of high importance. Prior local and recycling knowledge was deemed to be important because the public were expected to be inquisitive about the service and to be looking for advice and further help. For safety reasons, interviewers were advised to go around in groups of no fewer than two people. Each group worked on the same street and everyone remained in sight of each other, all carried mobile phones for communication. The team wore SORT Team fleeces which had the Council logo on them. This uniform also has an insignia familiar to the public. The uniform was perhaps the reason why after 694 door knocks, only one member was asked for identification. Doorstep surveys were undertaken between 11am and 7pm. This timing was chosen as most practicable for the SORT team whose normal working hours would have been between 9am-5pm. As expected, more people were in from 4pm – 7pm. To maximise the number of householders contacted at home, any households missed in the morning and afternoon were recorded and returned to in the early evening. On the door step, every householder that answered in areas 1, 2 and 3 was offered clear bags. In Area 4, where householders received only the 'passive' awareness techniques, bags were left on every household's doorstep. This enabled those households that were already participating in the kerbside collection scheme to replenish their stock of clear bags and gave those that were not participating one less reason not to start.

6.2.8 The five trial areas and awareness methods used

Each of the five trial areas made up a kerbside collection round in the RCTCBC case study area. Households were selected within these areas based on prior recycling behaviour and targeted with different types of waste awareness raising techniques to assess their effectiveness for changing recycling behaviour in an area (see Section 6.2.2 for more details). Table 6.2 presents the different awareness methods used and shows which area received exactly what awareness technique.

Table 6.2 The trial areas and the awareness methods they each received

Target Area	Selective targeting of households	Awareness type	Scheme leaflet	Interview / doorstep advice	Feedback leaflet	Clear bags distributed	*Rapidly Changing Times* Received
Area 1	All households in Area 1	Engaging +passive	Yes	Yes	Yes	To households that requested them	Yes
Area 2	Households that had previously participated	Engaging + passive	Yes	Yes	Yes	To households that requested them	Yes
Area 3	Households that had not previously participated	Engaging + passive	Yes	Yes	Yes	To households that requested them	Yes
Area 4	All households in Area 4	Passive	Yes	No	Yes	To all households	Yes
Area 5	All households in Area 5 (Control group)	None (Control group)	No	No	No	No	Yes (un-avoidable)

6.2.9 Minimising awareness message cross over

Since June 2003, the SORT team had been active in waste awareness throughout the Borough. Activities had included dissemination of information through stands at supermarkets, schools, and other events (see Appendix 6.3 for a full list of SORT Team activities from June 2003 to August 2004). From June 2003 to the end of January 2004 (during the waste awareness campaign), the SORT Team attended 38 school assemblies, staffed stands for a day in 16 supermarkets, and also staffed stands at 11 special events. It should be noted that to minimise the awareness message seeping into neighbouring

areas, a meeting was held with SORT members to ensure none of these events took place within five miles of the five waste awareness trial areas.

6.3 AWARENESS IMPLEMENTATION

The project was divided into three distinct phases with numerous sub-sections. These three phases were:

- Phase 1. Pre-awareness
- Phase 2. Public Awareness Campaign
- Phase 3. Post awareness

6.3.1 Phase 1: Pre-awareness

This phase endeavoured to:

- assess the weekly set out rate of the five trial areas in the kerbside recycling scheme.
- examine average material capture and material quality by performing a 'pre-awareness' recyclable waste classification in each of the five trial areas.
- design waste awareness campaign literature from the findings of past research and best practice.

6.3.2 Phase 2: Public Awareness Campaign

The following were the main aims in this phase:

- To implement the first promotional activity in each of the five trial areas as shown in Figure 6.3 as Stage 1 (S1).
- To assess the set out rate of the five trial areas in the kerbside recycling scheme after the first stimulus.
- To implement the second promotional activity in each of the five trial areas as shown in Figure 6.3 as Stage 2 (S2).
- To find out targeted householders' attitudes towards waste and recycling through doorstep interviews (results of which have been presented in Chapter 5).

- To assess the set out rate of the five trial areas in the kerbside recycling scheme after the second stimulus.
- To monitor the third promotional activity in each of the five trial areas as shown in Figure 6.3 as Stage 3 (S3).

6.3.3 Phase 3: Post awareness

In this phase, main objectives were:

- To analyse the effect of the awareness campaign on weekly set out rate in the five trial areas in the kerbside recycling scheme.
- To examine average material capture and material quality by performing a 'post-awareness' recyclable waste classification in each of the five trial areas.

The waste awareness campaign timetable is shown in Figure 6.3.

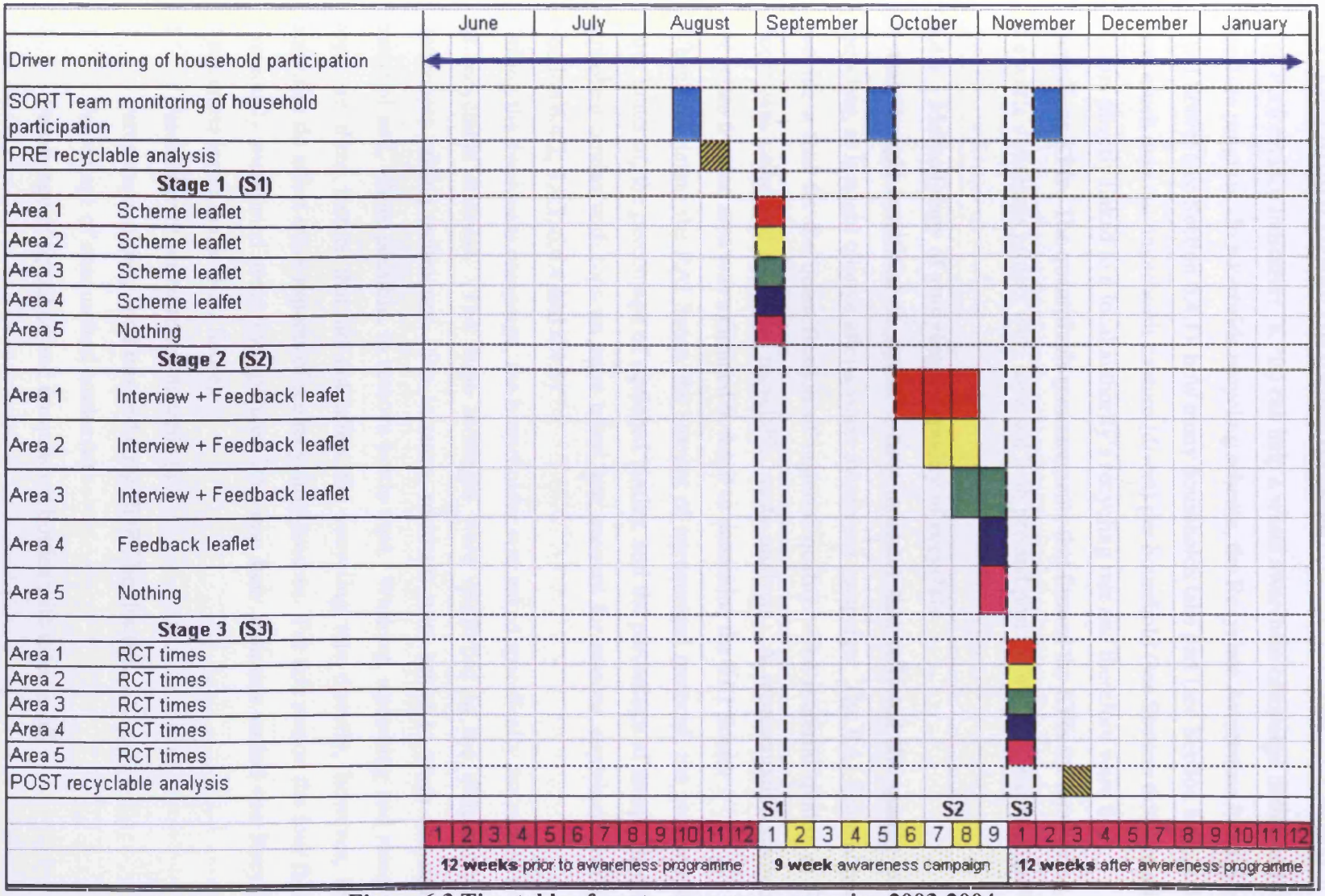


Figure 6.3 Timetable of waste awareness campaign 2003-2004

6.4 METHODOLOGIES OF EXPERIMENTS

Key Performance Indicators (KPIs) can help a waste awareness campaign define and measure progress. In a kerbside recycling scheme, the Recyclate Awareness Index Score (RAI Score) (see Section 6.4.1), how many households take part (see Section 6.6), and how much material households capture (divert) per household (see Section 6.5), are all factors directly linked to a local authority's recycling rate and therefore were the campaigns KPIs. The quantifiable measurements that formed the KPIs for monitoring the waste awareness project were assessed both pre and post the awareness campaign.

6.4.1 Methodology of studying the quality of recyclate

It was thought beneficial to devise a new indicator that reflected the quality of the recyclate, as it might change after a waste awareness campaign. The RAI Score aimed to provide a tool for the quantification of material quality. The material quality or RAI Score was calculated from the recyclable waste analysis. A representative sample of recyclate from an area was examined in detail to determine the RAI Score.

When calculating the RAI Score, the amount of unrequested material, the percentage of dirty material, the percentage of squashed bottles, and the percentage of unsquashed and squashed bottles with tops on were taken into account for reasons explained later (see Section 6.4.2, 6.4.3, 6.4.4 and 6.4.5).

During the awareness campaign, the householder was asked specifically for certain types of recyclable material. The same messages were reinforced in the different waste awareness raising techniques. For instance, residents were asked to wash and squash material and, where possible, to remove bottle tops. Washing, squashing and removing tops are three factors that do not affect the recycling rate directly, however, these activities do affect other aspects of the recycling process. For this reason the four factors previously mentioned were incorporated into one new indicator called the Recyclate Awareness Index Score (RAI Score):

1 Percentage of unrequested material (a)

2 Percentage of dirty food tins and dirty HDPE bottles (b)

3 Percentage of unsquashed bottles (c)

4 Percentage of squashed and unsquashed bottles with tops on (d)

The overall RAIS was extracted directly from the aforementioned four factors. The individual RAI Scores for the four factors were combined and divided by forty, to give the one overall Recyclate Awareness Index Score (RAI Score).

RAI Score = a+b+c+d / 40

The RAI Scoring scale ranged from 0 to 10, 0 representing a household that put out no unrequested material, no dirty food tins or milk bottles, no unsquashed bottles, and no bottles with tops on, i.e. was totally compliant with all that had been requested in the scheme, to 10 representing a household that was using the kerbside collection scheme as a second refuse collection. The 'pre' waste awareness RAI Scores were compared to the 'post waste awareness' RAI Scores to see which awareness raising method had had the greatest effect on lowering RAI Scores. The lower the RAI Score the more the householder had complied as requested in the scheme.

6.4.2 Unrequested material

A certain percentage of material collected consisted of unrequested materials of no use to the local authority at the present moment in time. The weight of the rejected material directly affects the recycling rate because it ultimately has to go for disposal.
The RAI Score used households' average percentage of unrequested material (a) as one of the four factors contributing to the score.

6.4.3 WHY wash bottles?

The need to clean dirty recyclate at home prior to its collection is open to debate. There are positive and negative environmental effects of washing recyclate at home or, alternatively, just before the material is reprocessed. One of the greatest concerns of residents was that animals would rip open bags or upturn boxes (Cardiff University, 2002), rummage in the recyclate and create a litter problem. All collected material was sorted by hand at a Materials Recovery Facility (MRF) in the case study area. It was a common complaint of work staff that the material sorted was dirty (Cardiff University, 2002), for example, food was left in tins and milk in bottles. The RAI Score was

achieved by combining the percentage of milk bottles cleaned and the percentage of tins cleaned and dividing this result by two to obtain a percentage representing cleanliness. This figure was then used as one of the four factors (b) from which the RAI Score was derived.

6.4.4 WHY take tops off bottles?

Many people often enquire why they are advised to remove the lids from plastic bottles when putting them out for recycling. The reason is that the lids are usually made from a different type of plastic to the bottle. If plastic bottle tops are mixed with the plastic bottles this causes contamination of the polymer type, reducing both the quality and value of the material. The removal of lids also aids bailing of collected bottles for transport. Bottles with their lids on are more difficult to squash and present a health and safety hazard in the bailing process.

The RAI Score was derived by combining the percentage of PET and HDPE bottles with tops off, and dividing the result by two to obtain the overall percentage for bottles with tops off. This figure was then used as one of the four factors (c) contributing to the RAI Score.

6.4.5 WHY squash bottles?

In the interest of sustainability, householders were asked to squash plastic bottles, for the reason that the relatively low bulk density of plastic means it is not cost effective or environmentally friendly to transport unsquashed bottles around after collection. It was therefore thought that squashing bottles would increase the sustainability of the collection process by enabling more efficient use of clear bags. Determinants of the RAI Score were specific to the messages put across in the RCTCBC waste awareness campaign. For example, residents were asked to squash bottles and part of the RAI Score was determined by the percentage of unsquashed bottles. Other local authorities, for example, Norfolk County Council ask for bottles not to be squashed because they are subsequently separated in a MRF that relies on the bottles retaining their original shape.

The percentages of PET and HDPE bottles not squashed, were combined and divided by 2 to obtain an overall percentage of bottles not squashed. This figure was then used as one of the four factors (d) that contributed to the RAI Score.

6.5 METHODOLOGIES OF STUDYING MATERIAL CAPTURE PER HOUSEHOLD

Two recyclable waste analyses were conducted. The first pre, and the second post the waste awareness campaign. Both recyclable waste analyses were conducted on all five areas in the trial. From a recyclable waste analysis, the material capture per household and the RAI Score of the recyclate could be calculated.

6.5.1 Pre-awareness waste classification

A recycled waste classification was performed to determine the quantities and quality of recyclable materials put out for collection by participating households in the kerbside scheme. The material requested by the Council in the scheme and the type and quantity of material actually recovered in the scheme from participating households, was thought to be an important factor in kerbside recycling behaviour.

6.5.2 Sample size in the pre-awareness waste classification

Based on a previous Cardiff University report (2003) of a pilot kerbside recycling scheme in a typical Welsh valley community, a 10 per cent sample (by weight) was considered statistically representative of the recyclate from a round. On average, each round put out around 2000kg per week, therefore 200kg was considered a reliable sample of recyclate from a round in the area under study (also see Parfitt et al. 1997).

Past recyclable waste analyses (Cardiff University 2002) have shown the weekly percentage consistency of dry recyclables to have little variation (except around holiday periods, for example, bank holidays and the Christmas period), so it was thought practicable to get the unpleasant job of sorting over in one week.

The recyclable waste analysis was conducted in September 2003, by sorting approximately 700kg of waste per day from about 100 households. It was considered necessary to collect more than 10 per cent (200kg) as the research was primarily focused

on the dry recyclable element of the household waste stream and, in summer, it was anticipated that anything up to 50 per cent could potentially be green waste (Cardiff University, 2002). It turned out that 33 per cent was green waste, signifying that our sample size of 700 kg comprised, on average, 462 kg of dry recyclables, over double the 10 per cent sample size by weight required to represent an area. Over the sorting period, a total sample size of about 3500kg was hand sorted from all five areas.

The sorting was conducted in a Transfer Depot under cover to protect the recyclate from birds, vermin and the weather. The waste analysis was conducted on a tarpaulin over a sealed concrete floor. The area was easily accessible to the vehicles used to transport the waste samples. The sorting area was well lit and ventilated.

6.5.3 Collecting a representative sample of waste in the pre-awareness waste classification

The pre-awareness waste analysis required a representative sample of material put out for kerbside recyclate collection. Possible methods of choosing which households were to be selected fell into two categories: random selection determined by household address, or selective sampling i.e. collecting every other or every third participating household's bags spread throughout the round. In the interests of practicality for the Waste Research Team, it was decided to adopt the selective sampling methodology. An estimation was made of how many households on the round in question would set out in a given week (past set out surveys completed by collection drivers were used) and a corresponding collection plan devised. It was decided to collect every third bag put out between the hours of 7am-9am for the pre-awareness waste analysis. This provided an even spread of collected recycling bags across the whole round/trial area. It should be noted that health and safety considerations were of the upmost importance. Risk assessments were carried out in accordance with local authority protocols and procedures. These included correct waste handling methods, personal protective equipment requirements, and appropriate hygiene procedures. Staff were aware of both health and safety requirements, appropriately trained, and were considered competent to carry out their appointed tasks safely.

6.5.4 Material categories in the pre-awareness waste classification

The recovered material was sorted by hand under cover and was placed in bins clearly labelled under 33 different material categories (see Table 6.3). All bins' tare weights were recorded and written on bins prior to the analysis.

Table 6.3 Waste analysis material categories and sub-categories

MATERIAL 'SORT' CATEGORIES and SUB-CATEGORIES	MATERIALS INCLUDED (EXAMPLES)
GLASS	
Bin 1. BEER BOTTLES	
Bin 2. WINE BOTTLES	
Bin 3. SPIRIT BOTTLES	
Bin 4. MINERAL WATER BOTTLES	
Bin 5. OTHER GLASS	Bottles and packaging
Bin 6. GLASS JARS (attempt to clean contents)	
Bin 7. GLASS JARS (no attempt to clean contents)	
METAL	
Bin 8. FERROUS FOOD TINS (attempt to clean contents)	Cleaned tins: pet food
Bin 9. FERROUS FOOD TINS (no attempt to clean contents)	Dirty tins: pet food
Bin 10. FERROUS BEVERAGE CANS	
Bin 11. NON FERROUS BEVERAGE CANS	
Bin 12. FERROUS FOIL	Foil.
Bin 13. NON FERROUS FOIL	Foil.
Bin 14. OTHER FERROUS METAL	Keys, bike parts, biscuit tins, paper clips.

Bin 15. OTHER NON FERROUS METAL	Aerosols, copper piping, saucepans.
PAPER	
Bin 16. NEWSPAPER	
Bin 17. MAGAZINES	Glossy publications
Bin 18. JUNKMAIL+ INSERTS	Not including plastic windows or packaging.
Bin 19. DIRECTORIES	Catalogues, directories.
Bin 20. CARD PACKAGING	Boxes and packets for: cereal, washing powder, eggs, tissues, corrugated card, greetings cards, postcards.
Bin 21. COMPOSITE PACKAGING (plastic windows)	Food packaging, envelopes, junk mail in plastic packaging.
Bin 22. OTHER PAPER (including small unpickable bits)	Wall paper removed from walls, shredded paper, photos, toilet paper, tissues, kitchen paper, and paper sweet wrappers.
PLASTICS	
Bin 23. PET (1) BOTTLES	Bottles for fizzy bottles, mineral water, squash, cider, beer.
Bin 24. HDPE (2) BOTTLES	Bottles for milk, bleach, fruit juice.
Bin 25. PLASTIC CARRIER BAGS (2,4)	Supermarket carrier bags
Bin 26. RCT RECYCLING BAGS (4)	Clear recycling bags
Bin 27. PLASTIC FILM (2,3,4,5,7)	Clingfilm, crisp packets, packaging film.
Bin 28. OTHER PLASTICS (3,4,5,6,7)	Margarine tubs, freezer containers, expanded polystyrene, yoghurt pots, cassette tapes, compact discs or any plastic not assigned to any of the above groups.
Bin 29. **TEXTILES**	Clothing and other household items made from man-made or natural fibres.
Bin 30. **GARDEN WASTE**	Grass cuttings, weeds, flowers, hedge trimmings.

KITCHEN WASTE	
Bin 31. Vegetable waste	Vegetable peelings and trimmings, fruit.
Bin 32. Animal products	Kitchen waste containing any meats.
Bin 33. **OTHER WASTE**	Fluorescent light bulbs, WEEE, potentially hazardous wastes, toys, nappies, mobiles, rubble, crockery, fines.

The data were used in conjunction with data from a prior full household waste analysis conducted by Cardiff University (2000). This allowed for a comparison of data derived from the full household waste analysis in RCT 2000 and the recyclable materials actually captured in the present pre-awareness waste analysis.

After each material had been sorted into the categories presented in Table 6.3, the bins were attached to a hook and lifted onto a spring balance. The balance was elevated from the ground by a harness. The scales were accurate to 100g and had a 60kg limit.

6.5.5 RAI Score indicators in the pre-awareness waste classification

The material analysis did not stop after all the materials had been weighed. The plastic tarpaulin was brushed clean before all PET and HDPE bottles were emptied onto it for counting (not at the same time, PET bottles were counted first, then HDPE bottles).

The bottles were then separated into three categories for counting: bottles that had no squash, a slight squash, and a major squash. After counting the bottles in each category, the number of tops left on bottles was also counted. The whole process was conducted for both PET and HDPE bottles. An additional visual observation was made of HDPE bottles, whether or not they had been rinsed out and the percentage for each.

6.5.6 Post-awareness recyclable waste classification

Post-awareness recyclable waste classification differed in its sampling technique to pre-awareness classification. Pre-awareness classification sought to establish the average recyclable arisings for each area prior to the awareness campaign. The sample size had therefore to be representative of a particular round and consequently area. The post-awareness waste classification attempted to identify the effect of different awareness

raising techniques on each of the targeted households. This meant focusing specifically on individual households that were in a particular target area and had definitely been exposed to the appropriate stimuli. A list of all individual households was kept which indicated what awareness material each individual house had received.
As past analyses had shown that weekly percentage consistency of dry recyclables tended not to vary (Cardiff University, 2002), so again, on this basis, it was thought practicable to get the unpleasant job of sorting over in one week.

6.5.7 Sample size in the post-awareness waste classification

The post-awareness recyclable waste analysis was conducted in November 2003. Sorting sample sized varied from 138kg to 490kg of recyclate per day, with the amount from targeted households depending directly on the success of the awareness programme in a particular area. The total sample size sorted post awareness campaign was 1900 kg.
The recovered material was sorted by hand under cover and placed in bins labelled with the same 33 pre-awareness waste analysis material categories (see Table 6.3). The data were used in conjunction with data derived from a prior full household waste analysis conducted in 2000 (Cardiff University, 2000), in order to compare recyclable materials actually captured from weekly participating households in the present study and the full household waste stream in 2000.

6.5.8 Selective sampling of recycling bags in the post-awareness waste classification

As the post waste analysis sought to assess the effectiveness of each awareness method, it was necessary to ensure that individual households in Areas 1-5 had definitely been exposed to the appropriate stimuli or none at all. This was achieved by selective sampling of recycling bags. On collection day, the research team only picked up a household's recyclate on a particular round if the household had definitely been exposed to the pre-determined awareness methods. This was known by referring to pre-formatted lists of household addresses known to have been stimulated in the manner determined for that area. For example, when collecting from Area 2 (an area where households that had previously participated in the kerbside recycling scheme were targeted), the research

team collected only recycling bags from those households on the list of households that had definitely received both the engaging and passive awareness methods.

6.5.9 Material categories in the post-awareness waste classification

The recyclate was sorted into the same material categories as the pre waste analysis to enable a direct comparison (see Table 6.2).

6.5.10 RAI Score indicators in the post-awareness waste classification

The new indicators were assessed the same way as in the pre-awareness waste analysis (see Section 6.5.5).

6.6 METHODOLOGIES OF STUDYING HOUSEHOLD SET OUT IN THE SCHEME

Set out rate was monitored and analysed in three time blocks: a twelve week block prior to the awareness campaign, a nine week block during the waste awareness campaign; and a twelve week block after the waste awareness campaign. A twelve week block of time was thought sufficient to identify any change in participation frequency. A list of individual households that had definitely been exposed to the different waste awareness techniques in each area, were input onto a spreadsheet. Driver surveys were filed at the end of the day and individual households' set out data in all five trial areas were inputted onto a spreadsheet on a weekly basis. The data were then analysed for each time block, twelve weeks prior and post the awareness programme, and nine weeks during the awareness programme's implementation (see Figure 6.3 for the timetable).

Households' set out rate in the twelve week blocks 'pre' and 'post' the awareness campaign, respectively, were then analysed and compared. Each individual household's set out was analysed in detail for the 12 week period 'pre' and 'post' the awareness campaign. Participation frequency was categorised according to the definitions explained in Chapter 4, Section 4.3.3.1. Participation frequency categories for 'pre' and 'post' the awareness campaign were compared against each other, in order to identify any differences which were a result of the waste awareness campaign.

On occasions where households were reported by drivers as participating once only in the recycling scheme during the 12 week period, this was considered to be a driver reporting error (see Chapter 4, Section 4.3).

6.7 RESULTS OF THE PRE AWARENESS EXPERIMENTS

In order to assess the effectiveness of the targeted awareness trial it was thought necessary to establish 'baseline' information for each of the trial areas. Three groups of indicators were used in this assessment: a) material diversion; b) RAI Score; and c) household set out rate. They have been discussed in detail in Sections 6.4, 6.5 and 6.6.

Once the project was completed, results from the pre-awareness analysis could be compared to those from the post-awareness analysis to ascertain the effectiveness of the awareness programme in each of the targeted areas.

6.7.1 Overall pre diversion data

Details of the analysis methods have been presented in Section 6.5.

In total, around 3793 kg were sorted in the pre-awareness recyclable waste analysis. Of this, 1302 kg or 33 per cent by mass was green waste (see Figure 6.4). The total mass of material (3793kg) was diverted from 525 households, with an average 105 households (525/5 rounds) per collection round being analysed.

In areas 1, 2, 3, 4 and 5, the number of households from which recyclate was sorted was 120, 96, 112, 101 and 96, respectively.

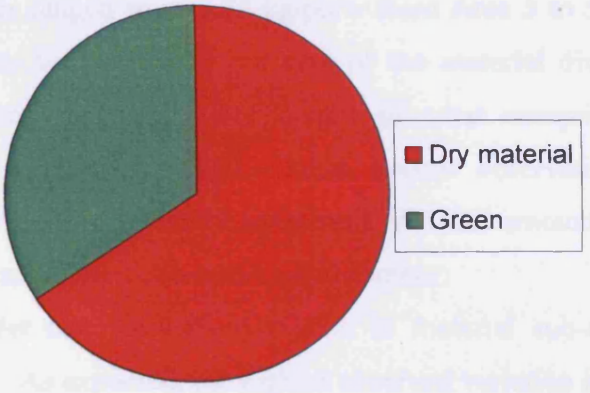


Figure 6.4 Percentage breakdown of pre-awareness recyclable waste into green and dry material

The overall average mass of dry recyclable material from all trial collection areas combined was found to be 4.5 kg per participating household per week (kg/ph/w). If the green waste fraction is included there is a cumulative weight of 7 kg/ph/w, and if 'other waste' unsuitable for recycling is added, a cumulative weight of 7.3 kg/ph/w is obtained. For a breakdown of material diversion from area to area see Table 6.4.

Table 6.4 Breakdown of material diversion according to area pre awareness campaign

	Material diversion kg/ph/w					
Material	Area 1	Area 2	Area 3	Area 4	Area 5	Average material diversion
Dry recyclables	3.92	5.11	3.75	4.93	4.57	4.46
Green waste	1.87	3.61	1.46	3.18	2.57	2.54
Other waste	0.18	0.32	0.45	0.31	0.41	0.33
Total diversion	5.97	9.04	5.66	8.42	7.55	7.33
% of unrequested dry material	15.3	16.3	21.8	19.5	20.9	18.76

The pre-awareness recyclable waste analysis shows that Area 2 put out the greatest quantity of materials for collection at 9.04 kg/ph/w and Area 3 the lowest quantity at 5.66 kg/ph/w.

Observed dry recyclables ranged from 3.75 kg/ph/w from Area 3 to 5.11 kg/ph/w from Area 2. On average, by weight, 18.76 per cent of the material diverted through the scheme was 'unrequested' material. For details of what comprised 'unrequested' materials (see Chapter 4, Section 4.3.3). From overall observations made by the University and RCTCBC staff prior to the awareness trial, the amount of dry, green and 'unrequested' material varied from one trial area to another.

In Figure 6.5, the reader can view the variation in material sub-category diversion collected from all areas. As expected, the highest observed variation in material diverted through the recycling collection scheme is in the sub category 'garden waste'.

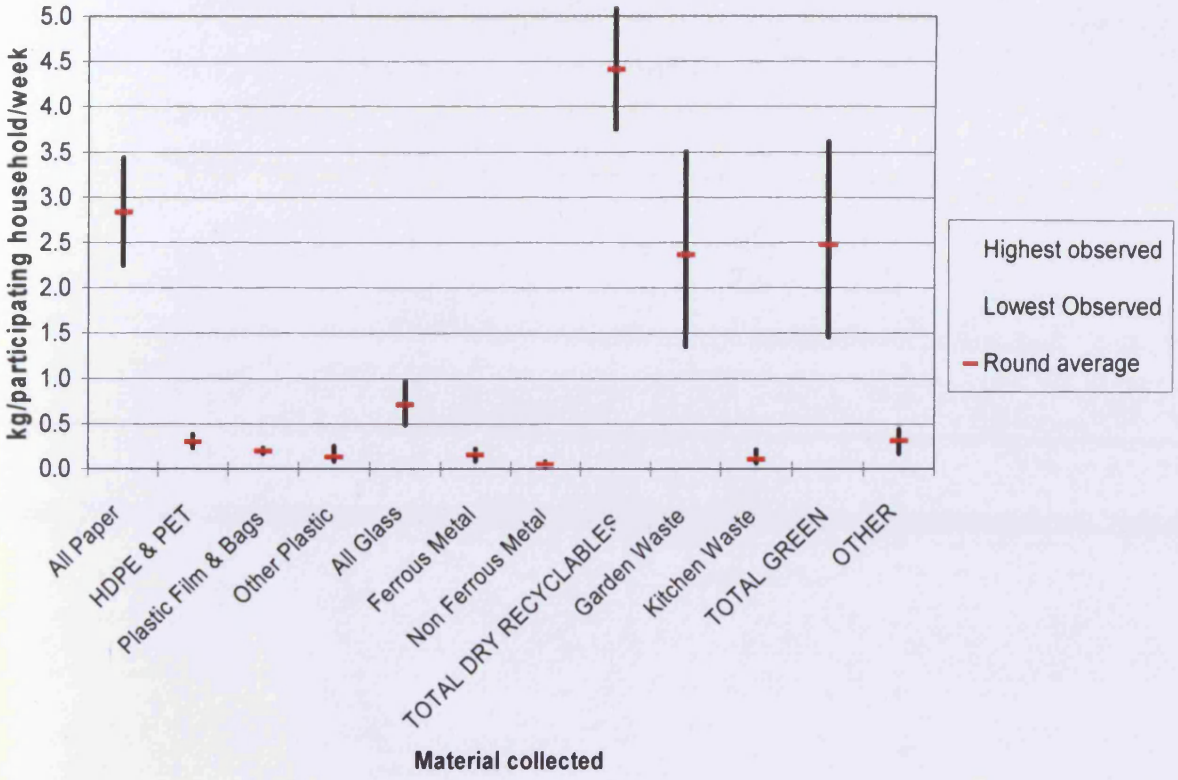


Figure 6.5 Variation in material sub category diversion pre awareness campaign

The quantity of garden waste collected each week can be affected by a number of factors, the most important being the existence and size of a garden, and the type of accommodation. Seasonal effects are also important in that less garden waste is produced in the winter than the summer. Weather conditions can also influence the amount of garden waste produced. For instance, more gardening will be conducted in sunny than rainy periods. Additionally, extra time to conduct gardening activities, such as holiday periods and, more importantly, bank holidays, have an effect on the amount of waste produced.

Due to the fact that the green waste fraction had the greatest variation and was dependent on a number of interrelated variables mentioned above, it was considered preferable to view the overall results of percentage diversion from each category of dry material collected, in terms of the total percentage of dry recyclables only.

6.7.2 Sub categories' diversion pre awareness campaign in detail

The range of sub category diversion from areas (1-5) is summarised in Table 6.5. A list of scheme requested recyclables can be found in Chapter 4, Section 4.2.3.

Table 6.5 The range of sub category diversion pre awareness campaign from areas (1-5)

Material category	Pre-awareness recyclable analysis area average (kg/ph/w)	Highest area material diversion (kg/ph/w)	Lowest area material diversion (kg/ph/w)	Difference between highest and lowest (kg/ph/w)	The difference between the highest and lowest in 'material equivalents'* is shown below: *See Appendix 6.4 for material weight breakdowns*
All paper	2.84	3.43 Area 2	2.25 Area 3	1.18	 Five extra 'newspapers' per household per week diverted into recycling
Glass	0.72	0.97 Area 4	0.49 Area 1	0.48	 Two extra 'glass jars' per household per week diverted into recycling
PET bottles	0.174	0.238 Area 4	0.133 Area 1	0.105	 Two extra '2 litre drink bottles per household per week diverted into recycling
HDPE bottles	0.13	0.146 Areas 2 & 5	0.1 Area 1	0.046	 One extra '4 pint HDPE milk container' per household per week being diverted into recycling
Super market carrier bags	0.038	0.054 Area 3	0.021 Area 5	0.033	 Seven extra super market carrier bags per household per week diverted into recycling

Material category	Pre-awareness recyclable waste analysis area average (kg/ph/w)	Highest area material diversion (kg/ph/w)	Lowest area material diversion (kg/ph/w)	Difference between highest and lowest (kg/ph/w)	The difference between the highest and lowest in 'material equivalents'* is shown below: *See Appendix 6.4 for material weight breakdowns*
Plastic film	0.053	0.068 Area 2	0.045 Area 4	0.023	Three extra 'empty crisp packets' being put out per household per week
Other plastics (#3-#7)	0.14	0.25 Area 5	0.09 Area 3	0.16	Four and a half extra '400g strawberry punnet containers' being put out per household per week
Ferrous metals	0.164	0.223 Area 4	0.141 Area 5	0.082	 One and a half extra 'food tins' per household per week diverted into recycling
Non-Ferrous metals	0.056	0.077 Area 3	0.043 Area 2	0.034	 Two extra 'drinks cans (330 ml)' per household per week being diverted into recycling
Kitchen waste	0.11	0.21 Area 4	0.07 Areas 1 & 5	0.14	The 'potato peelings' from five potatoes per household per week diverted into recycling

* It should be noted that material equivalents are calculated to give the reader an understanding of what the weight difference would mean to the average householder in terms of commonly diverted items. For the actual weights of the materials used as examples see Appendix 6.4.

'All Paper' was on average the most abundant by mass of all material categories. The only other material category to divert a similar amount by mass was garden waste.

The household waste analysis performed in 2000 found 4.78 kg/h/w of 'All paper' in Rhondda Cynon Taf's household waste stream. In the present pre-awareness recyclable analysis, the weight varied from 2.25 kg/ph/w in Area 1 to 3.43 kg/ph/w in Area 3. The difference in 'All paper' diversion between the full household waste analysis and the pre-awareness analysis of recyclable waste and full household waste analysis was 1.94 kg/ph/w. Participating households were missing the opportunity to put out the material equivalent of one '200 page glossy magazine' and 3 'tabloid newspapers' per household per week.

The pre-awareness waste analysis revealed there were variations in material sub-categories' amounts from area to area (see Figure 6.6). The observed range in mass of 'All paper' from the highest area diversion to the lowest was 1.18 kg/ph/w. This range was large when compared to the total dry recyclate range of 1.19 kg/ph/w. Area 2 diverted the greatest quantities of 'All paper' sub-categories, putting out the most newspaper, cardboard and office paper per participating household per week in all the areas.

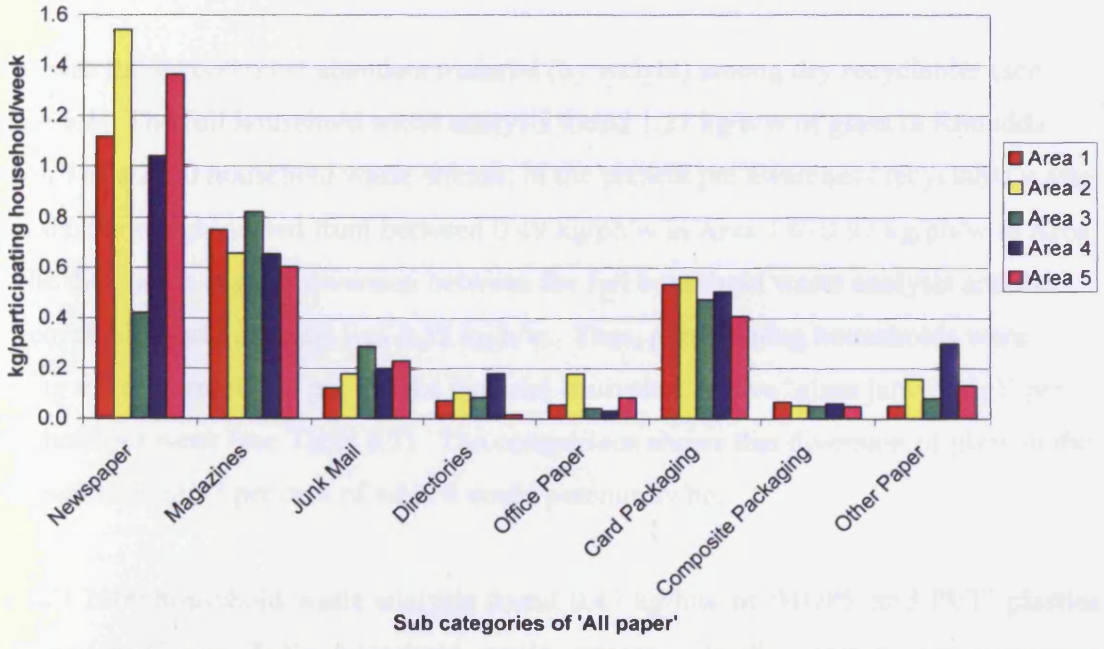


Figure 6.6 Breakdown of 'All paper' sub-categories diverted for each area

The full 2000 household waste analysis found 1.2 kg/household/week of magazines in Rhondda Cynon Taf's household waste stream. The pre-awareness recyclable waste

analysis round average found 0.7 kg/ph/week, depicted in Figure 6.7. The comparison shows that magazine diversion in the latter was around 60 per cent of what it could potentially be from those setting out in the scheme.

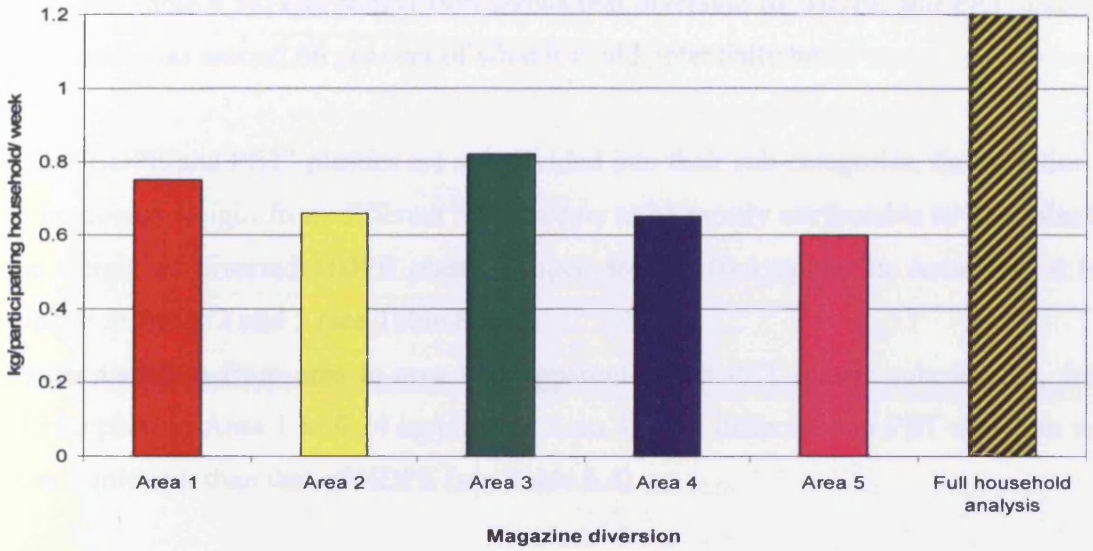


Figure 6.7 Magazine diversion for each area compared with full household analysis

Glass was the second most abundant material (by weight) among dry recyclables (see Figure 6.5). The full household waste analysis found 1.27 kg/h/w of glass in Rhondda Cynon Taf's 2000 household waste stream. In the present pre awareness recyclable waste analysis, the weight varied from between 0.49 kg/ph/w in Area 1 to 0.97 kg/ph/w in Area 4. The difference in glass diversion between the full household waste analysis and the pre recyclable waste analysis was 0.55 kg/h/w. Thus, participating households were missing the opportunity to put out the material equivalent of two 'glass jars (525g)' per household per week (see Table 6.5). The comparison shows that diversion of glass in the latter was around 57 per cent of what it could potentially be.

The full 2000 household waste analysis found 0.47 kg/h/w of 'HDPE and PET' plastics in Rhondda Cynon Taf's household waste stream. In the present pre-awareness recyclable waste analysis, the weight of 'HDPE and PET' plastic diversion varied from between 0.23 kg/ph/w in Area 1 to 0.38 kg/ph/w in Area 4 (see Figure 6.5). The difference in 'HDPE and PET' plastic diversion between the full household waste

analysis and the pre-awareness recyclable waste analysis round average was 0.16 kg/h/w. Participating households were missing the opportunity to put out the material equivalent of one '2 litre fabric conditioner bottle' and one '1litre Coke bottle' per household per week (see Table 6.5). The comparison shows that diversion of 'HDPE and PET' plastics in the latter was around 66 per cent of what it could potentially be.

When 'HDPE and PET' plastics are sub-divided into their sub-categories, the variation in the combined weight from different areas seems to be mostly attributable to PET plastic. The weight of diverted HDPE plastic ranged from 0.10 kg/ph/w in Area 1 to 0.146 kg/ph/w in Areas 2 and 5 (see Table 6.5).
Greater variation from area to area was apparent in the PET plastic subcategory, from 0.13 kg/ph/w in Area 1 to 0.24 kg/ph/w in Area 4. The difference in PET variation was more significant than that of HDPE (see Table 6.4).

It should be noted that, unless otherwise stated, the following categorisation of metal combines the requested metals, food tins and drink cans, with 'unrequested' metals.

The full 2000 household waste analysis found 0.8 kg/h/w of 'ferrous metal' in Rhondda Cynon Taf's household waste stream, of which approximately 0.51 kg/h/w was 'ferrous metal' requested by the Council for kerbside recycling. In the pre-awareness recyclable waste analysis, the weight of 'ferrous metal' diversion varied from between 0.141 kg/ph/w in Area 5 to 0.223 kg/ph/w in Area 4 (see Table 6.4). The difference in 'ferrous metal' material diversion between the full household waste analysis (requested ferrous metal) and the pre-awareness recyclable analysis round average was 0.35 kg/ph/w. Participating households were missing the opportunity to put out the material equivalent of six (empty) '400g baked bean' tins per household per week (see Table 6.5). The comparison shows that diversion of requested ferrous metal' in the latter was around 31 per cent of what it could potentially be.

The full 2000 household waste analysis found 0.12 kg/h/w of 'non-ferrous metal' in Rhondda Cynon Taf's household waste stream, of which approximately 0.06 kg/h/w was

'non-ferrous metal' requested by the Council for kerbside recycling. In the pre-awareness recyclable waste analysis, the weight of 'non-ferrous metal' diversion varied from between 0.043 kg/ph/w in Area 5 to 0.077 kg/ph/w in Area 3 (see Table 6.5). The difference in 'non-ferrous metal' material diversion between the full household waste analysis and the pre-awareness recyclable waste analysis was therefore negligible. Hence it was assumed that most of the requested non-ferrous metal potential was being diverted into the recycling scheme.

The full 2000 household waste analysis found 3.77 kg/ph/w of 'kitchen waste' in Rhondda Cynon Taf's household waste stream, of which approximately two-thirds, or 2.17 kg/ph/w, was guestimated to be vegetable or fresh fruit suitable for recycling collection. In the pre-awareness recyclable waste analysis, the weight of 'kitchen waste' diversion varied from between 0.07 kg/ph/w in Areas 1 and 5 to 0.21 kg/ph/w in Area 4 (see Figure 6.5). These extremely low diversion results were anticipated as kitchen waste is an undesirable category to separate and store in the household.

Garden waste weight varied significantly from area to area. Garden waste was the second most abundant material category by mass, although, as stated earlier, it should be noted that it is prone to large fluctuations due to numerous factors, such as garden availability and size, and changeable weather conditions and season. Weights per round varied dramatically from 1.46 kg/ph/w to 3.61 kg/ph/w (see Figure 6.5).

6.7.3 Sub categories of 'unrequested' material pre awareness campaign

A list of the scheme requested and non-requested recyclables can be found in Chapter 4, Section 4.3.3.

The main differences observed between unrequested recyclable material categories from area to area were as follows:

The 'all paper' category included two sub-categories of paper which were not requested by the collection authority. These were composite packaging (i.e. paper with plastic windows) and 'other paper' (e.g. small bits of un-pickable paper). In the pre-awareness

recyclable waste analysis, the two unrequested 'All paper' sub categories made up on average 7 per cent by weight of the 'all paper' material.

Diversion of composite packaging varied per round from 0.05 kg/ph/w in Areas 2, 3 and 5 to 0.07 kg/ph/w in Area 1.

Diversion of 'other paper' varied significantly from 0.05 kg/ph/w in Area 1 to 0.30 kg/ph/w in Area 4.

Plastic material had three sub categories unrequested by the collection authority. These were 'plastic carrier bags', 'plastic film' and 'other plastics' which included all remaining plastic materials. In the pre-awareness recyclable waste analysis, all three of these sub-categories made up on average 39 per cent by weight of overall plastic diversion. Figure 6.8 presents a percentage breakdown of the average diversion of unrequested plastic from the trial collection rounds.

'Plastic carrier bags' (e.g. supermarket carrier bags) made up an average of 6 per cent by weight of overall plastic diversion.

'Plastic film' (e.g. empty crisp packets) made up 9 per cent by weight of overall plastic diversion.

'Other plastics' (e.g. plastics marked 3-7 or unmarked) made up an average of 24 per cent by weight of overall plastic diversion.

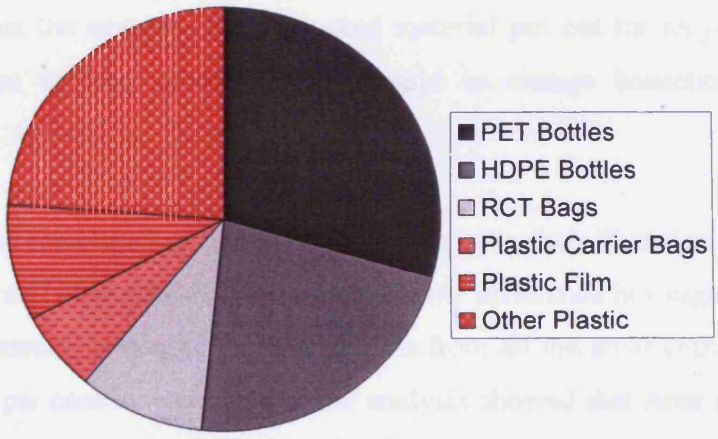


Figure 6.8 Percentage of requested (coloured red) and unrequested (shaded) plastic diversion

In the metal category, 'other metal' comprised any metal other than food tins or drinks cans. This subcategory was reclassified into the further sub category of 'other ferrous' or 'other non-ferrous' metal material.
'Other ferrous' metal on average made up 8.8 per cent by weight of the total ferrous metal diversion monitored during the trial.
'Other non ferrous' metal on average made up 7.5 per cent by weight of the total non ferrous metal diversion monitored during the trial.

Among the dry material collected, the 'other waste' category varied from 0.18 kg/ph/w in Area 1 to 0.45 kg/ph/w in Area 3. 'Other waste' was an unrequested material category that could not be assigned for recycling in its own right. It included any unrequested material that could not be assigned to other categories and sub categories, for example, crockery, nappies, cigarette ends, and sanitary towels.

6.8 PRE AWARENESS CAMPAIGN MATERIAL QUALITY

The overall percentage average of unrequested dry recyclable materials from the trial collection rounds was found to be 18.7 per cent by weight. The pre-awareness recyclable waste analysis showed that Area 3 put out the greatest quantities of unrequested materials for collection and Area 1 the lowest quantities, 21.8 per cent and 15.8 per cent of all unrequested dry recyclable materials collected from rounds, respectively. Therefore, it was observed that the amount of unrequested material put out for recyclable collection varied from area to area, prior to any attempt to change householders' recycling behaviour.

The percentage of food tins that had been cleaned prior to their diversion was recorded by separating clean and dirty tins and then looking at the difference in weight.
The overall percentage average of unwashed tins from all the areas combined was found to be around 50 per cent by weight. Further analysis showed that Area 1 had the highest percentage of unwashed tins and Area 2 the lowest percentage, 75 per cent and 33 per cent, respectively.

When counting the tops left on bottles, PET and HDPE bottles were counted separately. In total, 3053 such bottles were sorted in the pre-awareness recyclable waste analysis. Of these, 1745 were PET bottles and 1298 were HDPE bottles. The overall percentage average of tops left on PET bottles from all areas combined was high, 80 per cent. The overall percentage average of tops left on HDPE bottles from all areas combined was found to be similarly high, 82 per cent.

The counting of tops left on PET bottles indicated that Area 5 left the highest percentage of tops on and Area 2 left the lowest number on PET bottles, 90 per cent and 64 per cent, respectively.

The counting of tops left on HDPE bottles revealed that Area 4 left the highest percentage of tops on and Area 2 left the lowest percentage of tops on, 87 per cent and 70 per cent, respectively.

When counting the number of bottles that had not been squashed, again HDPE and PET bottles were counted separately. The bottles were divided into three groups: those that had not been squashed at all, i.e. were in their original shape, those that had been slightly squashed, and those that had been squashed significantly. Due to the subjective nature of assessing the degree to which a bottle had been squashed, the only state of squash that could be recorded accurately was a bottle that had not been squashed at all.

The overall percentage average of PET bottles that were unsquashed from all the areas combined was found to be high, 68 per cent. The overall percentage average of HDPE bottles that were unsquashed from all the areas combined was higher, 75 per cent.

The counting of unsquashed PET bottles showed that Area 4 had the highest percentage of unsquashed bottles and Area 2 the lowest percentage, 72 per cent and 65 per cent, respectively.

The counting of unsquashed HDPE bottles showed that Area 5 had the highest percentage of unsquashed bottles and Area 4 the lowest percentage, 79 per cent and 66 per cent, respectively.

Most HDPE bottles (95 per cent) were observed to be milk containers. The percentage of milk containers that had not been cleaned prior to their diversion was recorded by visual

assessment. The overall percentage average of HDPE bottles that had not been cleaned prior to diversion from all the areas combined was found to be high, 78 per cent.

6.9 PRE-AWARENESS CAMPAIGN RAI SCORE

The method of calculating a RAI Score can be found in Section 6.4.1. The results ranged from Area 2 having a RAI Score of 5.1 to Area 1 having a RAI Score of 6.3 (see Table 6.6). Ultimately, this suggests the RAI Score varied slightly from area to area, prior to any waste awareness campaign. The average area RAI Score was 5.9 for the five areas. It would seem that Area 2's lower RAI Score of 5.1, significantly below the average 5.9, may be due to the more affluent socio-economic characteristics of the area (see Appendix 6.1).

Table 6.6 Pre-awareness RAI Scores for each trial area

Trial area	Pre-awareness RAI Score
Area 1	6.3
Area 2	5.1
Area 3	6.0
Area 4	5.8
Area 5	6.1

6.10 PRE-AWARENESS CAMPAIGN SET OUT RATE

All rounds were monitored weekly by collection drivers for household set out rate in the kerbside recycling scheme. The weekly (driver recorded) set out rate was averaged over a period of 12 weeks prior to the start of the awareness campaign, from June to the end of August 2003, and the data are shown in Table 6.7. Table 6.7 also displays the SORT team's quality assurance recordings of participation for each of the areas. The variation between the two set out recordings was not unexpected, due to the time of actual set out recording. Driver set out surveys were slightly inaccurate, despite attempts to make it as easy as possible for drivers to input data on forms provided. This was due to over reporting on the part of certain drivers. The SORT Team set out surveys, although not inaccurate, were recorded before the collection team arrived and, therefore, missed data on households that put out recyclables as the collection crew arrived (see Chapter 4,

Section 4.3 for further details regarding the accuracy of set out recordings). Both set out rates from drivers and SORT Team staff identified Area 1 as having the lowest weekly set out rate, and Area 5 as having the highest weekly set out rate.

Table 6.7 Recorded kerbside scheme set out pre awareness campaign

	SORT team - Quality assurance (one week only August 2003)	Driver recorded (Average over 12 weeks)
Area 1	22	25
Area 2	28	40
Area 3	28	42
Area 4	28	41
Area 5	32	46

The driver recorded set out results varied, as one would expect, from week to week as shown in Figure 6.9.

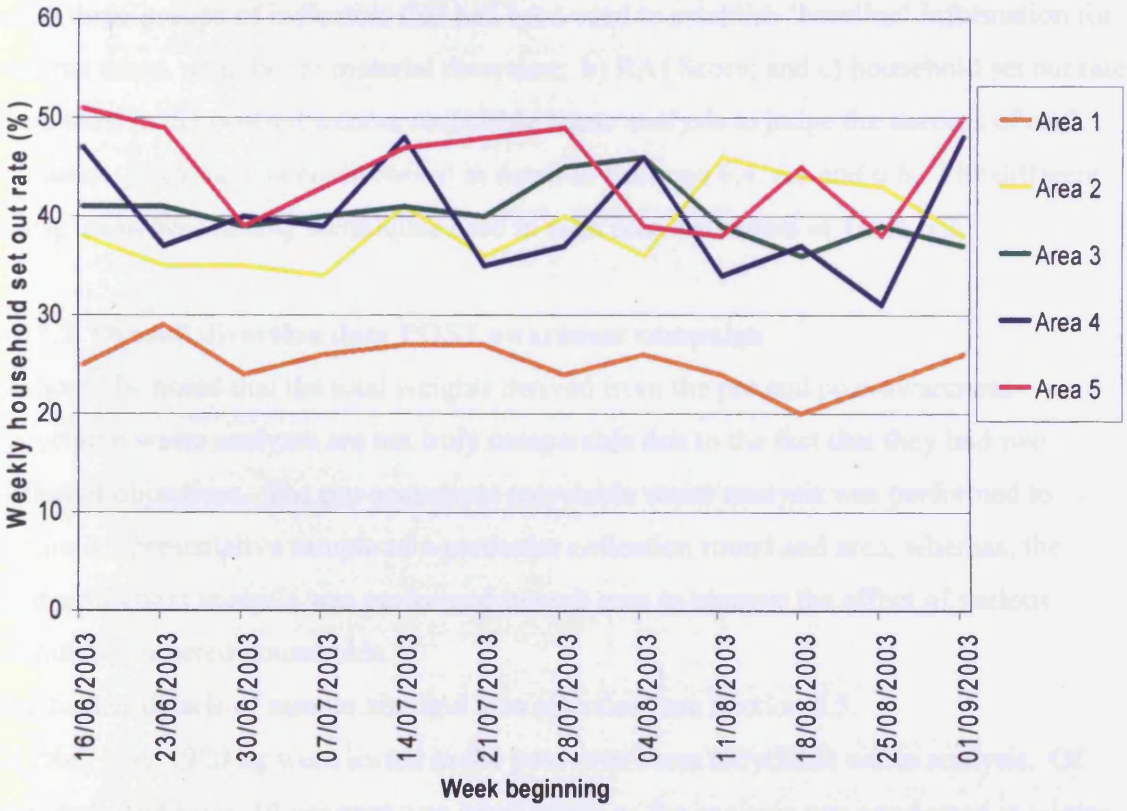


Figure 6.9 Weekly household set out in the trial areas (12 weeks prior to the awareness campaign)

Figure 6.9 shows that over the 12 week period prior to the awareness campaign, each area's average weekly participation rate tended to fluctuate by about 5 per cent above or below the average participation for a particular area. Weekly set out rate as recorded by drivers, identified Area 1 as having the lowest and Area 5 as having the highest weekly set out rate. It is worth noting that the data in Figure 6.9 would be subject to the drivers recording error as indicated in Chapter 4, Section 4.3.3.9 and is normally an over-estimate of some 7%.

6.11 POST-AWARENESS CAMPAIGN RECYCLABLE WASTE ANALYSIS

After the introduction of different community waste awareness techniques to targeted householders, it was necessary to quantify the effect of the various stimuli. In order to observe any effect, a post-awareness recyclable waste analysis was conducted and the results compared to those derived from the pre awareness recyclable waste analysis. The same three groups of indicators that had been used to establish 'baseline' information for the trial areas, namely: a) material diversion; b) RAI Score; and c) household set out rate were used in the post-awareness recyclable waste analysis to judge the success of each stimulus. They have been discussed in detail in Sections 6.4, 6.5 and 6.6. The different waste awareness raising techniques used in each area are shown in Table 6.2.

6.11.1 Overall diversion data POST awareness campaign

It should be noted that the total weights derived from the pre and post-awareness recyclable waste analyses are not truly comparable due to the fact that they had two different objectives. The pre-awareness recyclable waste analysis was performed to obtain a representative sample of a particular collection round and area, whereas, the post-awareness analysis was performed in each area to observe the effect of various stimuli on targeted households.

For further details of sample size and area selection, see Section 6.5.

In total, over 1900 kg were sorted in the post-awareness recyclable waste analysis. Of this, only 194 kg or 10 per cent was green waste as the analysis was conducted in winter. For a breakdown of green and dry material, see Figure 6.10.

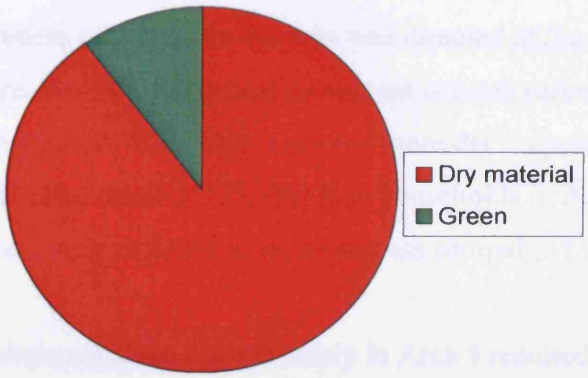


Figure 6.10 Percentage breakdown of post analysis material into green and dry

The overall mass of dry recyclable material from the post-awareness recyclable waste analysis of samples was found to be 5.3 kg per participating household per week (kg/ph/w). If the green waste fraction is included, there is a cumulative weight of 6.0 kg/ph/w, and if 'other waste' unsuitable for recycling is also added, a cumulative weight of 6.2 kg/ph/w is obtained.

The pre and post awareness campaign data for material diversion for each area are are displayed in Table 6.8. The table shows that in Area 5 (the control area) there was little fluctuation in dry recyclate diversion or the percentage of un-requested material, from pre to post awareness.

In Area 2, where households already participating in the kersbdie recycling scheme were targeted there was an increase of 2.4 kg/ph/week in material diversion, there was also a clear reduction in the percentage of unrequested dry material in Area 2, from 16.3% to 5.3%.

The majority of households analysed in Area 1 post awareness had been previously participating in the scheme, although, diversion increased by only 0.6 kg/ph/w. This suggests that different areas respond differently to the same techniques. The most prominent differences between the areas is housing stock and socio-economic characteristics. Area 1 had a Townsend score of 3.4 while Area 2 was more affluent with a Townsend score of 1. Once again adding evidence to the finding of Chapter 5 where a clear relationship between Townsend Score and set out was discussed.

In Table 6.8 the data for the pre awareness households in Area 3 refer to the mean values for that area. The awareness campaign in the area was directed at the non- participating households and therefore, the data in the post awareness column refers to the new recruits only. It is seen that new recruits from Area 3 put out more dry recyclate material (4.7 kg/ph/w) and less unrequested material (15.7%) than households in Area 3 already participating and not previously exposed to an awareness campaign (3.8 kg/ph/w and 21.8% respectively).

'Passive' awareness techniques alone trialled solely in Area 4 resulted in a slight increase in material diversion, an increase of around 0.5 kg/ph/w. The increase in material diversion was similar to that observed in Area 1. This suggests that in areas with low socio-economic indicators, 'passive' awareness techniques are just as effective at increasing material diversion as 'engaging' ones.

Table 6.8 Material diversion for each area PRE and POST-awareness

Pre-awareness analysis of targeted households' diversion kg/ph/w (Autumn)						
Material	Area 1	Area 2	Area 3	Area 4	Area 5 (control)	Average material diversion
Dry recyclables	3.9	5.1	3.8	4.9	4.6	4.5
Green waste	1.9	3.6	1.5	3.2	2.6	2.5
Other waste	0.2	0.3	0.5	0.3	0.4	0.3
Total diversion	6	9.0	5.7	8.4	7.6	7.3
% of unrequested dry material	15.3	16.3	21.8	19.5	20.9	18.8

Post-awareness analysis of targeted households' diversion kg/ph/w (Winter)						
Material	Area 1	Area 2	Area 3	Area 4	Area 5 (control)	Average material diversion
Dry recyclables	4.5	7.5	4.7	5.4	4.5	5.3
Green waste	0.3	2.2	0.3	0.5	0.2	0.7
Other waste	0.2	0.04	0.2	0.2	0.4	0.2
Total diversion	5.0	9.8	5.1	6.1	5.1	6.2
% of unrequested dry material	12.0	5.3	15.7	14.3	19.8	13.4

For a detailed breakdown of the material diversion in Areas 1,2,3,4 and 5, see Tables 6.9 , 6.10, 6.11, 6.12 and 6.13 respectively. The range of sub category diversion from 'PRE' to 'POST' analyses in Area 1 are summarised in Table 6.9.

Table 6.9 – The range of sub category diversion from 'PRE' to 'POST' analyses in Area 1

Material category	'PRE' analysis material diversion (kg/ph/w)	'POST' analysis material diversion (kg/ph/w)	Difference between PRE and POST (kg/ph/w)	The difference between the 'PRE' and 'POST' analysis in 'material equivalents'* are shown below: *See the Appendix 6.4 for material weight breakdowns*
All paper	2.76	2.99	0.23	 Two extra '60 page TV guide magazines' per household per week being diverted into recycling
Glass	0.49	0.71	0.22	 One extra 'Glass jar (525 g)' per household per week being diverted into recycling
PET bottles	0.133	0.16	0.027	 One extra '500 ml drinks bottle' per household per week being diverted into recycling
HDPE bottles	0.1	0.106	0.006	 Just 6g extra of HDPE per household per week being diverted into recycling
Super market carrier bags	0.042	0.027	-0.015	 Two extra 'Super market carrier bags' per household per week **NOT** being diverted into recycling
Plastic film	0.054	0.059	0.005	One extra 'Empty crisp packet' being put out per household per week

Material category	'PRE' analysis material diversion (kg/ph/w)	'POST' analysis material diversion (kg/ph/w)	Difference between PRE and POST (kg/ph/w)	The difference between the 'PRE' and 'POST' analysis in 'material equivalents'* are shown below: *See the Appendix 6.4 for material weight breakdowns*
Plastic film	0.054	0.059	0.005	One extra 'Empty crisp packet' being put out per household per week
Other plastics (#3-#7)	0.104	0.08	-0.024	Two thirds of a 'Strawberry punnet (400g) container' **NOT** being put out per household per week
Ferrous metals	0.086	0.182	0.096	 Two extra 'food tins' per household per week being diverted into recycling
Non-Ferrous metals	0.055	0.037	-0.018	 One extra 'drinks can' per household per week being **NOT** diverted into recycling
Kitchen waste	0.07	0.16	0.09	The 'potato peelings' from three potatoes per household per week being diverted into recycling

* It should be noted that the material equivalents are calculated based on the weight difference between 'PRE' and 'POST' analysis. There purpose is to act as a guide, to give the reader an understanding of what the weight difference means to the average householder, in terms of commonly diverted items.

The range of sub category diversion from 'PRE' to 'POST' analyses in Area 2 are summarised in Table 6.10.

Table 6.10 - Sub category diversion from 'PRE' and 'POST' analyses in Area 2

Material category	'PRE' analysis material diversion (kg/ph/w)	'POST' analysis material diversion (kg/ph/w)	Difference between PRE and POST (kg/ph/w)	The difference between the 'PRE' and 'POST' analysis in 'material equivalents'* are shown below: *See the Appendix 6.4 for material weight breakdowns*
All paper	3.43	5.55	2.12	 Two and a half extra '200 page glossy magazines' per household per week being diverted into recycling
Glass	0.8	1.06	0.26	 Two extra 'small beer bottles (250 ml)' per household per week being diverted into recycling
PET bottles	0.177	0.26	0.083	 Two extra '1 ltr drinks bottle' per household per week being diverted into recycling
HDPE bottles	0.146	0.16	0.014	 'ne extra 'pint HDPE milk container' per household per week being diverted into recycling
Super market carrier bags	0.036	0.04	0.004	 An extra half a 'super market carrier bag' per household per week being diverted into recycling
Plastic film	0.068	0.03	-0.038	Seven extra 'Empty crisp packet's' NOT being put out per household per week

Material category	'PRE' analysis material diversion (kg/ph/w)	'POST' analysis material diversion (kg/ph/w)	Difference between PRE and POST (kg/ph/w)	The difference between the 'PRE' and 'POST' analysis in 'material equivalents'* are shown below: *See the Appendix 6.4 for material weight breakdowns*
Other plastics (#3-#7)	0.12	0.07	-0.05	One and a half extra 'strawberry punnet (400g) container's' NOT being put out per household per week
Ferrous metals	0.173	0.232	0.059	 One extra 'food tin' per household per week being diverted into recycling
Non-Ferrous metals	0.036	0.036	0	 Diversion stayed the same
Kitchen waste	0.11	0.03	-0.08	The 'potato peelings' from two and a half potatoes per household per week **NOT** being diverted into recycling

* It should be noted that the material equivalents are calculated based on the weight difference between 'PRE' and 'POST' analysis. There purpose is to act as a guide, to give the reader an understanding of what the weight difference means to the average householder, in terms of commonly diverted items.

The range of sub category diversion from 'PRE' to 'POST' analyses in Area 3 are summarised in Table 6.11.

Table 6.11-Sub category diversion from 'PRE' and 'POST' analyses in Area 3

Material category	PRE analysis material diversion (kg/ph/w)	POST analysis material diversion (kg/ph/w)	Difference between PRE and POST (kg/ph/w)	The difference between the PRE and POST analysis in 'material equivalents'* are shown below: *See the Appendix 6.4 for material weight breakdowns*
All paper	2.25	3.86	1.61	 Four and a half extra 'newspapers' per household per week being diverted into recycling
Glass	0.61	0.59	-0.02	 Just 20 g of glass per household per week **NOT** being diverted into recycling
PET bottles	0.161	0.019	-0.142	 Three extra '2 Ltr drinks bottle's' per household per week **NOT** being diverted into recycling
HDPE bottles	0.129	0.019	-0.11	 Two and a half extra '4 pint HDPE milk container's' per household per week **NOT** being diverted into recycling
Super market carrier bags	0.054	0.019	-0.035	Five extra 'super market carrier bags' per household per week **NOT** being diverted into recycling

Material category	PRE analysis material diversion (kg/ph/w)	POST analysis material diversion (kg/ph/w)	Difference between PRE and POST (kg/ph/w)	The difference between the PRE and POST analysis in 'material equivalents'* are shown below: *See the Appendix 6.4 for material weight breakdowns*
Plastic film	0.054	0.019	-0.035	Five extra 'empty crisp packet's' **NOT** being put out per household per week
Other plastics (#3-#7)	0.09	0.04	-0.05	One and a half extra 'strawberry punnet (400g) container's' **NOT** being put out per household per week
Ferrous metals	0.205	0.083	-0.122	 Two extra 'food tin' per household per week **NOT** being diverted into recycling
Non-Ferrous metals	0.077	0.015	-0.062	 Four extra 'drink cans' per household per week **NOT** being diverted into recycling
Kitchen waste	0.12	0.22	0.1	The 'potato peelings' from three and a half potatoes per household per week being diverted into recycling

* It should be noted that the material equivalents are calculated based on the weight difference between PRE and POST analysis. There purpose is to act as a guide, to give the reader an understanding of what the weight difference means to the average householder, in terms of commonly diverted items.

The range of sub category diversion from 'PRE' to 'POST' analyses in Area 4 are summarised in Table 6.12.

Table 6.12 - The range of sub category diversion from PRE and POST analyses in Area 4

Material category	PRE analysis material diversion (kg/ph/w)	POST analysis material diversion (kg/ph/w)	Difference between PRE and POST (kg/ph/w)	The difference between the PRE and POST analysis in 'material equivalents'* are shown below: *See the Appendix 6.4 for material weight breakdowns*
All paper	2.96	3.29	0.33	 One extra 'newspaper' per household per week being diverted into recycling
Glass	0.97	1.13	0.16	 One extra 'small beer (250 ml)' per household per week being diverted into recycling
PET bottles	0.238	0.221	-0.017	 Three quarters of a '500 ml drinks bottle' extra per household per week **NOT** being diverted into recycling
HDPE bottles	0.139	0.176	0.037	 One and a half of a 'pint HDPE milk container' per household per week being diverted into recycling
Super market carrier bags	0.035	0.088	0.053	Seven and a half extra 'Super market carrier bags' per household per week being diverted into recycling

Material category	PRE analysis material diversion (kg/ph/w)	POST analysis material diversion (kg/ph/w)	Difference between PRE and POST (kg/ph/w)	The difference between the PRE and POST analysis in 'material equivalents'* are shown below: *See the Appendix 6.4 for material weight breakdowns*
Plastic film	0.045	0.044	-0.001	Just 1 g extra of 'plastic film' **NOT** being put out per household per week
Other plastics (#3-#7)	0.15	0.07	-0.08	One extra 'yoghurt pot' **NOT** being put out per household per week
Ferrous metals	0.223	0.224	0.001	 Just 1 g extra of 'ferrous metal' per household per week being diverted into recycling
Non-Ferrous metals	0.066	0.069	0.003	 Just 3 g extra of 'non ferrous metal' per household per week being diverted into recycling
Kitchen waste	0.21	0.44	0.23	The 'potato peelings' from eight potatoes per household per week being diverted into recycling

* It should be noted that the material equivalents are calculated based on the weight difference between PRE and POST analysis. There purpose is to act as a guide, to give the reader an understanding of what the weight difference means to the average householder, in terms of commonly diverted items.

The range of sub category diversion from 'PRE' to 'POST' analyses in Area 5 are summarised in Table 6.13.

Table 6.13 - The range of sub category diversion from PRE and POST analyses in Area 5

Material category	PRE analysis material diversion (kg/ph/w)	POST analysis material diversion (kg/ph/w)	Difference between PRE and POST (kg/ph/w)	The difference between the PRE and POST analysis in 'material equivalents'* are shown below: *See the Appendix 6.4 for material weight breakdowns*
All paper	2.88	2.99	0.11	 One extra 'TV guide magazine' per household per week being diverted into recycling
Glass	0.77	0.69	-0.08	 Half of a 'small beer (250 ml) bottle' per household per week **NOT** being diverted into recycling
PET bottles	0.172	0.16	-0.012	 Half of a '500 ml drinks bottle' extra per household per week **NOT** being diverted into recycling
HDPE bottles	0.146	0.115	-0.031	 One and a half of a 'pint HDPE milk container' per household per week **NOT** being diverted into recycling
Super market carrier bags	0.021	0.032	0.011	 One and a half extra 'Super market carrier bags' per household per week being diverted into recycling
Plastic film	0.047	0.058	0.011	Half of a 'strawberry punnet (440g) container' extra, being put out per household per week

Material category	PRE analysis material diversion (kg/ph/w)	POST analysis material diversion (kg/ph/w)	Difference between PRE and POST (kg/ph/w)	The difference between the PRE and POST analysis in 'material equivalents'* are shown below: *See the Appendix 6.4 for material weight breakdowns*
Other plastics (#3-#7)	0.25	0.154	-0.096	One and a half of a 'yoghurt pot' **NOT** being put out per household per week
Ferrous metals	0.141	0.149	0.008	 Just 8 g extra of 'ferrous metal' per household per week being diverted into recycling
Non-Ferrous metals	0.043	0.032	-0.011	 Just less than a 'drinks can' per household per week **NOT** being diverted into recycling
Kitchen waste	0.07	0.18	0.11	The 'potato peelings' from four potatoes per household per week being diverted into recycling

* It should be noted that the material equivalents are calculated based on the weight difference between PRE and POST analysis. There purpose is to act as a guide, to give the reader an understanding of what the weight difference means to the average householder, in terms of commonly diverted items.

6.12 PRE AND POST-AWARENESS RAI SCORE COMPARISONS

Pre and post RAI Scores were calculated as detailed in Section 6.5. Post-awareness RAI Scores were lower than pre-awareness RAI Scores by between 0.9 to 1.3 points for Areas 1-4, but only by 0.2 points for Area 5 (see Table 6.14). The results suggest that whatever awareness raising method was used, either 'engaging' or 'passive', or whether targeting households with known recycling behaviour, all were just as effective for lowering the RAI Score. The results indicate that after the awareness campaign there were less non-requested materials, less dirty materials, less un-squashed bottles, and more bottles with tops off, being put out for collection.

Table 6.14 PRE and POST-awareness RAI Score comparisons in each area

Trial area	Pre-awareness RAI Score	Post-awareness RAI Score	Reduction in RAI Score
Area 1	6.3	5	1.3
Area 2	5.1	4	1.1
Area 3	6.0	5.1	0.9
Area 4	5.8	4.6	1.2
Area 5	6.1	5.9	0.2

6.13 NEW RECRUITS POST AWARENESS CAMPAIGN

Any attempt to compare 'pre' and 'post' set out rate data for the whole of each area would have not have been warranted, because the awareness campaign only targeted select households in each area. For example in Area 2 there were 707 households only 108 were actually targeted. For this reason the emergence of new recruits or change in individual household participation frequency were the parameters of interest.

Two categories were used to identify new recruits to the trial areas. The first new recruit category were households recorded as participating 'once only' in the 12 week monitoring period. Because of the vast amount of set out rate data available, it was possible to identify the households that participated once only in the twelve week period and plot the participation in a histogram to see if the once only participants were randomly spread throughout the 12 week monitoring period (see Figure 6.12). The second, more reliable category to define a new recruit, was a household that had taken

part two or more times in the 12 week period. An example of the set out rate data analysis for an area can be seen in Appendix 6.5.

It is also useful to note the Borough as a whole, weekly set out rate 'Pre' awareness, during the awareness implementation and 'Post' awareness campaign. Figure 6.11 shows driver recorded household set out rate data for the whole Borough, June 2003 to January 2004.

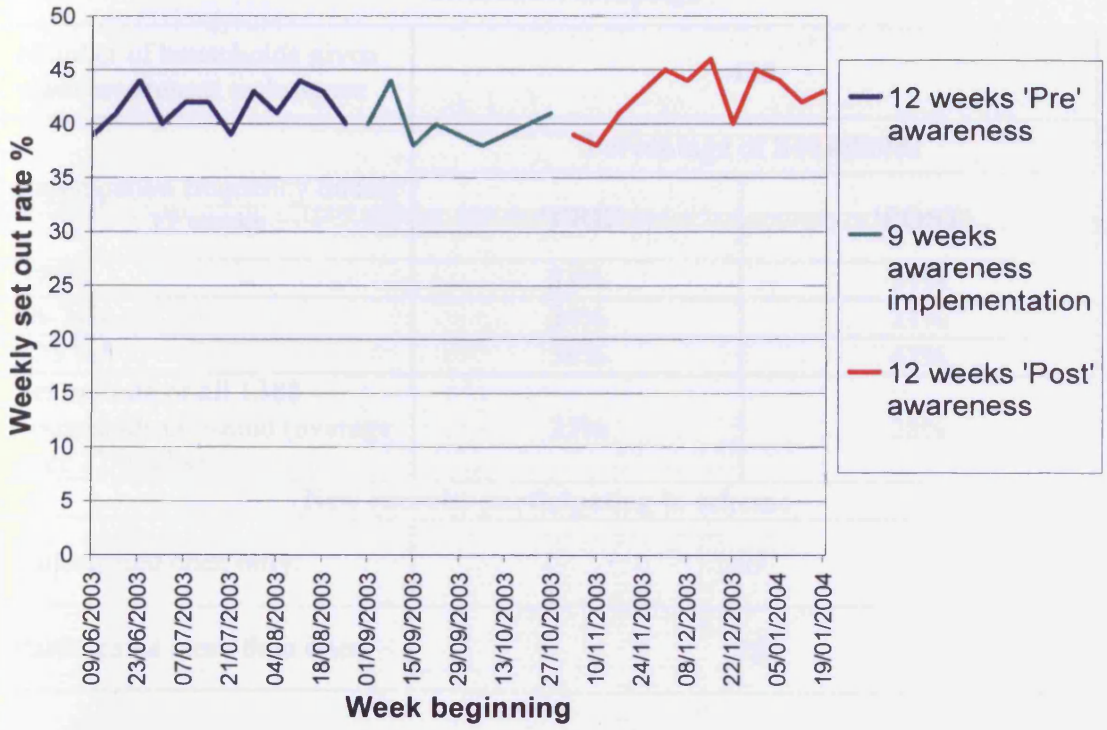


Figure 6.11 Weekly set out rate data for the households in Rhondda Cynon Taf County Borough, June 2003 – January 2004.

The average weekly set out for the 12 week period 'Pre' awareness was 42% (as detailed previously in Chapter 5, Section 5.5.2). The average weekly set out for the 9 week implementation period was 40%. The average weekly set out for the 12 week period 'Post' awareness was 43%.

6.13.1 Area 1

Four hundred and thirty-eight households of the 1388 in Area 1 were exposed to both engaging and passive waste awareness techniques. The participation rate of the 438

households was then analysed for two twelve week periods 'pre' and 'post' the awareness campaign (see Appendix 6.5). The recycling behaviour of households 'pre' and 'post' the awareness campaign in Area 1 is shown in Table 6.15. There was found to be a difference in participation frequency and set out rate, between 'pre' and 'post' awareness.

Table 6.15 Participation of individual household in Area 1 'Pre' and 'Post' the awareness campaign

Number of households given waste awareness techniques	**438**	
Participation frequency during 12 weeks	**Percentage of households**	
	'PRE'	**'POST'**
>75%	31%	37%
26-74%	34%	21%
<25 %*	36%	42%
Set out rate of all 1388 households on round (average over 12 weeks)	25%	28%
New recruits participating in scheme		
Participated once only.	67	
Participated more than once.	28	

'Pre' awareness analysis revealed that 165 of the 438 households (36 per cent) subjected to the awareness scheme had put out more than once in the 12 week monitoring period. Of the 273 households identified as not setting out in the 'pre' awareness 12 week monitoring period, only 28 new recruits set out recyclate more than once in the 'post' awareness 12 week monitoring period. The 28 new recruits equated to the awareness scheme being able to convert 10 per cent of households not previously participating, to start participating. It should be noted that drivers recorded 67 new recruits participating 'only once'. Figure 6.11 shows the distribution of the 67 new recruits through the 12 week monitoring period. These new recruits are spread relatively evenly throughout the 12 week period, with 17 'once only' new recruits, participating in the last 4 week period. The distribution of 'once only' participants was assumed therefore to be random and not

a cluster of participants. The total number of new recruits was 95 (28 'more than once'+ 67 'only once') equating to the awareness scheme being able to convert 35 per cent of households not previously participating. As with all the set out data the 'once only' participants could be the result of driver over recording as detailed in Chapter 4, Section 4.3. Area 1's average weekly set out rate increased from 25% to 28% 'post' awareness. This increase was made more significant when Area 5's (the control) average weekly set out rate decreased from 46% to 41% over the same time period (see Table 6.19), although it should be noted that the set out rate for the whole Borough increased by one percentage point during the same period (Figure 6.11). It is probable that the 95 new recruits (of varying participation frequency, see Table 6.15) were responsible for increasing the 'post' awareness average weekly set out rate in Area 1 by at least 2%.

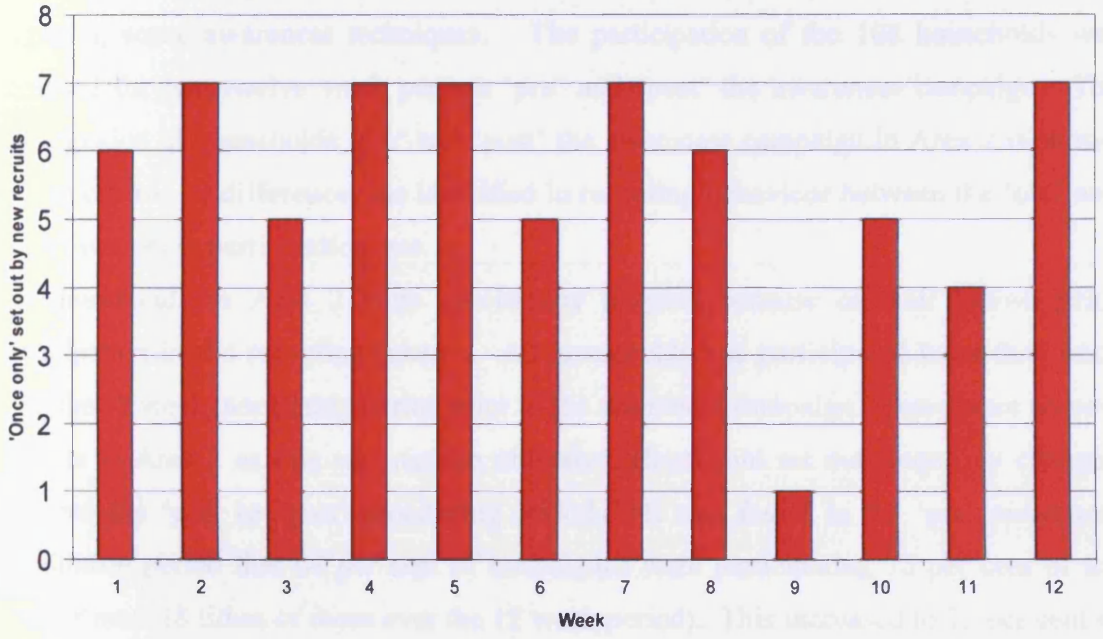


Figure 6.12 Weekly distribution of the 67 new recruits setting out 'once only' in 12 week monitoring period

New recruits were attributed directly to the 'engaging' waste awareness techniques used in Area 1.

Household set out frequency also changed from 'pre' to 'post' the awareness campaign. It was found in the 'pre' awareness monitoring period that 31 per cent of households

were setting out 75 per cent of the time or more (or 8 times or more in the 12 week period). This increased to 37 per cent of households after the awareness campaign.
There was a decline in households putting out between 26-74 per cent of the time or between 4 and 7 times in the 12 week period. This decrease was thought to be due more to households putting out more than 75 per cent of the time. It was found in the 'pre' awareness monitoring period that 36 per cent of households were setting out 25 per cent of the time or less (4 times or less in the 12 week period). This increased to 42 per cent of households after the awareness campaign, due to the presence of the 67 'once only' new recruits.

6.13.2 Area 2

One hundred and eight households of the 707 in Area 2 were exposed to the passive and engaging waste awareness techniques. The participation of the 108 households was analysed for two twelve week periods 'pre' and 'post' the awareness campaign. The participation of households 'pre' and 'post' the awareness campaign in Area 2 is shown in Table 6.16. A difference was identified in recycling behaviour between the 'pre' and 'post' awareness participation rate.
All households in Area 2 were specifically targeted because of their known prior participation in the recycling scheme. All households had participated more than once over the 12 week monitoring period prior to the awareness campaign. There were no new recruits in Area 2 as this was not the objective. Household set out frequency changed between the 'pre' to 'post' monitoring periods. It was found in the 'pre' awareness monitoring period that 64 per cent of households were participating 75 per cent of the time or more (8 times or more over the 12 week period). This increased to 75 per cent of households after the awareness campaign. Therefore, it is can be seen that the awareness campaign caused households to participate more often.
There was a decline in households putting out between 26-74 per cent of the time or between 4 and 7 times in the 12 week period. The 11 percentage point decrease is thought to be directly linked to the 11 percentage point increase in households putting out 75 per cent or more of the time. In Table 6.16 the data for the pre awareness households in Area 2 refer to the mean values for that area. The awareness campaign in the area was directed

at the participating households only, therefore there was no link between the set out rate data in the post awareness column that decreased from 40% to 36% (as all the households targeted were continually participating).

Table 6.16 Participation of individual household in Area 2 'Pre' and 'Post' the awareness campaign

Number of households given waste awareness techniques	**108**	
Participation frequency during 12 weeks	**Percentage of households**	
	'PRE'	**'POST'**
>75%	64%	75%
26-74%	36%	25%
<25 %*	0%	0%
Set out rate of all 707 households on round (average over 12 weeks)	40%	36%

6.13.3 Area 3

One hundred and forty-eight households of the 1159 in Area 3 were exposed to the passive and engaging waste awareness techniques. All households in Area 3 were specifically targeted because of their known non-participation prior to the awareness campaign. None of the households had set out even once in the 12 week monitoring period prior to the awareness campaign. The set out rate of the 148 households was then subsequently analysed for the twelve week period 'post' the awareness campaign. The recycling behaviour of new recruits in Area 3 is shown in Table 6.17. There were 25 new recruits setting out more than once after the awareness campaign, who had not previously participated. This equated to the awareness campaign being able to convert 17 per cent of households who were not previously participating, to start participating. It should be noted that drivers recorded 54 new recruits setting out only once. The total number of new recruits was 78 (24 'more than once'+ 54 'only once') equating to the awareness scheme being able to convert 72 per cent of households not previously participating. As with all the set out data some of the 'once only' participants could be the result of driver over recording as detailed in Chapter 4, Section 4.3. Area 3's average weekly set out rate

increased from 42% to 43% 'post' awareness. This increase was made more significant when Area 5's (the control) average weekly set out rate decreased from 46% to 41% over the same time period (see Table 6.19). It should be noted that again, however, that the set out rate for the whole Borough increased by one percentage point also during the same period and it is difficult to quantify the effect of the awareness campaign in this area.

Table 6.17 Participation of individual household in Area 3 'Pre' and 'Post' the awareness campaign

Number of households given waste awareness techniques	**148**	
Participation frequency during 12 weeks	**Percentage of households**	
	'PRE'	**'POST'**
>75%	n/a	31%
26-74%	n/a	16%
<25 %*	n/a	53%
Set out rate of all 1159 households on round (average over 12 weeks)	42%	43%
New recruits participating in scheme		
Participated once only.	54	
Participated more than once.	24	

New recruits, average household set out frequency in Area 3 was as follows: 31 per cent of households were participating 75 per cent of the time or more (or 8 times or more in the 12 week period), 16 per cent of households were putting out between 26-74 per cent of the time or between 4 and 7 times in the 12 week period, and 53 per cent were participating 25 per cent of the time or less.

6.13.4 Area 4

All 971 households in Area 4 were exposed to the passive waste awareness techniques. The set out rate of all 971 households was also analysed for two twelve week periods 'pre' and 'post' the awareness campaign. The recycling behaviour of households 'pre' and 'post' the awareness campaign in Area 4 is shown in Table 6.18.

Table 6.18 Participation of individual household in Area 4 'Pre' and 'Post' the awareness campaign

Number of households given waste awareness techniques	**971**	
Participation frequency during 12 weeks	**Percentage of households**	
	'PRE'	**'POST'**
>75%	38%	40%
26-74%	30%	27%
<25 %*	32%	33%
Set out rate of all 971 households on round (average over 12 weeks)	41%	40%
New recruits participating in scheme		
Participated once only.	117	
Participated more than once.	3	

Detailed analysis is required before it is possible to say that there was a difference in recycling behaviour between the 'pre' and the 'post' participation. Analysis of the 'pre' awareness participation revealed that 289 (30%) of the 971 households exposed to the awareness scheme had put out more than once in the 12 week monitoring period prior to their exposure. Of the 620 households identified as not setting out in the 'pre' awareness 12 week monitoring period, 3 new recruits only set out recyclate more than once in the 'post' awareness campaign 12 week monitoring period. It should be noted that drivers recorded 117 new recruits setting out 'only once'. The total number of new recruits was 120 (3 'more than once'+ 117 'only once') equating to the awareness scheme being able to convert 19 per cent of households not previously participating. As with all the set out data the 'once only' participants could be the result of driver over recording as detailed in Chapter 4, Section 4.3.

The 3 new recruits participating 'more than once', equated to the awareness campaign being able to convert only 0.5 per cent of households who were not previously participating, to start participating frequently.

Household set out frequency also changed between the 'pre' and 'post' awareness campaign monitoring periods. It was found in the 'pre' awareness monitoring period that 38 per cent of households were setting out 75 per cent of the time or more (or 8 times or more in the 12 week period). This increased to 40 per cent of households after the awareness campaign. There was a decline in households putting out between 26-74 per cent of the time or between 4 and 7 times in the 12 week period post the awareness campaign. The drop was from 30 per cent 'pre' to 27 per cent 'post' the awareness campaign. There was also an increase but probably not significant from the 'pre' awareness monitoring period to the 'post' awareness of households participating 25 per cent of the time or less (4 times or less in the 12 week period), from 32 per cent to 33 per cent.

6.13.5 Area 5

Area 5 was the control area and subsequently exposed to only one unavoidable waste awareness raising technique the *Rapidly Changing Times* (see Table 6.2). The participation of all 1086 households was analysed for two twelve week periods 'pre' and 'post' the awareness campaign. The recycling behaviour of households 'pre' and 'post' the awareness campaign in Area 5 is shown in Table 6.19. There was found to be a small difference in recycling behaviour between 'pre' and 'post' awareness participation, although the difference was viewed as insignificant. 'Pre' awareness set out rate analysis revealed that 412 (38 per cent) of the 1086 households exposed to the awareness scheme had put out more than once in the 12 week monitoring period. Of the 620 households identified as not setting out in the 'pre' awareness 12 week monitoring period, no new recruits set out more than once in the 'post' awareness 12 week monitoring period. It should be noted that drivers recorded 126 new recruits setting out 'only once'.

Household set out frequency also changed between 'pre' and 'post' awareness campaign monitoring periods. It was found in the 'pre' awareness monitoring period that 38 per cent of households were participating 75 per cent of the time or more (or 8 times or more in the 12 week period). This increased to 40 per cent of households after the awareness campaign. There was a decline in households putting out between 26-74 per cent of the time or between 4 and 7 times in the 12 week period, from 31 per cent in the 'pre' to 29

per cent in the 'post' awareness set out analysis. However, there was a decrease from the 'pre' awareness monitoring period to the 'post' awareness of households participating 25 per cent of the time or less (4 times or less in the 12 week period), from 33 per cent to 32 per cent. The largest variation in participation frequency observed between 'pre' and 'post' awareness campaign was 3 percentage points (see Table 6.19). This variation of 3 percentage points in the control area was subsequently used as a benchmark against which to judge change in frequency of individual household set out due to the awareness campaign. A decrease of 5% was observed between 'pre' and 'post' awareness campaign set out rate averages over the 12 week period. This decrease of 5 percentage points in the control area was subsequently used as a benchmark against which to judge significant change in average set out rate due to the awareness campaign. It should be noted that the set out rate for the whole Borough increased by one percentage point during the same period, therefore the behaviour of households in the control area over that time period was different to that of the Borough as a whole, thus making exact comparisons very difficult.

Table 6.19 Participation of individual household in Area 5 'Pre' and 'Post' the awareness campaign

Number of households given waste awareness techniques	**1086**	
Participation frequency during 12 weeks	**Percentage of households**	
	'PRE'	**'POST'**
>75%	36%	39%
26-74%	31%	29%
<25 %*	33%	32%
Set out rate of all 1159 households on round (average over 12 weeks)	46%	41%
New recruits participating in scheme		
Participated once only.	130	
Participated more than once.	0	

16.14 SUMMARY

16.14.1 Increasing material diversion

All of the four awareness methods employed aimed to increase material diversion. The ideal scenario would have been for every household to put out 100 per cent of the requested recyclate material or, on average, 10.5kg of dry recyclables per household week.

The increase in material diversion in the control area was only 0.1kg per household, indicating very little change in dry recyclable diversion without an awareness campaign. Any difference between pre and post analysis greater than that observed in the control area, was thought to be a result of the awareness method used in that area.

The awareness methods used in Area 2 were 'passive and engaging' and specifically targeted those households already participating in the recycling scheme. Area 2 saw the largest increase in material diversion. Its average weekly household dry recyclable diversion increased from 5.1kg to 7.5 kg after the awareness campaign.

Fundamentally, Area 1 received the same 'passive and engaging' awareness methods as Area 2, but, all households were targeted. Further, Area 1's average weekly household dry recyclable diversion increased from 3.9 kg to 4.5 kg after the awareness campaign. However, because Area 1 did not respond in terms of increase in material diversion as well as Area 2, this suggests that other factors, such as the socio-economic characteristics of the area, influenced how households responded to the waste awareness campaign. Area 2 had a Townsend score of 1 compared to Area 1's score of 3.4.

In Area 3, those households not previously participating in the recycling scheme were specifically targeted. Area 3's pre campaign waste analysis produced 3.9 kg as the average weekly household dry recyclable diversion. New recruits in Area 3 put out an average weekly household dry recyclable diversion of 4.7 kg. So it would seem that, on average, new recruits as a result of the awareness campaign put out more for collection than an average household already participating in the scheme. Looking at the post-awareness analysis of recyclate composition reveals new recruits' recyclate mainly

consisted of paper and glass. This suggests that informing households of what they should put out for collection by 'passive and engaging' awareness methods before they start, can increase overall diversion in the scheme to more than that of a mature scheme participant.

Passive awareness techniques were employed in Area 4, therefore, because household participation in the scheme increased by only 0.5 per cent, it can be assumed that any change in the quality and quantity of material diversion can be attributed to the awareness message (leaflet only) received by those already participating. Area 4's average weekly household dry recyclable diversion saw a slight increase, from 4.9 kg to 5.4 kg after the awareness campaign. This result is interesting as the increase was similar to that in Area 1, yet the awareness raising technique was much simpler to deliver.

6.14.2 Decreasing the RAI Score

All of the four awareness methods employed aimed to decrease the RAI Score. The ideal scenario would be for each household to put out dry recyclables with a RAI Score of zero.

The decrease in RAI Score was measured by comparing the pre-awareness analysis score with the post-awareness analysis score. The control area's RAI Score decreased by 0.2 points per household from pre to post-awareness analysis, indicating very little change in RAI Score without a stimulus. Any difference greater than 0.2 points was considered to be a result of the awareness method used in that area.

All areas exposed to an awareness method seemed to show a decrease in RAI Score by around 1 point. This suggests that 'passive' awareness methods are just as effective for changing recycling behaviour with respect to the quality of recyclate as 'engaging' awareness methods.

6.14.3 Increasing participation

Three of the four awareness methods employed aimed to recruit new participants.

Areas 1 and 3 used 'passive and engaging' awareness methods. Area 1 targeted all households and succeeded in converting 10 per cent of those previously not participating to participate more than once in the twelve week post-awareness period. The study also converted 35 per cent of those previously not participating to participate once or more in the twelve week post-awareness period. Gaining new recruits was slightly less successful in Area 1 than Area 3. This finding also suggests that not every area will respond in the same way to a waste awareness campaign, although, overall, both Area 1 and Area 3 responded poorly.

Area 4 used 'passive' awareness methods, including giving every household a roll of 20 clear bags. Of the 971 households in Area 4 exposed to the awareness methods used, only 3 households started participating (more than once) in the scheme that had not done so in the 12 week time block prior to the awareness campaign, a new recruit (more than once) percentage of just 0.5 per cent. However, Area 4 did succeed in converting 19 per cent of those previously not participating, to participate once or more in the twelve week post-awareness period.

Areas 2 and 5 did not gain any new recruits participating more than once during the 12 week time period after the awareness campaign. This is due to targeting those households already in Area 2 participating in the scheme and Area 5 as the control area did not receive the awareness raising methods.

CHAPTER 7

7 THE SCHOOLS' WASTE EDUCATION PROGRAMME

A trial schools' waste education programme was undertaken to try to change 7-11 year old children's attitude towards waste and ultimately their kerbside recycling behaviour at their home. The schools' waste education programme used voluntary/carrot and financial/carrot style incentives (see Chapter 8, Section 8.1 for more incentive styles). This chapter explains the purpose of the schools' waste education programme and the aim of accompanying experiments. The structure of the schools' waste education programme is outlined and the methodologies of each experiment to monitor the trial's effectiveness are explained. To summarise, all pupils aged 7-11 in six primary schools were targeted. All the households of pupils had a weekly kerbside recycling collection in the case study authority (RCTCBC). The purpose of the experiments was to quantify any change in two different types of indicators, soft and hard, before and after the schools' waste education programme. Soft indicators examined change in children's attitudes towards waste, whilst hard indicators measured change in the kerbside recycling behaviour at their homes. All results were compared to those derived from pupils of a control school that did not receive the schools' waste education programme. The study findings will provide decision makers with an objective view of the effectiveness of a schools' waste education programmes.

It is thought that forcing children towards a 3Rs (reduce, reuse and recycle) strategy can only produce huge benefits (Vallini, 2005). In fact, activities associated with this philosophy aim at improving social responsibility, citizenship and environmental consciousness in schools as well as in the wider community (Vallini, 2005). They also contribute to improving the environmental management of schools, the development of cross-curricular links through the delivery of environmental education programmes, saving costs on materials and waste disposal, and finally to raising the profile of schools within their local communities (Vallini, 2005). In the UK, Waste Watch operates a Schools' Waste Action Club (www.waste-watch.org.uk/education), although most schools run waste education programmes under the umbrella of ECO-Schools (Eco-Schools is a global initiative which aims to raise students' awareness of sustainability issues through classroom study and the wider curriculum of the school). Most of the literature specific to waste education in schools focuses on change in pupils' attitudes and change in schools' overall waste diversion 'post' education

programmes (Grodzinska-Jurczak et al. 2001, Smith et al. 2003; Angus et al. 2003; Sperlungo et al. 2003; Armstrong et al. 2003; and Grodzinska-Jurczak et al. 2006), based on the hypothesis that students' relatives and the whole local community became more environmentally conscious, through the process of intergenerational communication and influence (Ballantyre et al. 1998). (Vallini, 2005) highlights the need to critically evaluate how waste education in schools affects social, economic and practical aspects of waste management. This Chapter attempts to provide more knowledge on the effectiveness of waste education programmes in schools.

7.1 EXPERIMENTS TO MONITOR THE EFFECTIVENESS OF A SCHOOLS' WASTE EDUCATION PROGRAMME

A number of experiments were conducted to quantify change in soft and hard indicators solely due to a schools' waste education programme. The study attempted to establish children's attitudes towards waste, both pre and post the schools' waste education programme. The study also investigated the effectiveness of a financial/carrot incentive called the "recycling pledge" (explained in Section 7.2.1). Recycling behaviour at the homes of children from six schools was assessed by monitoring changes in performance indicators of the kerbside recycling scheme. Performance indicators included material capture, the quality of recyclate, and household set out rate. These indicators were used to analyse recycling performance after the schools' waste education programme in order to determine whether the programme had been effective. Findings were compared with those derived from a control group.

7.1.1 Purpose of studying the children's attitudes towards waste and recycling

It was thought appropriate to conduct a survey to ascertain the attitudes of pupils towards waste. Pupils aged 7-11 subjected to a schools' waste education programme were surveyed both before and after it, using an attitudinal survey to assess their prior waste related knowledge and attitudes, and their families' existing waste management regime and how it may have been altered due to the schools' waste education programme.

7.1.2 Purpose of the schools' "recycling pledge" initiative

The schools' "recycling pledge" initiative was a financial/carrot incentive for children and parents to recycle at home, to financially benefit the school. The more pledge forms returned to the school stating that pupils' households would recycle in the kerbside scheme, the greater the financial reward for the school. The returned pledge forms also provided the research team with the names and addresses of pupils that were subjected to the schools' waste education programme. The addresses were then used to identify households for the recyclable waste analysis undertaken to assess any change in recycling behaviour at the household concerned. On the reverse of the pledge form was a survey for parents, questioning them about their household waste management practices.

7.1.3 Purpose of the targeted recyclable waste analysis

It was thought appropriate to ascertain if the material put out in the kerbside recyclate of households of pupils subjected to the schools' waste education programme differed from that of households of pupils that had not been subjected to the programme. If there was a significant change in material being put out and a significantly different Recyclate Awareness Index Score (see Chapter 6, Section 6.4.1) these could be attributed to the waste education programme, and provide evidence that the information given to pupils at school was filtering through and having an effect on kerbside recycling behaviour at home.

7.2 THE SCHOOLS' WASTE EDUCATION PROGRAMME STRUCTURE

All pupils aged 7-11 in the trial schools were subjected to the schools' waste education programme. It was important that the media and messages employed could be easily replicated by other local authorities, therefore, the schools' waste education programme was introduced under the umbrella of ECO-Schools. To keep the trials fair and ensure targeted householders had all been subjected to the same stimuli, public waste awareness raising techniques, such as door step interviews and supermarket promotions were not used by the SORT Team within the catchment area of schools participating in this study. There were also no waste related radio or TV messages broadcast in RCTCBC as Waste Awareness Wales had not yet started its TV and radio campaign, which commenced in late 2004. This is because it would

have been impossible to know which pupil and households had been exposed to what message.

The schools' waste education programme included the following activities:

- The recycling pledge initiative (all pupils aged 7-11)
- A special assembly conducted by the SORT team and University waste research team (all pupils aged 7-11)
- Special recycling bins and posters in each classroom (all classrooms in schools)
- A trip to the Education Centre at Bryn Pica Landfill Site (just one class from each school)
- A visit from Cycler the Rapping Robot (all pupils in all schools)
- The Alu Pro Recycling Scheme (all pupils in schools)
- The Yellow Pages Recycling Challenge (all pupils in schools)
- Finale assembly (all pupils aged 7-11)

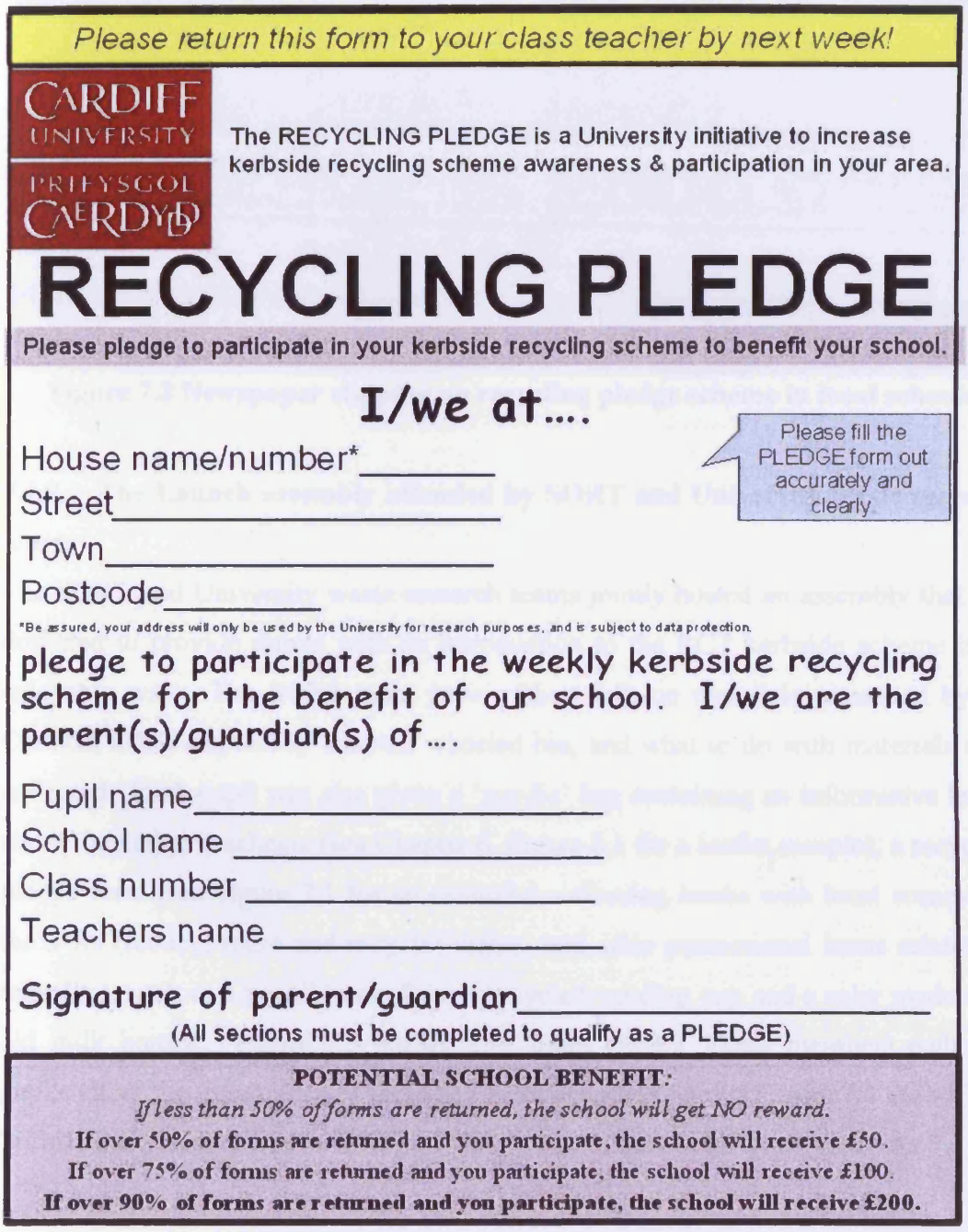
7.2.1 The "recycling pledge" initiative

The "recycling pledge" initiative was launched in September 2003, by Cardiff University in an assembly for pupils. It was seen as a way of encouraging more participation in the kerbside scheme. It focused on providing a fiscal incentive for participation (albeit claimed participation), for example, the more parents who became involved in the scheme, the greater the potential monetary reward for the schools attended by their children. Although, the reward was a oneoff payment, it was hoped that once involved in the scheme, people would continue to participate in it. Each child at Key Stage 2 level (aged 7-11) was given a recycling pledge form in a 'goodie bag' (see Section 7.2.2 for more information) distributed during the assembly. It asked parents to commit to participating in the scheme for the benefit of their children's schools. Potential school benefits were as follows:

- If less than 50% of forms were returned, the school would receive no reward
- If over 50% of forms were returned and parents participated in the scheme, the school would receive £50
- If over 75% of forms were returned and parents participated in the scheme, the school would receive £100

- If over 90% of forms were returned and parents participated in the scheme, the school would receive £200

An example of a recycling pledge is shown in Figure 7.1. The launch of the pledge initiative in each school received local media attention (see Figure 7.2 for a sample newspaper cutting).



Please return this form to your class teacher by next week!

CARDIFF UNIVERSITY
PRIFYSGOL CAERDYDD

The RECYCLING PLEDGE is a University initiative to increase kerbside recycling scheme awareness & participation in your area.

RECYCLING PLEDGE

Please pledge to participate in your kerbside recycling scheme to benefit your school.

I/we at....

Please fill the PLEDGE form out accurately and clearly

House name/number*_____
Street_____
Town_____
Postcode_____

*Be assured, your address will only be used by the University for research purposes, and is subject to data protection.

pledge to participate in the weekly kerbside recycling scheme for the benefit of our school. I/we are the parent(s)/guardian(s) of....

Pupil name_____
School name _____
Class number _____
Teachers name _____

Signature of parent/guardian_____

(All sections must be completed to qualify as a PLEDGE)

POTENTIAL SCHOOL BENEFIT:

If less than 50% of forms are returned, the school will get NO reward.

If over 50% of forms are returned and you participate, the school will receive £50.
If over 75% of forms are returned and you participate, the school will receive £100.
If over 90% of forms are returned and you participate, the school will receive £200.

Figure 7.1 Recycling pledge form

CYNON VALLEY LEADER, DECEMBER 11, 2002 NEWS 9

Got a story? Ring the newsdesk on 01685 884406

WASTE NOT, WANT NOT: Representatives of AMGEN Cymru and Cardiff School of Engineering with Cwmdare head Paul Davies and his pupils, who show off their recycling pledges

Recycling is good news

PUPILS in Cynon Valley have taken the pledge to wage war on waste.

BY LINDA ELIAS

Youngsters at Llwydcoed and Cwmdare Primary are among hundreds of students throughout the borough helping to increase recycling in Rhondda Cynon Taf.

The Cardiff School of Engineering, in partnership with the local authority, have launched a number of waste awareness schemes which will try to change the children's and adults' perception and attitude towards waste.

The School of Engineering's Bryn Pica Education Centre at Llwydcoed, situated on the Bryn Pica landfill, owned by AMGEN Cymru, will play an important role in increasing waste awareness.

Cwmdare and Llwydcoed students made a pledge to take the recycling message home to their parents.

The waste awareness research is one of many waste-related projects at Cardiff University, which has been chosen as the base for the Centre of Excellence in Waste Research, a Wales-wide initiative backed by the Welsh Assembly Government.

Figure 7.2 Newspaper clipping on recycling pledge scheme in local schools

7.2.2 The Launch assembly attended by SORT and University waste research teams

The SORT and University waste research teams jointly hosted an assembly that was designed to provide pupils with an introduction to the RCT kerbside scheme in an enjoyable way. The SORT team gave a short talk on materials requested by the Council, using a specially adapted wheeled bin, and what to do with materials once collected. Each pupil was also given a 'goodie' bag containing an informative leaflet about the kerbside scheme (see Chapter 6, Figure 6.1 for a leaflet sample), a recycling pledge form (see Figure 7.1 for an example), colouring books with local scenes and the 3 Rs (reduce, reuse and recycle) theme, and other promotional items relating to recycling, such as a pencil made from a recycled vending cup and a ruler made from old milk bottles. Figure 7.3 shows Tim Jones (SORT Team member) enthusing pupils about the importance of recycling in an assembly, whilst Figure 7.4 shows Tom Woollam explaining what would be found in the 'goodie bags' (see Appendix 7.1).

Figure 7.4 Tom Woollam explains 'goodie bag' contents

Figure 7.3 Tim Owen (SORT Team) enthusing children about the importance of recycling

7.2.3 Special recycling bins and posters in each classroom

To firmly implant recycling behaviour in the children's psyche, special recycling bins and posters of what to put in them were placed in every classroom of the chosen schools to encourage children to get into the habit of recycling. Not one of the chosen schools had any form of recycling in place before the waste education programme began. The Council provided the recycling bins free of charge and also started to collect the recyclables from the trial schools.

7.2.4 A trip to the Education Centre at Bryn Pica Landfill Site

A class of pupils from each trial school also visited the Education Centre at Bryn Pica landfill site. During the 2 hour visit, the children experienced a 'Landfill Safari', a tour of the landfill in a four wheel drive vehicle, aimed at increasing their knowledge of what happens to their waste. The children also participated in a number of workshop exercises, including experiments based on the recyclables that RCT collects, to show the various ways in which the recyclables are used and possible end products once reprocessed. The programme run for schools at Bryn Pica links particularly well to Citizenship in the National Curriculum in schools, as it aims to raise awareness of waste issues, leading to informed decision making and ultimately pupils and staff taking responsibility for sustainable waste management within their schools and at home. In addition, activities sought to establish links with associated

subjects (geography, science, maths and art) and cross-curricular initiatives, such as Education for Sustainable Development (ESD) and ECO-schools. A typical session is shown in Figure 7.5. As can be seen, sessions were "hands on" and interactive, so pupils' engagement could be both developed and maintained.

Figure 7.5 A typical 'hands on' interactive session at one of the workshops held at the Bryn Pica Education Centre

7.2.5 A visit from Cycler the Rapping Robot

Cycler the Rapping Robot is a unique, free educational show for primary schools that are interested in environmental education provided by Waste Watch and supported by Biffaward through the Landfill Tax. Waste Watch is the leading national organisation promoting and encouraging action on the 3 Rs – Reduction, Reuse and Recycling. Cycler raps, sings and dances messages emphasising the 3 Rs with the aim of providing entertainment while at the same time educating school children. The robot itself is made from recovered waste material to highlight the ways in which 'rubbish' can be used (Waste Watch 2004). Each of the trial schools had a show and informative talk about the 3 Rs from Cycler (depicted in Figure 7.6), and a Waste Watch representative.

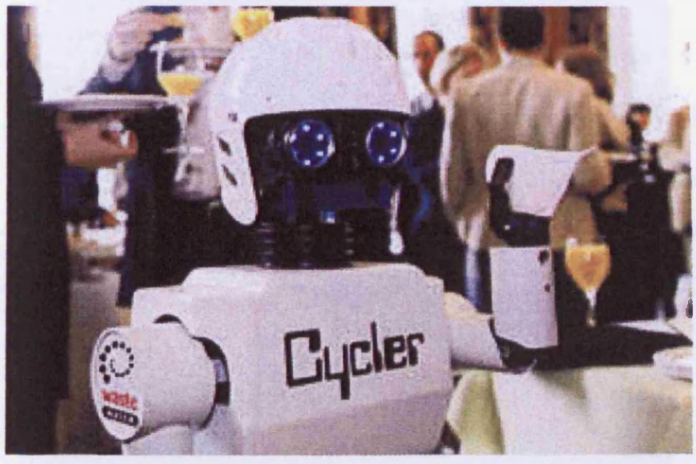


Figure 7.6 Cycler 'the Rapping Robot'

7.2.6 AluPro Recycling Scheme

The AluPro scheme is an adaptation of the main Cash for Cans and Plant a Tree scheme especially for primary schools. AluPro have stated that they will plant a tree sapling for every tonne of aluminium collected as part of its scheme. This type of incentive scheme is classed by Mitchel et al. 2005 as a voluntary/carrot (see Chapter 8, Section 8.4 for more details). Schools are being encouraged to take part in this scheme by collecting cans and taking them to their nearest Cash for Cans centre. For every tonne of cans collected, the school can claim a free tree to be planted in the school grounds, up to a maximum of ten. Trees offered to schools will be selected by the Woodlands Trust to suit the ecology of the area. There are teachers' notes and curriculum links that accompany the scheme to allow the recycling message to be portrayed effectively, so that children can benefit from it fully (AluPro 2004). The six trial schools took part in the AluPro scheme.

7.2.7 Yellow Pages Recycling Scheme

The Yellow Pages Recycling Scheme is a challenge presented to schools by Yellow Pages, The Directory Recycling Scheme, and the Woodlands Trust. It is a UK wide competition with a total prize fund of £50,000, split into regional prizes for those schools which collect the most directories per pupil. This type of incentive scheme is classed (Mitchel et al. 2005) as a voluntary/carrot (see Chapter 8, Section 8.4 for more details). For every pound given to schools in cash prizes, a pound will be given to the Woodlands Trust. In RCTCBC, schools asked pupils to bring as many old Yellow Pages as possible to school. The top three schools with the highest number of Yellow Pages per pupil won money. The six trial schools took part in the Yellow Pages Recycling Scheme.

Figure 7.7 Presentation of money to the top three schools in RCTCBC with the highest number of Yellow Pages per pupil

7.2.8 Finale assembly

Each of the six trial schools participated in the finale assembly. University waste team representatives spent 15 minutes reminding and reinforcing to pupils what waste education they had been exposed to over the duration of the programme. The assembly ended with pupils being thanked for taking part in the waste education programme and urged to become recycling champions and to continue to participate in the kerbside recycling scheme at home. Pupils were also given a feedback leaflet to give to their parents (see Figure 7.8). All trial schools were presented with a certificate thanking them for taking part in the waste education programme, regardless of the extent of their success. Where appropriate, cheques and an outdoor recycling bin (shaped like a frog) were presented to schools (see Figure 7.9).

CARDIFF UNIVERSITY
PRIFYSGOL CAERDYDD

NEWSLETTER: Week beginning February 9th 2004

Dear Parent/Guardian and Pupil,

On behalf of Cardiff School of Engineering we would like to thank you for participating in the recycling pledge scheme. As you are aware back in September 2003 Cardiff University launched it's recycling pledge. If a certain percentage of pupils participated in the kerbside recycling scheme at home, then the school would win a cash prize.

You will be pleased to hear that at Penygawsi Primary, 90% of pupils involved in the pledge scheme recycled at home. This means the school receives a £200 cash prize from the School of Engineering! Additionally the S.O.R.T – Team are kindly donating a frog shaped recycling bin for the playground!

We thank you for taking part in Rhondda Cynon Taf County Borough Council's kerbside recycling scheme. All your comments in the recycling survey were very useful and will be passed on to the Council in a report.

Picture shows: Rhondda Cynon Taf Council - Sort Out Recycling Together (SORT) Team, with pupils from a trial school pledging to recycle at home.

Most importantly! Please continue to take part in the recycling scheme now the pledge is over. THANKS.

Figure 7.8 Feedback letter to parents post the waste education programme (front)

Figure 7.8 Feedback letter to parents post the waste education programme (reverse)

Figure 7.9 Finale assembly with presentation of prizes to school

7.3 LOCATIONS OF THE TRIAL SCHOOLS

There were six trial schools in the waste education programme and one control school. Two schools were chosen by RCTCBC from each of the three local authority areas that had been combined in 1996 to make up the unitary authority of RCTCBC. The choice of schools reflected the old geo-political history of the area with two schools chosen from each of the three local authorities that now make the unitary authority. Llwydcoed and Cwmdare Primary Schools were chosen from the Cynon Valley, Pentre and Ton Pentre Primary Schools from the Rhondda Valley, and Penygawsi and Pontyclun Primary Schools were chosen from the Taf-Ely region. Dolau Primary School, also located in the Taf-Ely region, was chosen by the authority as the control school. The locations of schools within the RCTCBC boundary are shown in Figure 7.10.

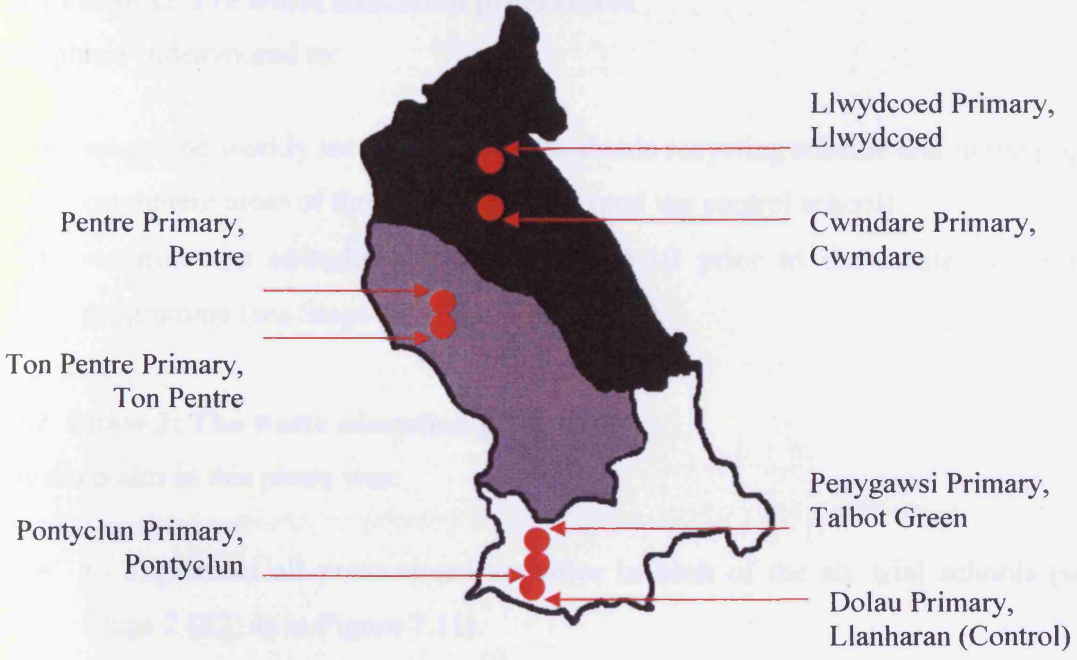


Figure 7.10 Location of trial schools within RCTCBC's boundary

7.4 CONTAINMENT OF THE AWARENESS MESSAGE

From June 2003, the SORT team had been active in waste awareness throughout RCTCBC. Activities had included dissemination of information through stands at supermarkets, schools, and other events (see Appendix 6.3 for a full list of SORT Team activities from June 2003 to April 2004). From June 2003 to the end of January 2004 (during the waste education programme), the SORT Team attended 38 school

assemblies, staffed stands for a day in 16 supermarkets, and also staffed stands at 11 special events. It should be noted that efforts were made to contain the awareness message within the trial schools' catchment areas (a map of each trial school's catchment area can be found in Appendix 7.2).

7.5 WASTE EDUCATION PROGRAMME TIMETABLE

The project was divided into three main phases as listed below:

- Phase 1. Pre-waste education programme
- Phase 2. The waste education programme
- Phase 3. Post-waste education programme

7.5.1 Phase 1: Pre waste education programme

This phase endeavoured to:

- assess the weekly set out rate in the kerbside recycling scheme and in the pupil catchment areas of the six trial schools (and the control school).
- examine the attitudes of pupils aged 6-10 prior to the waste education programme (see Stage 1 (S1) in Figure 7.11).

7.5.2 Phase 2: The waste education programme

The main aim in this phase was:

- to implement all promotional activities in each of the six trial schools (see Stage 2 (S2) as in Figure 7.11).

7.5.3 Phase 3: Post waste education programme

In this phase, the main objectives were:

- to examine material capture and quality, by performing a post waste education programme recyclable waste classification.
- examine the attitudes of the same pupils aged 7-11 after the waste education programme (see Stage 3 (S3) in Figure 7.11).

The waste awareness campaign timetable is shown in Figure 7.11.

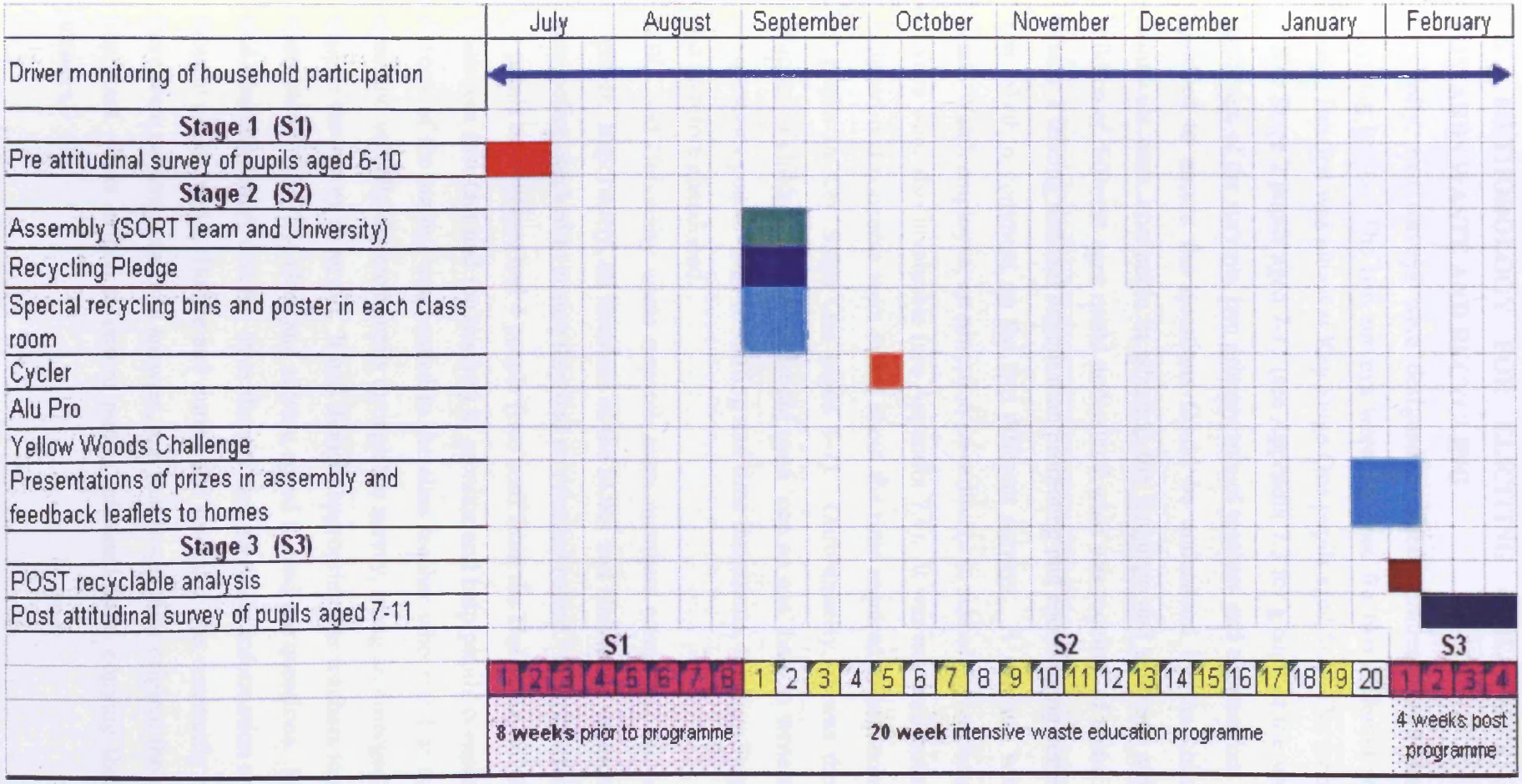


Figure 7.11 The waste education programme timetable 2003 - 2004

7.6 METHODOLOGY FOR ELICITING CHILDREN'S ATTITUDES TOWARDS WASTE AND RECYCLING

Originally, two surveys were designed to elicit children's attitudes and current recycling habits. The two surveys were designed for two different school learning levels. The first was aimed at Key Stage One pupils aged 5-7. The second was aimed at Key Stage 2 pupils aged 7-11 (see Appendix 7.3 for a copy of the survey). During the design of the surveys, two primary school teachers and a classroom assistant were involved to ensure the questions Could be understood by the children. Their comments were invaluable in adapting the language and sentence structure so that children of different ages could understand what was required of them. Also, Waste Watch, a leading national organisation promoting and encouraging action on the 3 Rs, was asked to comment on the two different surveys. A meeting was held with a Waste Watch employee, an education co-ordinator in schools. Her comments on both surveys were also invaluable (see Appendix 7.4). It was not until both surveys were designed that concerns were raised about the time required to implement the survey for pupils in Key Stage One (aged 5-7). Unfortunately, it was thought that the majority of children at this age would need 'one on one' help to write the answers to the questions posed. Due to staffing and time limitations, the Key Stage One survey was therefore abandoned.

SORT and University waste research team members completed the surveying task together. Importantly, all members of the SORT and University waste research teams were police checked to ensure they had no criminal record. Each classroom of around 30 pupils on average, had 4 people (two staff from the University or SORT Team, a classroom assistant and the teacher) to monitor and help pupils complete the survey. A copy of the survey was handed to the class teacher who stood at the front of the class and verbally directed pupils through the survey, using an enlarged laminated A2 copy of the survey as an aid. It was thought appropriate for teachers to do this as they knew the pupils in the class and at what speed to read the questions. Pupils were not told what the survey was for, other than its aim, to gather information about what they thought about waste. Before and during the survey it was constantly reinforced that there were no wrong or right answers, and that it was their original thoughts that were important. This helped to ensure pupils refrained from copying their neighbours' answers.

Over 700 pupils were surveyed twice across the six trial schools and the control school. Both surveys were conducted on pupils aged 7-11. The first survey prior to the waste education programme was conducted in July of 2003 and the second post the waste education programme in March 2004. During this period the 10-11 year olds in the first survey had moved up to secondary school so the survey was not conducted with exactly the same children, although they were from the same school. After the survey, the data derived were inputted into a spreadsheet and analysed.

7.7 METHODOLOGY FOR THE SCHOOL RECYCLING PLEDGE INITIATIVE

The recycling pledge initiative was launched in September 2003 by the University waste research team in an assembly for pupils (see Section 7.2.1). An example of the Pledge has been presented in Figure 7.1. Each child at the Key Stage 2 level (aged 7-11) was given a recycling pledge form in a 'goodie bag' (see Section 7.2.2 for more information) distributed during the assembly. Those households who signed the Pledge were inputted into a 'data protected' database so that a list of 'participating' addresses could be generated. Driver set out rate surveys were filed at the end of the day and individual households' set out data in all six trial school areas and the control school area were inputted into a spreadsheet on a weekly basis.

7.8 METHODOLOGY FOR TARGETED RECYCLABLE WASTE ANALYSIS

Two schools, Ton Pentre and Penygawsi Primary Schools, were chosen specifically for the targeted recyclable waste analysis as their responses had been the best of the six trial schools in the initial stages of the waste education programme, such as in the "recycling pledge" scheme. The control school, Dolau Primary School, was also included in the analysis. It was thought relevant to observe if there had been any change in dry recyclate (non green waste) and Recyclate Awareness Index Score (for details about the RAI Score see Chapter 6, Section 6.4.1) of households with a child that had been subjected to the schools' waste education programme. Green waste was collected in the analyses and its mass recorded. However, any change in green waste diversion was not thought a fair reflection of the effectiveness of the waste education

programme as not all households had a garden and arisings are seasonal and are affected by weekly weather patterns.

7.8.1 Sample size in recyclable waste analysis

In the week commencing 9th February 2004, clear bags from households identified were collected separately from the normal kerbside collection and taken to a test hall. Under normal circumstances, approximately 500kg (waste from ~60 households) would have been collected per analysis (Emery et al. 2002), but due to the smaller number of households from whom it was collected (those actually taking part in the Pledge scheme) the amount in all three analyses was reduced to around 250 kg per sort.

7.8.2 Material categories and sorting procedure

Twenty-seven receptacles, one for each material sub category, of varying size were arranged in a rectangular shape around the tipping/sorting floor within the test hall. The receptacles were grouped in their main categories to aid the sorting process. The 27 sub categories were:

- Paper – Newspaper, Magazines, Junk Mail, Directories, Office Paper, Card Packaging, Composite Packaging and Other Paper.
- Plastic – PET Bottles, HDPE Bottles, Plastic Carrier Bags, RCT Recycling Bags, Plastic Film and Other Plastic.
- Glass – Glass Bottles, Glass Jars (Clean) and Glass Jars (Dirty)
- Metals – Ferrous Drinks Cans, Aluminium Drinks Cans, Ferrous Tins (Clean), Ferrous Tins (Dirty), Foil, Other Non Ferrous and Other Ferrous.
- Green – Kitchen Waste and Garden Waste
- Other Waste

Of these 27 sub-categories, the following are not requested by the Council: Other Waste, Other Metals (both Ferrous and Non Ferrous), Plastic Film, Other Plastic, Composite Packaging, and Other Paper.

Receptacles storing the sorted recyclate were of varying sizes because previous waste analyses had shown that differing volumes could be expected in the collected waste. For example, PET and HDPE Bottles, Newspapers and Card Packaging were expected to be abundant in volume, therefore larger wheeled bins were used to receive these. Conversely as the expected volume of Ferrous Tins and Glass Jars was not expected to be large, 45 litre boxes, similar to those used in the initial Rhondda Kerbside Trial, were the chosen receptacles. If the volume collected exceeded the volume of available receptacles, extras receptacles could be provided without inconvenience.

Figure 7.12 Arrangement of Receptacles around the Sorting Area

The collected materials were deposited directly from the collection vehicle onto the sorting area (shown in Figure 7.12), to ensure that any materials from bags that had been damaged in transit were included in the analysis. The author of this thesis project managed the experiment, including the recyclate collection and sorting. Under the author's guidance, University and Council members of staff were directed to manually sort each bag's contents into the various receptacles.

Plastic Bottles were classified by inspecting the material for markings denoting their composition, based on the 1-7 scale of recyclable plastics, where PET is #1 and HDPE is #2. Figure 7.13 shows the respective receptacles containing plastic bottles.

Where a clear marking was not present, the material was classed as Other Plastic. Metal drinks cans were classified using a magnet. Clean and dirty glass jars and tins were classified based on volunteers' judgement, but, as a rule of thumb, they were classed as clean if an effort had been made to wash them, such as removal of labelling and the majority of residual contents had been washed out.

Figure 7.13 Separation of PET and HDPE Bottles

There was the slight possibility of cross contamination within the main categories of waste, for example, junk mail may have been deposited in the 'other paper' receptacle or plastic film may have been placed with the other plastic. Provided that this did not occur regularly, it was possible to ignore these occasional mistakes as the mass of each individual piece of waste was insignificant compared to the total mass at the end.

Once the sort was completed, each receptacle was weighed using a spring balance and recorded, (see Figure 7.14). Recorded weights were logged and compared against tare weights of the receptacles to gain a net weight of recyclable material. This value could then be used to calculate the mass for a household per week.

Figure 7.14 Weighing a Full Receptacle using a Spring Balance

Figure 7.15 Sorting the Bottles into Respective Categories

Once the weights had been recorded, the second phase of the experiment began. PET and HDPE bottles were separated into categories as requested in the information letter (see Chapter 6, Section 6.2.3). Each receptacle was emptied onto the sorting floor in

turn (Figure 7.15) and PET and HPDE bottles were separated into three categories – crushed, partly crushed and uncrushed, shown in Figure 7.16. The quantity of bottles in each pile was counted so that the percentage for each category could be calculated. The categories were then sub divided into bottles with tops removed and those with tops still on, and counted. A visual estimate was then made to assess the proportion of the total that had been washed out. The results from this experiment provided an indication of how well the information given to residents had been absorbed.

Figure 7.16 Sorting Plastic Bottles into Sub Categories

The switch by the case study authority to the clear bag scheme removed the need to adjust the values for moisture contamination. The clear bags did not allow any moisture (rain) in contrast to the previously trialled box receptacle which had no lid provided, hence the recyclate was exposed to the elements.

7.9 RESULTS - CHILDREN'S ATTITUDES TOWARDS WASTE

Over 700 pupils were surveyed twice. They were all aged between 7-11 and from the six trial schools and the control school. Due to space constraints and the fact that claimed and intended recycling behaviour has been shown to have no correlation with

actual recycling behaviour (see Chapter 5, Section 5.6.1), only significant results from the attitudinal survey, pre and post the waste education programme, are discussed here. The survey was conducted not only to assess pupils' knowledge of recycling but also to examine parents' recycling behaviour. It was hoped that educating children on waste awareness could influence their families' recycling behaviour at home. For this reason, Question 12 was included to assess how much of a potential there was for information given to pupils to be passed on to their parents, see Figure 7.17.

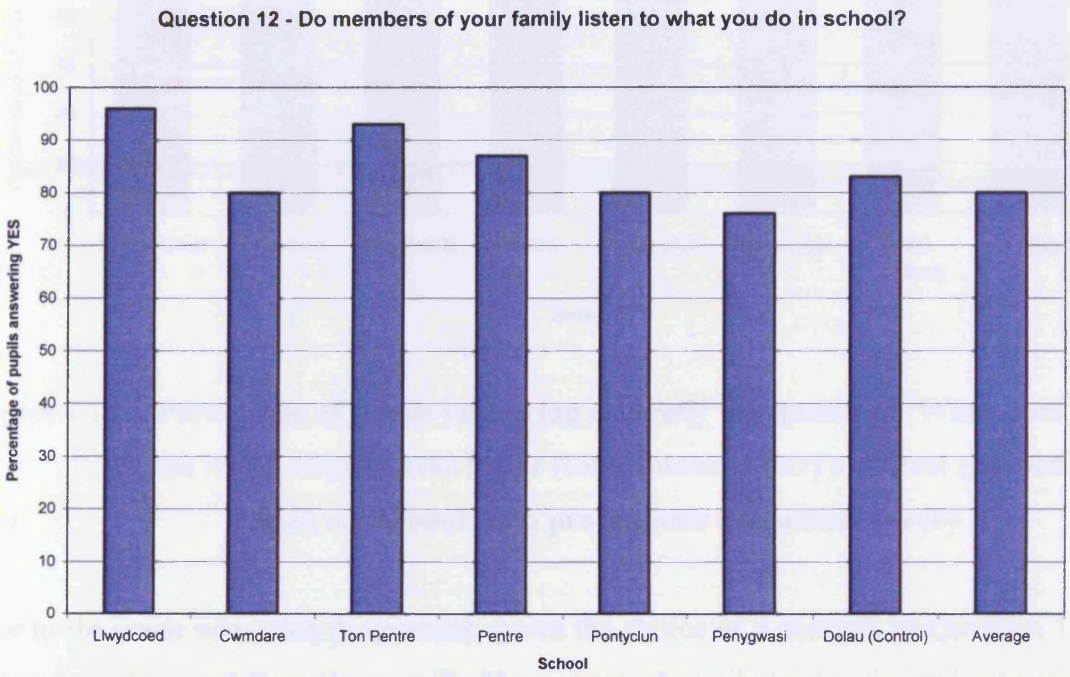


Figure 7.17 Percentage of families where the child's school work is discussed at home

It was encouraging to note that, on average, 80% of pupil's indicated thought that their families listened to what they did in school, inferring that any material given to pupils as part of the Schools' Pledge Initiative was likely to be passed onto parents. All data from the pupils' survey can be found in Appendix 7.5.

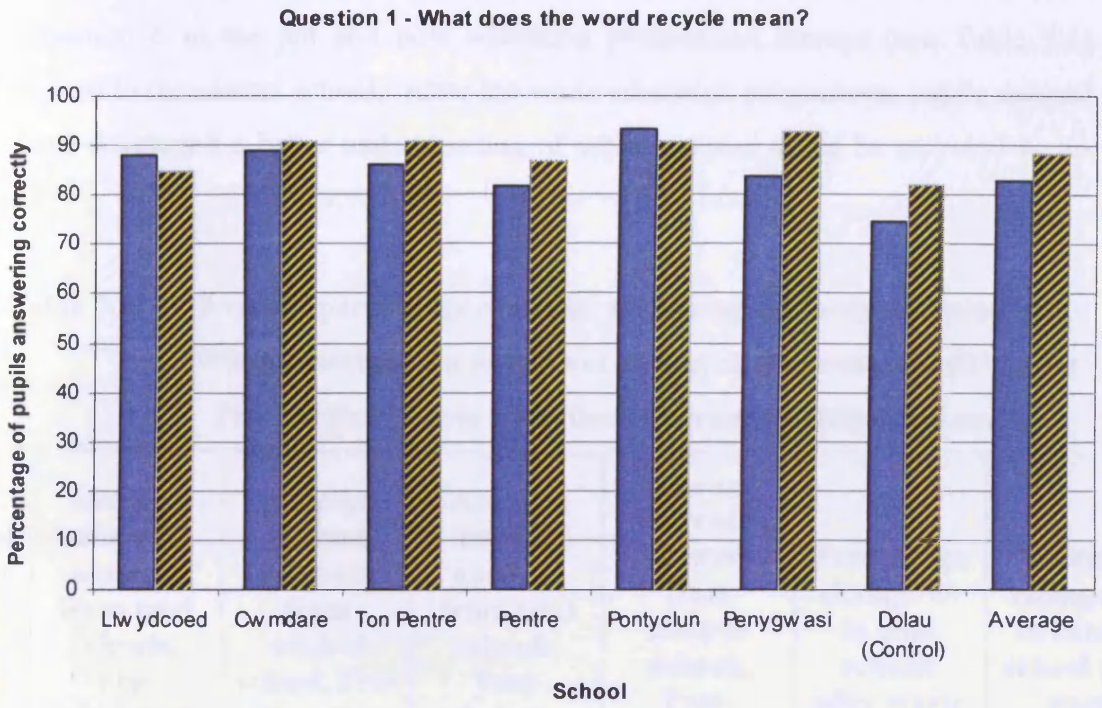


Figure 7.18 Percentage of pupils answering correctly the question: 'What does the word recycle mean?' Pre (solid coloured bar) and Post (striped bar) waste education programme attitudinal survey

Prior to the waste education programme, given the choice of 4 answers to Question 1 (What does the word Recycle mean?), 83 per cent of pupils in the six trial schools answered correctly (see the solid coloured bars in Figure 7.18), whereas the control school recorded a percentage below this. In the second survey, after the waste education programme, correct answers to Question 1 increased to an average of 89 per cent (see the striped bars in Figure 7.18). Statistically, *z* values over 2.56 at $P<0.01$ indicate a highly significant difference between the samples (Wheater, C. et al. 2000). A significant difference (*z* value= 3.24 at $P<0.01$) was found between the Pre (83%, SD +/- 0.64, n = 698) and Post (89%, SD +/- 0.44, n=657) waste education programme attitudinal survey percentage of pupils correctly answering the question on 'What does the word recycle mean?'

However, although statistically significant (due to the large sample sizes n=698 and n=657) the cause of this 6 per cent increase can not be solely attributed to the waste education programme because the number of pupils achieving the correct answer in the control school also increased significantly.

A large shift in pupils' awareness of recyclate was observed between their responses to Question 6 in the pre and post education programme surveys (see Table 7.1) compared to the control school. After the waste education programme, pupils seemed to have developed a better understanding of what material could be recycled or re-used.

Table 7.1 Average percentage of pupils answering correctly the question: 'What materials can or can not be recycled or composted?' in the Pre and Post waste education programme attitudinal survey

Material that 'can or cannot be recycled or reused?'	Average correct answers from trial schools, Pre-education programme attitudinal survey	Average correct answers from control school, Pre-education programme attitudinal survey	Average correct answers from trial schools, Post-education programme attitudinal survey	Average correct answers from control school, Post-education programme attitudinal survey	Percentage change +/- in trial schools after waste education programme	Percentage change +/- in control school after waste education programme
Plastic bottles	90	87	91	85	1	-2
Comics	75	81	88	84	13	3
Banana skins	9	12	64	14	55	2
Drinks cans	49	61	93	55	44	-6
Glass bottles	67	72	87	68	20	-4

Pupils from all six trial schools were asked pre and post the waste education programme whether or not they thought the material items shown in Table 7.1 could be recycled or reused. The percentage of pupils that knew plastic bottles could be recycled or reused was very high in both pre and post waste education programme surveys of the trial schools, 90 and 91 per cent, respectively. However, less than 10% of pupils in the trial schools thought banana skins could be recycled or reused before the education programme, compared to 64 per cent after its implementation (a change

of 55 percentage points). In the control group, only 2 percentage points more of pupils thought banana skins could be recycled/reused after the waste education programme, highlighting the effect the waste education programme had had on those pupils exposed to it, i.e. they had greatly extended their knowledge on what materials can or can not be recycled or composted?'.

On the whole, attitudes towards waste and recycling seemed to have evolved during the waste education programme. On average, pupils subjected to the waste education programme had gained a better understanding of the Council's recycling scheme. Children had become very receptive to the notion of the 3 Rs. Sections 7.9 and 7.10 examine whether this increased awareness and understanding resulted in a change in recycling behaviour at home.

7.10 RESULTS – "RECYCLING PLEDGE" INITIATIVE

The response to the "recycling pledge" initiative varied across the six participating schools. Table 7.2 shows that only 3 schools were able to claim prizes for returned pledges, and only one of them, Penygawsi, claimed the £200 prize for a 90 per cent return. Ton Pentre and Llwydcoed Schools both received the £50 prize.

The intended set out (calculated from the number of pledges returned) was above the actual weekly set out of households in the schools' catchment areas, with the exception of Pentre Primary School where pledge returns were lower (47%) than actual weekly set out (48%) see Table 7.2.

Two schools were chosen for further analysis, Ton Pentre from the Rhondda area and Penygawsi from the Taf-Ely area. Four different kerbside recycling behaviours could now be compared. In the first instance, claimed pupil set out could be assessed from the 'pre' education programme survey, secondly claimed parental set out in the scheme could be assessed from the household waste survey on the pledge form, thirdly intended set out could be assessed by the number of pledges returned, and, finally, actual set out in the school catchment area was recorded by drivers. The weekly household set out rate recorded by drivers could then be calculated for each, street, each collection round, and consequently for households in each of the trial schools' catchment areas. Figure 7.19 shows a large difference (30 to 50 per cent) between pledge returns (blue bar) and actual area set out (green bar).

Table 7.2 **The number of pupil households intending to and actually setting out in the kerbside recycling scheme, based on "recycling pledge" returns from each school**

School	No. of Pupils in Pledge Scheme	No. of Returned Pledges	Intended set out	Actual weekly set out rate in schools catchment area **
Pentre	72	34	47%	**48%**
Ton Pentre (School A)	131	93	72%	
Llwydcoed	79	46	58%	**33%**
Cwmdare	130	55	42%	
Dolau (Control)	179	n/a	n/a	**40%**
Penygawsi (School B)	84	75	90%	
Total	801	303	62%*	40%*

** Denotes average weekly set out from all schools, un-weighted mean.*

*** Calculated from SORT team data 01/04 - 02/04.*

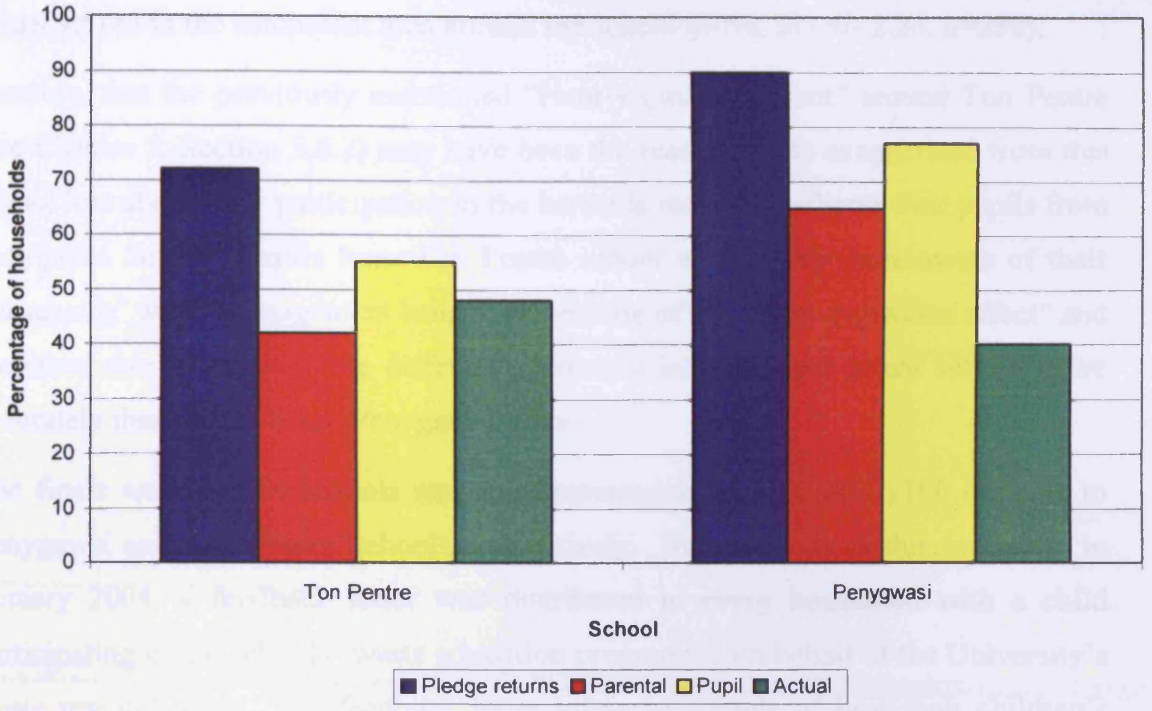


Figure 7.19 The percentage of pupils' households set out rates: intended, claimed by parent via pledge, claimed by child via attitudinal survey and actual set out in schools catchment area.

Actual set out in the catchment area around Ton Pentre school (48%, SD +/- 1.88, n=336) was greater than the actual set out in the catchment area around Penygawsi school (40%, SD +/- 2.26, n=280) because of the previously mentioned "Nant-y-gwddon effect" around Ton Pentre (see Chapter 5, Section 5.6.2).

Nevertheless, Figure 7.19 shows the exaggerated claimed set out by pupils who took part in the attitudinal survey. Over 50 per cent of pupils surveyed in Ton Pentre School claimed they were taking part in kerbside recycling at home, whereas set out claimed by parents in the Schools pledge survey was around 40 per cent. The Schools pledge survey can be observed in Appendix 7.6. Statistically, z values over 2.56 at $P<0.01$ indicate a highly significant difference between the samples. A significant difference (z value= 41.1 at $P<0.01$) was found between claimed pupil participation in households from Ton Pentre school (55%, SD +/- 3.93, n =72) and actual set out in the catchment area around the school (48%, SD +/- 1.88, n=336). An even greater significant difference (z value= 183.9 at $P<0.01$) was found between claimed pupil

participation in households from Penygawsi school (77%, SD +/- 4.20, n =65) and actual set out in the catchment area around the school (40%, SD +/- 2.26, n=280).

Possibly, that the previously mentioned "Nant-y-gwddon effect" around Ton Pentre (see Chapter 5, Section 5.6.2) may have been the reason pupils exaggerated from this school less about their participation in the kerbside recycling scheme than pupils from Penygawsi School. Pupils from Ton Pentre school were likely more aware of their households' waste management behaviour because of the "Nant-y-gwddon effect" and therefore able to identify the difference between intended and actual set out more accurately than pupils from Penygawsi school.

The finale assembly in schools saw the presentation of £200 and £100 cheques to Penygawsi and Ton Pentre Schools, respectively. Subsequently to this assembly, in January 2004, a feedback letter was distributed to every household with a child participating in the schools' waste education programme on behalf of the University's waste research team. The feedback letter informed parents of how their children's schools had performed in the trial. The reverse of this feedback letter contained extra information about recycling in RCTCBC. The letter asked for recipients' continued support of the kerbside scheme, despite the end of the pledge initiative. A copy of this letter can be found in Figure 7.8. The SORT team also donated a frog shaped recycling bin to each school shown in Figure 7.9, as a 'thank-you' for participating in the programme.

7.11 RESULTS - RECYCLABLE WASTE ANALYSES OF TARGETED HOUSHOLDS

The results of recyclable waste analyses of pupils' household wastes from Ton Pentre, Penygawsi Primary and Dolau Primary Schools are discussed in this section. Due to the smaller number of pupil households actually setting out on the day of analysis (those actually taking part in the Pledge scheme) the total amount of waste collected per round was less than in any previous waste analyses (see Section 7.8.1). Nevertheless, the number of households collected from was still a statistically representative sample size (Parfitt et al. 1997).

Table 7.3 shows the amounts of waste collected from each household with a child at Ton Pentre, Penygawsi or Dolau School. If it is assumed that the recyclate put out for

collection from each household is 100% recyclable (i.e. no un-requested items), the amounts presented would suggest that the waste education programme had increased diversion in Penygawsi school households 1.3 kg above Dolau school control households. However, a number of factors need to considered. The choice of control school may have influenced the higher diversion observed from households of pupils attending Penygawsi school than that from households of pupils from Ton Pentre school. Penygawsi and Dolau schools are located near each other and draw their children from catchment areas with similar socio-economic characteristics, whereas the area surrounding Ton Pentre school is more socially and economically deprived. Moreover, it has been shown that a more affluent area such as the pupil catchment area around Penygawsi and Dolau school is likely to put out more recyclate than a less affluent area, such as the catchment area around Ton Pentre (Cardiff University, 2003). This would mean that, ordinarily, a difference would be expected between the observed diversion of recyclate from Dolau and Ton Pentre. However, possibly due to the waste education programme, the diversion observed from households of pupils from Ton Pentre School (6.87 kg per household) was similar to that from the households of pupils from Dolau (control) school (6.78 kg per household) in a more affluent area where pupils were not subject to the waste education programme. The reader is reminded of all the waste analyses that have taken place in RCTCBC todate by observing Table 7.4.

Table 7.3 Total mass of recyclate collected per week from households with a child at Ton Pentre, Penygawsi or Dolau School (February 2004)

	Households of pupils aged 7-11 in February 2004 analyses		
	Ton Pentre School	**Penygawsi School**	**Dolau Control School**
Total mass of recyclate collected (kg)	240.6	267.2	305.2
Number of households	35	33	45
Mass of recyclate per household (kg)	6.87	8.10	6.78

Table 7.4 Waste analyses conducted todate in RCTCBC

	1999	2000	2002	2003	2003	2003	2004
	Summer	Summer	October	February	August	November	February
Full household waste analysis	X	X					
Recyclable waste analysis			X	X	X	X	X
Rhondda area			X	X	X	X	X
			Box	Clear bag	Clear bag	Clear bag	Clear bag
Cynon area	X	X	X	X	X	X	X
	Black bag	Black bag	Carrier bag	Clear bag	Clear bag	Clear bag	Clear bag
Taf Area			X	X	X	X	X
			Clear bag	Clear bag	Clear bag	Clear bag	Clear bag
Targeted		Different housing stock	Different storage receptacles	All households	All households	Households subject to awareness techniques	Households of pupils subject to schools waste education programme

Previous waste analyses conducted (Cardiff University 2002, August 2003) suggest there will be some contamination of recyclables with materials that cannot be recycled or are not requested as part of the scheme as shown in Table 7.5.

Table 7.5 The percentage of unrequested recyclables from households of pupils in the February 2004 analyses, compared to average household diversion in RCTCBC (2003)

	Households of pupils aged 7-11 in February 2004 analyses			Average household August 2003
	Ton Pentre School	Penygawsi School	Dolau Control School	
Percentage (%) of un-requested recyclables	15.0	13.5	24.4	12.4

The recyclable waste analysis of February 2004 targeted households with the known presence of at least one child aged 7-11 (as indicated in Table 7.4). Table 7.5 compares the findings from the targeted February 2004 analyses with those derived from an analysis of the average household diversion in RCTCBC in August 2003 (see Table 7.4). Table 7.5 shows that contamination of recyclables with un-requested materials was higher among households of the control school (24.4 per cent by weight) than among households involved in the waste education programme (between 15 and 13.5 per cent by weight).

The table also compares findings from the February 2004 analyses with those derived from an analysis of the average household diversion in RCT in August 2003.

Figure 7.20 shows material categories from the February 2004 and August 2003 analyses in kg per household per week compared with the amount of material requested by the Council from households. The amount of dry recyclables in the February 2004 analyses was 2 kg more per household per week in all households with a child aged 7-11, than in the August 2003 analysis. Green Waste contributed very little to recyclables in the February 2004 analysis when comparing to the August 2003 analysis, where it contributed over a third of the total mass of recyclables. Materials that were classified as 'other waste' did not vary much between the households of pupils from Ton Pentre and Penygawsi schools participating in the waste education programme and the average weight observed in the August 2003 analysis. However, there seemed to be a lack of understanding of what materials are requested in the kerbside scheme among households with a child aged 7-11 from the control school, Dolau, since they put out the most 'other waste', at 0.53 kg per household per week

(see Figure 7.20). Figure 7.20 shows that the amount of dry recyclables put out by households with a pupil from a stimulated school was between 5.7 – 7 kg per household per week. This is just over the amount the Council would expect if all requested dry recyclables were diverted from the waste stream. A more detailed analysis and explanation of findings is to be found in Section 7.9.2.

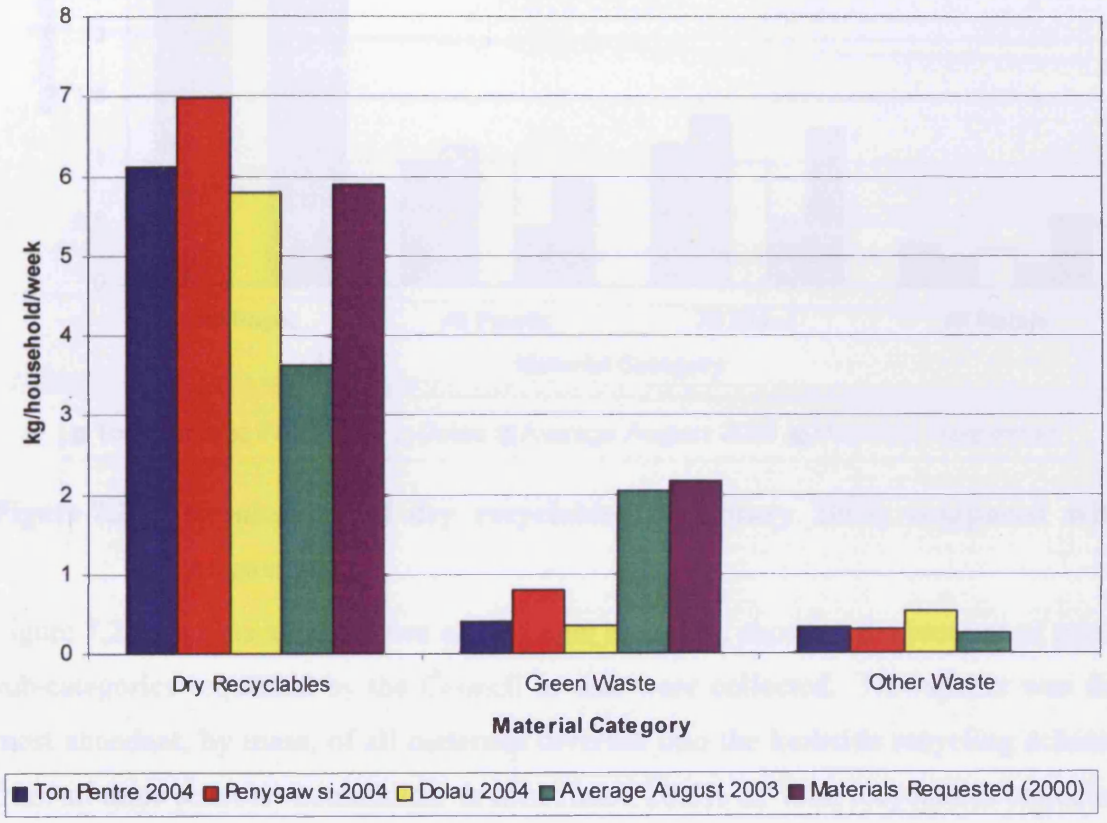


Figure 7.20 Comparison of material category diversion (February 2004) with the August 2003 result

Figure 7.21 presents a breakdown of dry recyclables into the main categories requested. The mass per household included all material, requested or unrequested in that category.

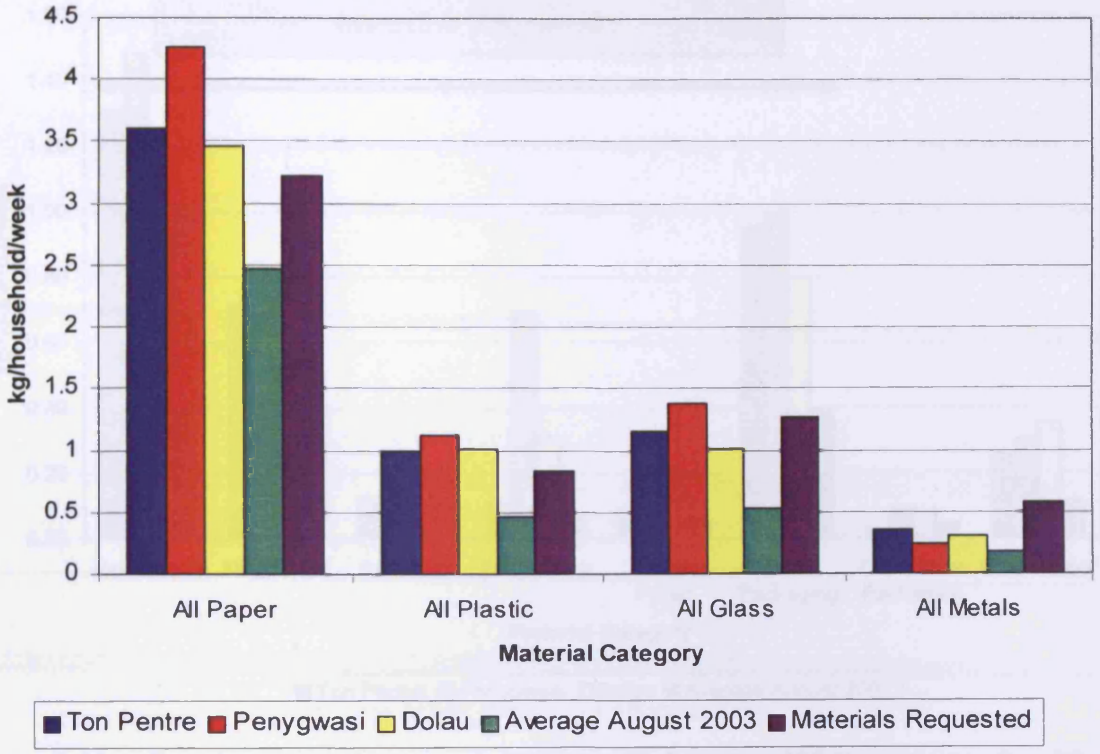


Figure 7.21 Breakdown of dry recyclables (February 2004) compared with August 2003

Figure 7.22 presents a breakdown of the paper category, showing the amount of paper sub-categories requested by the Council to that were collected. Newspaper was the most abundant, by mass, of all materials diverted into the kerbside recycling scheme from all three schools' households. It constituted 20.5% of total recyclables collected in Ton Pentre, 19.1% in Penygawsi, and 18.9% in Dolau. Therefore, unsurprisingly, the paper category comprised the majority of all dry recyclables. Figure 7.22 shows the households of pupils subject to the waste education programme diverted more paper than the control school, and all four material categories of dry recyclables exceeded the average collected in August 2003 (see 7.9.2).

Collection of directories had increased considerably in the Penygawsi area compared to the 2003 Borough average. However, the mass of one directory is much greater than any other subcategory of paper and, therefore statistically, only a small number of collected directories are needed to increase the mass per household. It should also be noted that operation of the Yellow Woods Challenge (see Section 7.2.7) at that particular time could have affected the 'normal' diversion results for the paper sub-category of directories.

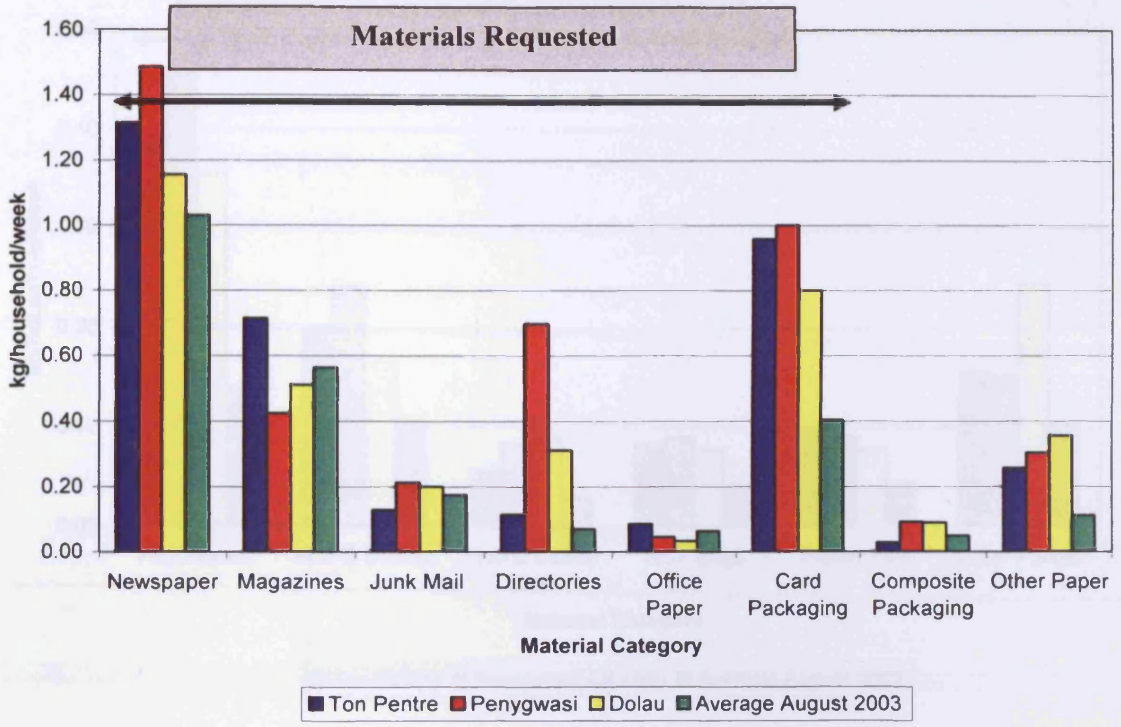


Figure 7.22 Breakdown of paper category (February 2004) compared with August 2003

The mass of cardboard packaging per household with a child aged 7-11 was at least double that found for the average household in 2003. The total mass of paper was also greater in households with a child aged 7-11 (see Section 7.9.2), as shown in Figure 7.21, and a contributory factor was an increase in Other Paper collected in all three areas. The total mass of paper, anticipated by the Council for kerbside diversion if an average household were to put out all their predicted potential based on the full waste analysis carried out in 2000, is 3.22 kg per household per week. The amounts collected from households with a child aged 7-11 from Ton Pentre, Penygawsi and Dolau schools were 3.31 kg, 3.86 kg, and 3.01 kg, respectively. Both areas participating in the waste education programme exceeded 3.22 kg per household (see Section 7.9.2), although the mass collected in Penygawsi was buoyed by the amount of directories collected. Figure 7.23 presents a breakdown of the plastic category, showing the amount of plastic sub-categories that the Council requested to be put out for collection and those sub-categories that were not. The mass of material collected was greater than August 2003, in all areas in every material sub category, (see Section 7.9.2).

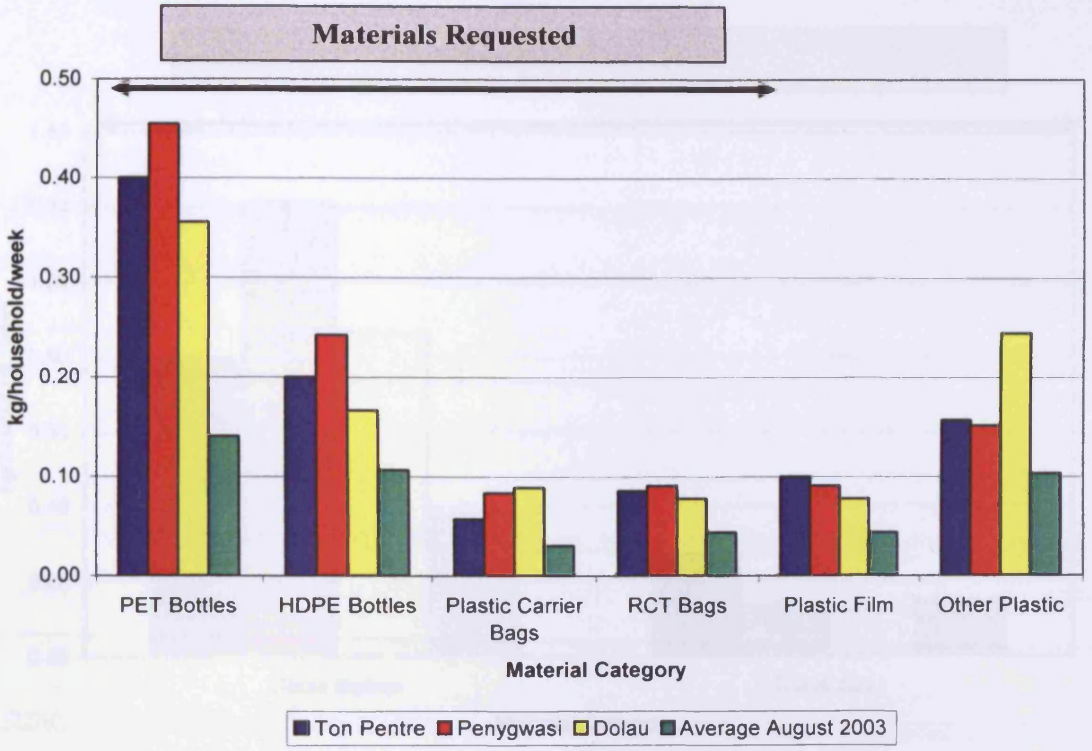


Figure 7.23 Breakdown of plastic category (February 2004) compared with August 2003

Figure 7.23 indicates that PET and HDPE bottles constituted the majority of plastic sub-categories diverted from households of pupils from all three schools, 60 per cent by weight in Ton Pentre, 62 per cent in Penygawsi, and 51 per cent in Dolau. Figure 7.24 presents a breakdown of the glass fractions collected as part of the waste analysis. It shows the mass of glass bottles collected from households with a child aged 7-11 was more than twice the amount diverted by the average household in August 2003 (see Section 7.9.2). Glass is recognised as one of the most popular materials collected by recycling schemes (Emery et al. 2002) and this was reflected in the results. By mass, glass was the second most abundant of the main categories of material, ranging from 16.1% of the total mass of recyclables from households of pupils from Dolau school to 17.4% households of pupils from Penygawsi school. The Council requests that all glass potentially in the full household waste stream is put out in its kerbside scheme, which corresponds to 1.27 kg per household per week based on the full waste analysis in 2000 of the average household (Cardiff University, 2000).

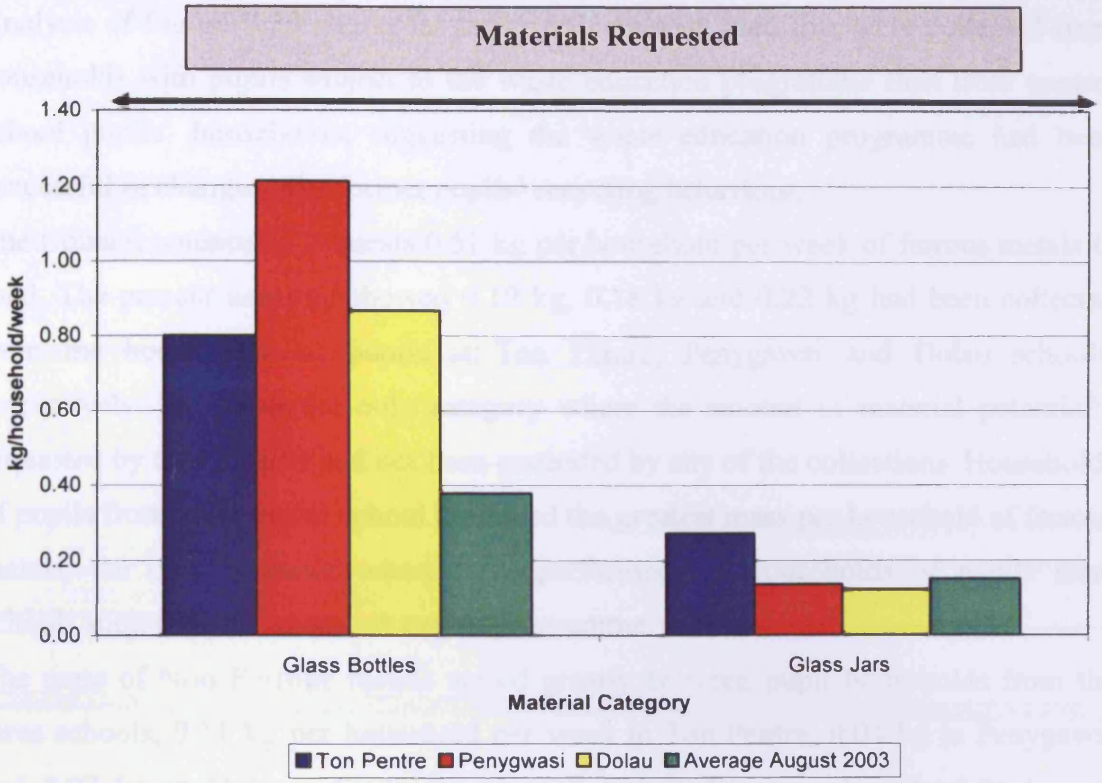


Figure 7.24 Breakdown of glass category (February 2004) compared with August 2003

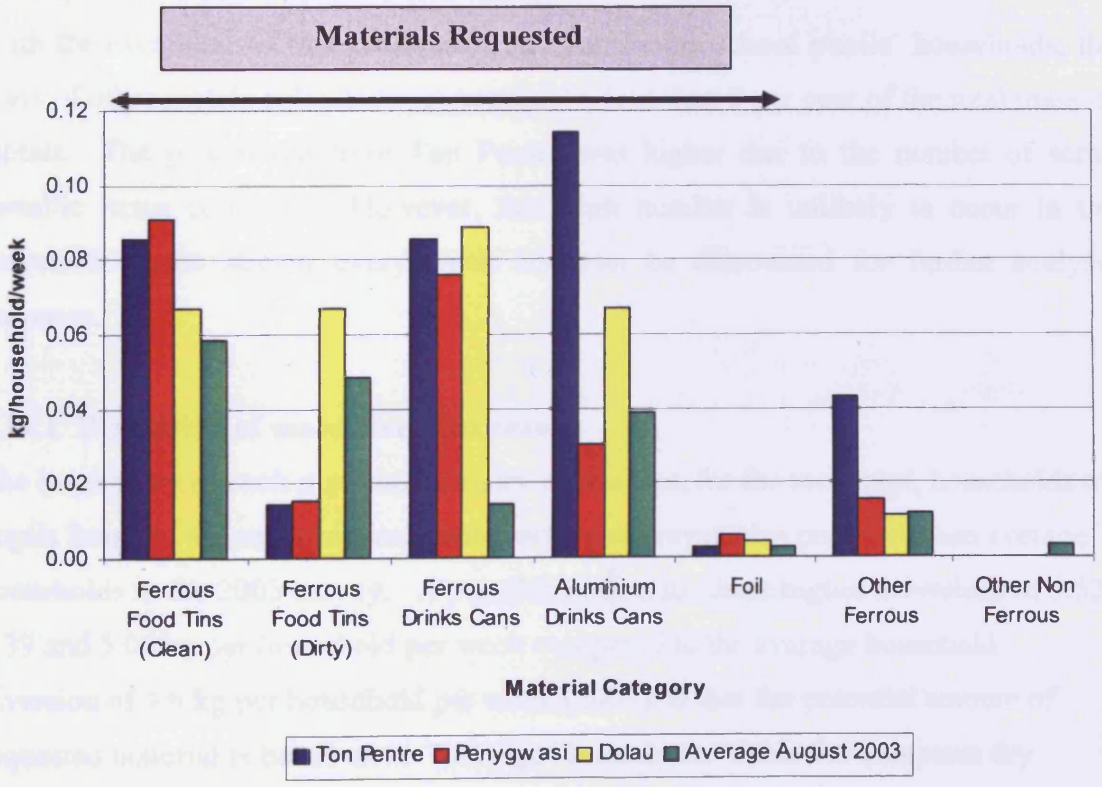


Figure 7.25 Breakdown of metal category (February 2004) compared with August 2003

Analysis of Figure 7.25 shows far fewer dirty ferrous food tins were collected from households with pupils subject to the waste education programme than from control school pupils' households, suggesting the waste education programme had been successful in changing the former pupils' recycling behaviour.

The Council potentially requests 0.51 kg per household per week of ferrous metals in total. The present analysis showed 0.19 kg, 0.18 kg and 0.22 kg had been collected from the households of pupils at Ton Pentre, Penygawsi and Dolau schools, respectively. This was the only category where the amount of material potentially requested by the Council had not been exceeded by any of the collections. Households of pupils from the control school produced the greatest mass per household of ferrous metals, the only instance where it outperformed the households of pupils from schools subject to the waste education programme.

The mass of Non Ferrous metals varied greatly between pupil households from the three schools, 0.11 kg per household per week in Ton Pentre, 0.04 kg in Penygawsi and 0.07 kg in Dolau. Since the Council potentially requests only 0.06 kg per household per week, households with pupils from Ton Pentre and Dolau schools exceeded the amount requested (see 7.9.2).

With the exception of that collected from Ton Pentre school pupils' households, the mass of other metals collected was negligible, less than 5 per cent of the total mass of metals. The percentage from Ton Pentre was higher due to the number of scrap metallic items collected. However, this high number is unlikely to occur in the recyclable waste stream every week and can be discounted for further analysis purposes.

7.11.1 Discussion of mass diversion results

The breakdown of each material category shows that, for the most part, households of pupils from the schools produced more requested recyclables per week than average households in the 2003 survey. A possible reason for these higher diversions of 5.52, 6.39 and 5.06 kg per household per week compared to the average household diversion of 3.6 kg per household per week (2003), is that the potential amount of requested material is based on an "average" household. Table 7.6 compares dry recyclate mass per household with mass of recyclate per person per week. The average number of people per household in RCTCBC at the time of study was 2.45 (231946 households/ 94553 number of people living in those households, National

Statistics 2005). The average number of people per household in households with a pupil aged 7-11 in the waste education programme was 4.15, taken from "recycling pledge" survey results. Therefore, households in the trial were probably generating more waste per household, due to more people per household to begin with. This would explain why trial households' diversion was greater than the average household diversion (2003) and why households were putting out more than the anticipated amount. Thus, it would not be fair to judge any change in material quantity during the schools waste education programme based on a unit change per household, the mass of material diverted per person, is the most appropriate indicator to use.

Table 7.6 Dry recyclate mass per household and per person according to of the 2004 analyses and the average household diversion in RCTCBC (2003)

	Households of pupils aged 7-11 in February 2004 analyses			**Average household August 2003**
	Ton Pentre School	**Penygawsi School**	**Dolau Control School**	
Mass of recyclate per household per week (kg)	5.52	6.39	5.06	3.36
Number of people per household	4.15	4.15	4.15	2.45
Mass of recyclate per person per week (kg)	1.33	1.54	1.22	1.42

The results shown in Table 7.5 show the mass of recyclate per person per week was 1.33kg and 1.54kg for households with children at Ton Pentre and Penygawsi schools respectively, compared to 1.22kg and 1.42kg for households with children at Dolau (control) school and the average household in RCTBC (2003), respectively. Comparing the mass of recyclate per person per week found in the RCTCBC (2003) survey with that reported in 2004 analysis derived from-the households with children attending Ton Pentre, Penygawsi and Dolau schools (Table 7.6) suggests the schools' waste education programme did not increase diversion significantly. In RCTCBC the full waste analysis conducted in 2000 suggested a potential 2.4 kg of requested dry recyclabes per person per week could be diverted from the full household waste stream. Therefore, even after pupils had been subject to the waste education

programme and their households were participating in the kerbside recycling scheme, 0.9 kg per person per week (37%) of potential requested dry recyclables was not being diverted away from landfill.

7.12 RESULTS - RAI SCORE

During the waste education programme, children and parents were asked specifically for certain types of recyclable material. In addition, the same messages were reinforced in all the different waste education activities. For instance, children were told to wash and squash plastic material and, where possible, to remove bottle tops. The RAI Score aimed to provide a tool for quantification of material quality (see Chapter 6, Section 6.4.1 for more details). The material quality or RAI Score was calculated from the recyclable waste analysis. The amount of unrequested material or contamination made up the first part of the RAI Score. Washing, squashing and removing tops are three activities that do not affect the recycling rate directly, however, they do affect other aspects of the recycling process. For this reason, they were also incorporated into the Recyclate Awareness Index Score whose components are listed below:

1 Percentage of unrequested material
2 Percentage of dirty food tins and dirty HDPE bottles
3 Percentage of unsquashed bottles
4 Percentage of squashed and unsquashed bottles with tops on

The overall RAI Score was extracted directly from the above four components. Table 7.7 shows the RAI Scores from the analyses of pupils' household material quality. Firstly, households with pupils from the control school (Dolau) and the average household August 2003 had similar RAI Scores, 5.6 and 5.7, respectively. Interestingly, the RAI Scores of households with children not subjected to the waste education programme were similar to those households that had also not been subject to any waste awareness programme (see Chapter 6, Table 6.9). Households in RCTCBC with children not subject to any waste education programme in schools or public waste awareness campaign were attaining a RAI Score of around 6 points. Households with children subject to the schools' waste education programme changed

behaviour to a degree similar to that of households subject to the waste awareness campaign presented in Chapter 6, Table 6.9.

Table 7.7 RAI Score results from the analyses of the material quality of households with pupils aged 7-11 (February 2004)

	Combining RAI Score components				
	1	**2**	**3**	**4**	**RAI Score**
Ton Pentre School	15	53.5	59	59	4.7
Penygawsi School	13.5	42	43	60.5	4
Dolau Control School	24.4	49	76	76.5	5.6
Average household Aug 2003	12.4	60	71.5	84	5.7

Households of pupils from Penygawsi school had a RAI Score of 4, 1.6 points less than households of pupils from the nearby Dolau (control) school (5.6), suggesting the observed change was not due to an area's socio-economic characteristics, but to the schools' waste education programme. The analysis of both 'Pre' and 'Post' RAI Score in Area 5 (the control area) of Chapter 6 (see Table 6.14), showed that the difference between 'Pre' and 'Post' was only 0.2 points. This indicates very little fluctuation in RAI Score without waste awareness stimuli.

Households of pupils from Ton Pentre school had a RAI Score of 4.7, 1 point less than the average household in RCTCBC 2003, and 0.9 points below the control school's value (5.6-4.7). It is thought that in addition to the schools' waste education programme, the 'Nant-y-gwddon effect' (see Chapter 5, Section 5.6.2) may have influenced the decrease in Ton Pentre's RAI Score.

Table 6.8 in Chapter 6, showed that the RAI Score changed after different waste awareness techniques, from between 0.9-1.3 points. This suggests the waste education programme in schools effectively changed recycling behaviour in the households of those children who participated in it, leading them to put out for collection less non-requested materials, less dirty materials, less un-squashed bottles, and more bottles with tops off. The results also indicate that the waste education

programme was more effective in changing households' RAI Score (a decrease of 1.6 points was recorded) than any of the previously trialled waste awareness techniques where the largest decrease was 1.3 points (see Chapter 6, Table 6.9).

7.13 CONCLUSIONS

Over recent years, waste minimisation and recycling projects at both national and local levels have been implemented in great number. Children are being taught about the 3Rs with the aim of improving social responsibility, citizenship and environmental awareness in schools. Many waste education initiative are being run in schools by various organisations. But no research other than attitudinal has been completed to quantify the effective of these programmes. Most of us are of the opinion that waste education of school aged children, as an integral part of the broader process of environmental education, is effective for the general improvement of waste management strategies. The results of this study actually quantify the effect of a trial waste education programme.

- Attitudes towards waste and recycling changed among pupils aged 7-11. After the waste education programme pupils were more aware of what materials they could recycle.
- Children aged 7-11 subject to the waste education programme took the recycling message home and changed their households' kerbside recycling behaviours, by reducing the RAI Score.
- The waste education programme was more successful than the public waste awareness campaign in lowering households' RAI Scores.
- Any change in the material quantity diverted during the schools' waste education programme should not be judged on the unit change per household. The mass of material per person is the most appropriate indicator to use.
- There is a clear role for waste education in schools. Although the waste education programme did not achieve a significant increase in the diversion of recyclate from the homes of pupils, it did provide an opportunity to educate school children about the benefits of recycling. Therefore, it can be said that despite no apparent significant improvements being gained (with the exception

of lowering the RAI Score), there is potential for long-term benefits by expanding the scheme – tomorrow's recyclers are being educated today.

CHAPTER 8

8 INCENTIVES FOR MEETING THE TARGETS

So, how can kerbside diversion of household waste be increased to meet the targets? In other words, how can the factors that affect kerbside recycling and composting discussed in Figure 4.3 be optimised?

Research has identified a range of financial and voluntary incentives aimed at improving the diversion of household waste through kerbside recycling schemes. They are explained under categorisations in the Scottish Executive study "Incentives for householders to change their waste practices" (Scottish Executive, 2005), and entitled financial/carrot, financial/stick and voluntary/carrot incentives. They are discussed in more detail below, together with other ways of increasing the diversion of household waste through recycling or composting.

8.1 Financial/carrot incentives

Individuals are encouraged to participate in a recycling scheme through a financial inducement. Financial/carrots incentivise individuals' sense of monetary value (Mitchel et al. 2005). Four generic types of financial/carrot identified by Mitchel et al. (2005) are:

- Prize draws (e.g. participating in recycling)
- Cash back incentives (e.g. subsidised real nappy scheme)
- Cash Rewards (e.g. 'cash for trash' schemes)
- Cash discounts (e.g. subsidised compost bins)

From our research in RCTCBC, 52.2 per cent of known non-participants were interested in prizes as a way to encourage recycling (See Chapter 5, Section 5.4.16), thus it would seem that financial/carrots incentives might be a popular type of incentive for local authorities to use (Mitchel et al. 2005). However, Chapter 7 of this thesis indicated that a cash reward given to an organisation (a school), in return for pupils' households' participation in the kerbside recycling scheme failed to significantly increase kerbside diversion.

There are many examples across the UK of various types of financial/carrot incentives, however, the schools' waste education programme detailed in Chapter 7 is the only scheme to-date whose effectiveness has been quantified.

Anecdotal evidence suggests that where local authorities have run prize draws, participation has not altered because the value of the prize (usually between £10 and £100) is too low for encouragement (London Borough of Barnet, East Hertfordshire District Council, London

Borough of Richmond upon Thames) (Mitchel et al. 2005). However, even the recently reported highest UK prize draw to encourage kerbside scheme participation among residents in Caerphilly County Borough Council did not lead to significantly increased participation. Residents' set out rate had been around 40% prior to the launch of the prize draw, where they could win a family car and numerous £200 cash prizes, and only increased to 43% after the year long publicity drive and prize incentives (Williams, 2005). This combined with results presented in Chapter 7, suggest that financial/carrot incentives are not achieving the desired results.

DEFRA, through a local authority pilot programme, is aiming to evaluate the effectiveness of a comprehensive range of such incentive schemes and to provide evidence for future policy development and guidance to local authorities on best practice. DEFRA has invested around £3.5 million in 51 pilot programmes. Incentive schemes range from community league tables with environmental enhancements for the winning area, to pledges leading to equipment for schools, although the most popular incentives appear to be lottery-style prize draws. A number of the proposed pilots will use waste weighing technology to measure accurately the impact of incentives. Incentives will be tested on a whole range of different target populations, ranging from villages to high-rise estates, and from the highest performers (where the focus is on waste minimisation and reducing contamination in recycling collections) to the lowest (where the focus is on encouraging more people to recycle). Attention should be drawn to methods used to determine the true effectiveness of the incentive schemes tested since this may not be known properly because in the "pre-scheme assessment" recommended by Mitchel et al. (2005) a pre and post waste sort is not incorporated; also, households in the test authorities will be exposed to the national 'Recycle – Now' waste awareness campaign and other local awareness messages, which means any change in household waste recycling behaviour cannot be solely attributed to a specific incentive alone.

Notwithstanding, the evidence is already out there: such incentives are not working (Williams, 2005).

8.2 Financial/stick incentives

Individuals face a cost or levy for non-participation in a scheme or additional costs for excessive waste generation. Financial/sticks act as "disincentives" that force people to do something they would otherwise not do (Mitchel et al. 2005).

Two generic types of financial/stick identified by Mitchel et al. (2005) are:

- Charging schemes (e.g. direct charging schemes)
- Compulsory participation (e.g. fines for 'non-recyclers')

From the research in RCTCBC, 77 per cent of householders that responded to the question thought fines were not an appropriate way to encourage recycling (See Chapter 5, Section 5.4.17). It seems that financial/sticks incentives are the least popular type of incentive used by local authorities to motivate householders to recycle (Mitchel et al. 2005).

The concept of 'direct charging' is a form of charging whereby refuse is charged for in relation to a quantifiable measure, such as weight, volume or the number of containers. The term 'direct charging' is synonymous with the terms 'variable charging', 'pay- as-you-throw (PAY-T)', and 'unit pricing'. International experience (Skumatz, 2002) appears to indicate strongly that the introduction of variable charging for household waste has been successful in encouraging the reduction in waste for final disposal, increasing recycling/diversion rates, and, to a more limited extent, encouraging waste minimisation (WARMER BULLETIN, 2002). Despite success abroad and advice at home (ENDS Report, 2001), within the UK Government there is opposition to such a system (ENDS Report 2003) and 'direct charging' would need a change in UK legislation. One of the few Councils in the UK to implement a 'crude' form of direct charging has been Blaby District Council. In 2001, the Council switched to wheeled bins, using powers under Section 46 of EPA 1990 to charge for containers (Coggins, 2004). A baseline refuse and recycling service was provided for 'free' (paid for in the Council tax) - which consists of a weekly collection of a 140 litre refuse bin and a fortnightly collection of a 140 litre recycling bin and pre-sort boxes. Residents then pay extra if they want more than this. In other words, they pay a 'one off' payment and an annual rental fee for an extra 140 litre waste bin, a 240 litre waste bin or a 360 litre waste bin. Residents can also pay extra for side waste bags and garden waste sacks or for a 240 litre garden waste bin (Herridge, 2004). Blaby Council saw a significant increase in recyclable tonnage when it was introduced (Open University, 2003).

In Ireland, all councils either have or are in the process of implementing schemes to charge households for the amount of non-recyclable waste they produce. February, 2004, saw a legal test case in the Republic of Ireland (Dublin City Council v. Samuel Wright), whereby the Irish Court ruled that flat-rate direct charging for collection and management of waste is consistent with EU law, with reference to the 'polluter pays principle' (Coggins, 2004).

The UK is the only country in Europe to have legislation which prevents implementation of charging (Herridge, 2004), despite the Strategy Unit's Report in 2002 recommending legislative change to allow local authorities the powers to charge if they so wish to do. The Government's reluctance to implement such a change can be clearly seen in the avoidance to set up legal provisions to allow local authorities to charge for waste in the Clean Neighbourhoods Act, 2005. Originally, there were provisions in the Clean Neighbourhoods Bill to amend section 45 (3) of the Environmental Protection Act 1990. The amendments would have allowed councils to charge for household waste collection where this was directly related to the amount of waste collected from each household (ENDS Report, 2005). However, by the time the Bill had its third passage through the House of Commons, the legal provisions had been removed for fear of an "increase in dumping (fly tipping) of rubbish rather than an increase in recycling" (Quote from: Alun Michael. ENDS Report, 2005). The British public would probably be wary of 'direct charging' and some would undoubtedly view it as a mechanism to fund public services, probably regarding it as a 'new tax', but a different way of paying. There is always opposition to change and implementation of direct charging for household waste in the UK would be a significant one, but in the case of direct charging, negative impacts can be anticipated and overcome by strict enforcement (Eunomia, 2002). In it's desire to lean away from direct charging, the government is "keen to try" schemes involving council tax discounts (ENDS Report, 2005). Our study showed that 90.3 per cent of responsive households in RCTCBC indicated that a reduction in council tax would encourage them to recycle (see Chapter 5, Section 5.4.19).

8.3 Compulsory recycling

Many countries, states and municipalities around the world have made recycling mandatory or compulsory, requiring households to separate certain materials from household waste or face some kind of penalty. The legislation seems to be set at the municipal level, usually in response to mandatory recycling rate implemented at state level (Open University, 2003). This approach can be seen, for example, in Canada, Germany, The Netherlands, Denmark, Austria (Macdonaly and Vopui, 1994). Everett and Pierce (1993) examined 670 dry recyclable kerbside schemes in the US and concluded that one of the most significant programme parameters was mandatory participation. Over half of kerbside recycling scheme are mandatory for households in the US (Open University, 2003). Studies have shown that mandatory kerbside recycling schemes achieve higher levels of set out and material diversion (Floz, 1991; Platt et al, 1991; Everett and Pierce, 1993; Noehammer and Byer, 1997).

The implementation of such a 'stick' to increase recycling needs adequate enforcement. In the UK, the Government is watching the London borough of Barnet's 'compulsory' recycling scheme "with great interest" (Quote from: Alun Michael, ENDS Report, 2005). In Barnet, residents are told that they will be fined (up to £1000) if they are seen to be putting recyclables in the refuse collection container. The scheme is targeting a limited number of recyclable materials - glass, tins and cans, paper and magazines. The legislation that Barnet Council is using to specify what waste is put into what container is the Environmental Protection Act 1990, Part 2, Section 46. In the Act it states that a person who fails without reasonable excuse to comply with it shall be liable on summary conviction to a fine not exceeding Level 3 on the standard scale (£1000). Six Street Enforcement Officers record which individual properties have participated or not in the scheme. Letters are then distributed to those properties which have not participated in the scheme. The first letter contains general information about the compulsory recycling scheme. If after letters have been distributed a property is still not taking part in the kerbside scheme a Recycling Assistant will visit the property. If householders persist in not complying with the scheme then legal action will be taken.

8.4 Voluntary/carrots incentives

The community is rewarded through individual participation. Voluntary/carrot incentives appeal primarily to people's good nature and natural willingness to do something good for the community and environment (Mitchel et al. 2005).

Two generic types of voluntary/carrot incentive identified by Mitchel et al. (2005) are:

- Community rewards (e.g. tree planting per tonne recyclate collected)
- Charitable donations (e.g. reward donation to school per tonne recyclate collected)

Community reward incentives are characterised by a reward being made to the community as a whole as opposed to offering a financial return to an individual. One of the most widespread examples of this type of incentive is Alupro's aluminium can recycling promotion 'Trees for Cans'. This initiative is run in partnership with local authorities and for every tonne of aluminium collected a tree is planted. This initiative was run in the schools' waste education programme in Chapter 7, see section 7.2.6. It is, however, thought that such initiatives have a comparably weak influence on kerbside diversion levels since findings

presented in Chapter 7 found the incentive did not increase household set out rate and material diversion, significantly.

Charitable donations encourage individuals to act for charitable causes. A well established example of this type of incentive is the national 'Yellow Woods Challenge' which is now in its third year of operation. In partnership with local authorities and schools across the UK, the Yellow Pages Group organise the collection and recycling of old Yellow page directories.

8.5 More awareness campaigns?

It is almost impossible to quantitatively judge the effectiveness of any national waste awareness campaign. Marketing and media companies are quick to state qualitative results when claiming how successful their campaigns have been, however, this thesis has shown that householders do not act in the way they claim they will act or have acted, therefore qualitative markers of success are not linked with actual behaviour. All the research results in this thesis suggest that those that want to recycle are already doing so (provided they are supplied with the necessary kerbside recycling infrastructure). Advertising the concept of 'recycling' in general is, in the author's opinion, 'preaching to the converted'. Another environmental campaign that has failed is the 'Keep Britain Tidy Campaign' with regard to stopping people dropping litter. The costly campaign continually reinvents itself and has been around since the 1950s, however, the problem of people persisting in dropping litter has not gone away but is getting worse. Of the 12,000 sites surveyed for the fourth Local Environment Quality Survey of England (LEQSE) (ENCAMS, 2005), over three-quarters were strewn with cigarette butts, drinks litter had risen by 65 per cent, and fast food rubbish by 450 per cent since 2001. It therefore seems that no environmental awareness campaign can change peoples' bad habits.

8.6 Alternate Weekly Collection (AWC)

Alternate weekly collections (AWC) schemes have attracted considerable interest in recent years. Well executed systems can deliver improved recycling levels and promote waste minimisation, while at the same time limiting the rate of increase in collection costs (WRAP, 2005).

An AWC is any scheme that collects one type of material on one week (week 1) and a different type of material on the following week (week 2). Significant diversions of household waste away from landfill have been observed when there is an alternate week

collection of residual waste and recyclable material. An AWC seems to be the most significant change a local authority can make to its collection system to increase diversion significantly. For example, the Vale Royal Borough Council went from a 15% household waste recycling rate in 2003/4 to 40% in 2004/5 solely due to the implementation of an AWC (WRAP, 2005). Unlike all the incentives trialled in the UK, an AWC seems to offer a step change in household waste diversion. However, the main obstacle to the implementation of AWCs seems to be a lack of political will to introduce such a radical system, since offering residents a fortnightly collection of residual waste is seen by many local councils as a vote loser.

8.7 Alternative technologies

It is not the intention to detail any of the alternative waste treatment technologies. There are a number of processes that do not require the householder to sort the waste at the kerbside. It is problematic and costly to require householders to sort waste at the kerbside to a significant level whereby Welsh, UK and EU imposed targets will be met. In Wales, alternative waste technologies can potentially add to WAG recycling targets, however, not to the WAG composting target since it is specifically stated that material has to have been derived from source segregated material. Alternative technologies can contribute significantly towards the LAS target, for example, energy derived from a waste (EfW) facility may reduce the need for landfill by up to 90%.

9 THESIS CONCLUSIONS

This chapter concludes the thesis and proposes several areas for future research.

9.1 CONTRIBUTIONS OF THE THESIS

Constantly evolving municipal waste management drivers and the UK's looming infraction fines for non-compliance with the Landfill Directive mean that municipal waste management practice must move away from an over-reliance on landfill to sustainable recovery options.

Local authorities are implementing municipal waste strategies in order to comply with the relevant legislation. The traditional diversion routes for MSW away from landfill are household waste recycling centres (HWRCs), 'supermarket' bring sites, and kerbside recycling schemes. At the turn of the 21st century, all local authorities in Wales had HWRCs and bring sites, however, only a handful had kerbside recycling schemes. In 2000, some local authorities had relatively high MSW recycling and composting rates. Local authorities achieving high diversion in 2000 were doing so predominately through HWRCs. Such local authorities were reliant on the public to voluntarily take large volumes of household waste to HWRCs. The high-diversion-achieving Welsh local authorities in 2000 (Powys and Ceredigion) are both affluent authorities in rural locations, reflected in the large amounts of green waste diverted. But not all local authorities have such favourable socio-economic conditions or such large amounts of green waste in the household waste stream. In 2002, the 'Wise about Waste' Welsh Waste Strategy set ambitious recycling and composting targets for MSW to be achieved by 2010 and since then there has been a proliferation in the number of households served by kerbside recycling schemes across Welsh local authorities. The kerbside recycling scheme was the last traditional method to be introduced to help divert MSW away from landfill, after HWRCs and 'supermarket' bring sites. All the traditional methods of diverting household waste away from landfill rely on the voluntary participation of the public. Prior to the introduction of kerbside recycling schemes across Wales, the Environment Agency had conducted studies, which found 90 % (EA, 2000) of householders claiming they would use kerbside recycling schemes if given access to

them. Due to such high anticipated participation in kerbside recycling schemes, many local authorities thought waste targets would be easily met through the provision of a multi material kerbside recycling scheme for all households. However, this thesis has shown that intended and claimed participation show no correlation with actual kerbside recycling scheme participation, as well as a number of other findings indicated below:

- The research results indicated a moderate to strong link between household set out rate (%) and deprivation in the case study area (RCTCBC), suggesting that the more deprived areas in a local authority, the less waste diversion through the kerbside recycling scheme.
- The thesis also highlighted a new phenomenon called the 'Nant-y-gwddon effect'. The 'Nant-y-Gwyddon effect' was thought to be the result of the presence of an active, highly vocal anti-landfill group called RANT. It is thought that the awareness raised by the group was responsible for the significantly increased set out rate in areas surrounding the landfill site.
- There was no correlation between ACORN score and set out rate at street level.

Currently, local authorities are not experiencing the anticipated waste diversion through kerbside recycling schemes. This is because significantly fewer households are taking part in the schemes than expected. Many local authorities consequently believe that the solution to improving kerbside recycling and composting diversion is to run schools' waste education programmes and public waste awareness campaigns. Importantly, this thesis has shown the effectiveness of a schools' waste education programme and a public awareness campaign run in a local authority, as detailed below.

- The largest increase in the household recyclate diversion was observed in households already participating before the awareness campaign.
- All areas exposed to an awareness method showed a decrease in RAI Score by around 1 point.
- 'Post' awareness campaign it was difficult to get new recruits to participate more than once in a 12 week period.

- The schools' waste education programme did not achieve a significant increase in the diversion of recyclate in the homes of pupils, but did reduce contamination or RAI Score.
- Interestingly, the schools' waste education programme was more successful than the public waste awareness campaign in lowering households' RAI Score.

Local authorities which implement kerbside recycling and composting schemes and still have significant tonnage to divert to meet the 2010 Wales Waste Strategy targets and reach the required BMW diversion set in the Landfill Allowance Scheme will likely only meet them through alternative waste treatment technologies or a significant change in kerbside recycling behaviour (thought only possible through financial/stick incentives or alternate weekly collections, see Chapter 8). Waste awareness campaigns and schools education campaigns have a role to play, but, should not be solely relied on to meet short term diversion targets.

It is also recommended future research be conducted as follows:

- The extent and verification of the 'Nant-y-Gwddon' effect.
- Development of tools and instruments to facilitate recycling behaviour change
- An in-depth examination of the waste composition and trends of material diverted in kerbside recycling and composting schemes.
- A full study into the additional diversion produced by kerbside recycling and composting alone in the UK.
- A benchmarking study of the performance of kerbside collection schemes.
- An investigation of the best way to enhance participation in garden and kitchen waste collection schemes.
- An examination of the impact of alternative weekly collections.
- An apolitical study on the true cost of separating recyclate and composting material at source or at a MRF.

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CHAPTER 9