The Management of Post-Consumer Plastics Waste Recycling in the UK

by

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Abstract

This thesis examines the management of post-consumer plastics waste recycling in the UK. It brings together information and approaches from a number of disciplines in order to present a comprehensive view of the post-consumer plastics waste recycling industry and provide insight into participation issues. Two Scottish collection schemes are utilised as case studies throughout.

The thesis summarises current practice in post-consumer plastics recycling and describes the processes associated with it. It also presents a summary of legislation relevant to plastics recycling in the UK, EC and US in particular.

The thesis includes a quantitative survey of 500 members of the public that analyses their recycling behaviour and factors that affect motivation. It also looks at public perceptions of plastics. This is complemented by a qualitative study of plastics recyclers that examines recycling routines in more detail, and explores issues that affect the participation, and quality of donation, of individuals.

The evaluation of post-consumer plastics recycling schemes is discussed, and models are developed in order to assess their financial viability.

The lessons gained from this programme of research are then summarised in a policy framework.

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Chapter 1: Introduction

1.1 Background

The aim of this thesis is to study the post-consumer plastics waste recycling industry and develop a set of recommendations for its development. This thesis is one of a number which have been carried out in the Management Science Department at the University of Stirling which consider waste management practices. The first waste management thesis was *A Systems Study of Waste Paper Recovery and Recycling* by TK Ho in 1982, followed by PE Rushbrook's *Costs of Collection and Disposal Operations run by Local Authorities* in 1984, and RB Matthews' *Technological Economics of Glass Recycling* in 1986.

1.2 Waste Management in the UK

Waste can be defined as material which has been discarded by industry, commerce or members of the public. Waste management is concerned with the collection, handling and disposal of these materials. In 1989, the UK produced 136 million tonnes (te) of waste. Of this,

15 million te was commercial waste (11%)

20 million te was domestic waste (15%)

32 million te was building/construction waste (23%)

69 million te was industrial waste (51%).

(DOE, 1989)

Of the 20 million te of domestic waste currently produced in the UK, around 90% is landfilled and around 10% is incinerated. Estimates for the amount of domestic waste recycled range from 2% (Coopers & Lybrand, 1993) to 2.6% (Letham, 1993). The 1995

Audit Commission Report on Local Authority Services and Spending in England and Wales shows average recycling rates of 3%, 5% and 6% for Metropolitan Councils, District Councils and London Boroughs respectively. The highest recycling rates are listed below in Table 1.1.

Local Authority	Percentage Recycled
Adur	21%
West Somerset	19.5%
Sutton	19%
Wey & Portland	18.5%
Bromley	14.5%
Richmond upon Thames	14%
Coventry	7.5%
Stockport	6%
Bury	5.5%

Table 1.1 Top nine recycling rates for local authorities in England and Wales (adapted from Audit Commission, 1995)

They also reported that a number of District Councils still had a recycling rate of zero (Audit Commission, 1995).

In 1974, the Control of Pollution Act made the collection, disposal and regulation of domestic waste in the UK the responsibility of local authorities. In England the Waste Collection Authority (WCA) is the district council, whilst the Waste Disposal Authority (WDA) is the County Council. In Scotland and Wales, both duties are the responsibility of the district council. Until 1990, the WDAs in all three countries were responsible for both the disposal and regulation of domestic waste. This dual role was considered to be the source of a possible conflict of interests. In 1990, the EPA introduced legislation directing local authorities in England and Wales to form Waste Disposal Companies (LAWDC). The LAWDCs would be separate, private entities and would be responsible for the disposal of domestic waste. The local authority continues to be responsible for the regulation of waste disposal within its jurisdiction.

1.3 Waste Management Options

The following sections describe and evaluate some of the waste management approaches and methods which can be taken.

1.3.1 Traditional Approaches

These approaches focus on strategies for disposing of waste. Two of the most common routes for domestic waste, landfill and incineration, fall into this category. See Figure 1.1.

Manufacture $\longrightarrow$ Use $\longrightarrow$ Disposal

Figure 1.1 Traditional route from cradle to grave

1.3.1.1 Landfill

Landfill is, as its name implies, the practice of filling large holes in the ground with waste. The holes are sometimes purpose built and sometimes left over from other industrial uses such as quarrying or open cast mining. Waste is delivered to the site and then compacted into the landfill. Once the landfill is full, it is sealed and covered over with topsoil.

Obviously, this option requires a large amount of land and capital. Even where money is available, it is becoming less easy to find suitable sites to build landfills close to the centres of population they serve (Basta, 1990; Sudol & Zach, 1991). One estimate gives the South East of England only 15 more years of landfill capacity for domestic waste (Ghazi, 1995(a)). Another view is that of the 4000 landfills in the UK, about half will be full in the next five years (Simmons, 1992). Problems with landfill as a method of disposal include methane emission from the degrading waste and leachate (liquid effluent from the waste) polluting underground springs (Lifset, 1992).

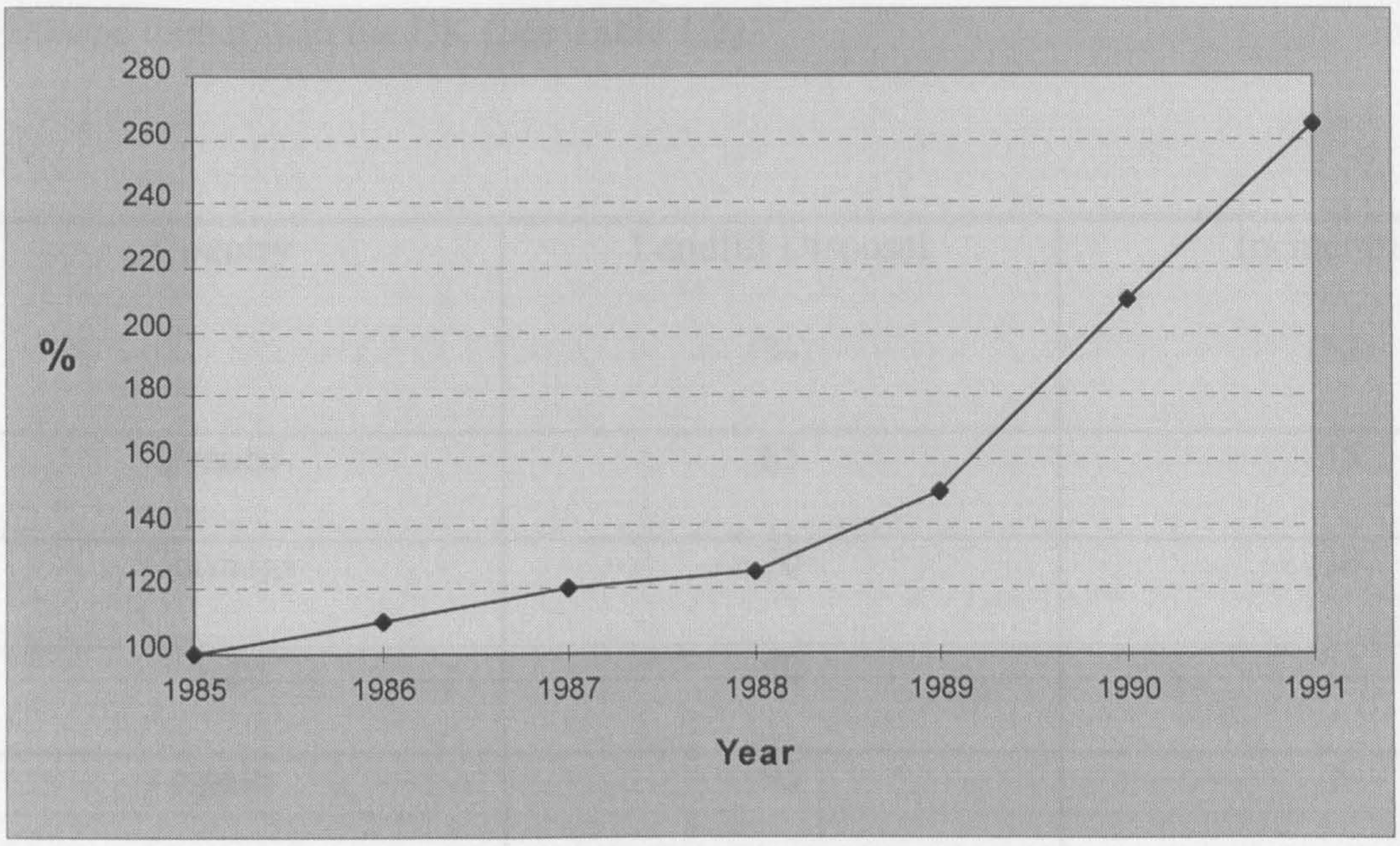
The Environmental Protection Act (DOE, 1990(a)) introduced a set of new requirements relating to landfill construction in order to combat these problems. This piece of legislation requires new landfill sites to be lined to help prevent leachate and sets a number of standards for their closure and long term maintenance, including monitoring of methane levels. The Environmental Protection Act also lists a number of requirements for the transportation of waste. The 'duty of care' legislation means that only licensed carriers may transport waste and the waste must be accompanied by full documentation (DOE, 1990(a)). These measures, which recognise some of the problems that have been caused by landfill in the past, will make landfill in the future more responsible and more expensive.

The experience of other countries shows that as the pressure increases on land use, the price of landfill increases and landfill location is pushed further and further from population centres, requiring the transport of waste over much longer distances (Kline, 1989). These increased transportation costs will also contribute to the expected increase in the cost of landfill over the next decade.

In a bid to reduce the UK reliance on landfill, the Government has proposed a landfill levy that will increase the current cost of using landfill by between 30 and 50 percent. It hopes this increase in costs will encourage waste minimisation and recycling policies in local authorities and waste producers (Brown, 1995).

Perhaps one of the most fundamental and least considered problems with landfill is its finality. Materials which are buried in the ground are not available for future use. Each item sent to landfill is lost to us forever. Many of the materials buried could have value if they were reused or reprocessed. In our society, 'waste' has come to be associated with 'worthless' rather than 'discarded', and this is reflected in our waste management practices. Recognising the value of waste materials and reprocessing them would reduce the amount of new materials required to fulfil our current needs and so prolong the lifetime of a number of our resources.

Graph 1.1 below shows the annual increase in landfill prices as an index of 1985 prices:



Graph 1.1 Annual increase in landfill prices since 1985 (adapted from CBI, 1991)

1.3.1.2 Incineration

Incineration is the burning of waste in huge, specially designed furnaces. There are two main types of input for incinerators: some are fuelled by raw waste, and others make use of Refuse Derived Fuel (RDF). In order to make RDF, the inert fractions of domestic waste, such as glass and metal are extracted. This helps ensure total combustion and reduce the residues. The material is then shredded or processed into bricks or pellets of fuel. This refined fuel can then be burned in specialised incinerators as a fuel supplement. In 1981, there were 6 operational RDF plants in the UK (Incpen, 1982). Newcastle County Council runs an RDF plant which can process up to 300,000 te of domestic waste each year (BPF, 1992).

Incineration is a much more common waste management practice in other parts of Europe than it is in the UK (See Table 1.2).

Country	Landfill Disposal (%)	Incineration (%)
France	65	35
Germany	70	30
Italy	80	20
Spain	95	5
Switzerland	20	80
UK	90	10

Table 1.2. Incineration levels in Europe (Russottoo, 1990)

The development of an incineration plant requires a high level of capital investment (Incpen,1982). Many UK authorities do not produce a high enough level of waste to justify the building of an incinerator. Co-operation between Waste Disposal Authorities would be required to both utilise and finance an incinerator.

Another problem with incineration is the emissions that it produces in the form of toxic gases. These can be 'scrubbed' effectively from the flues of incineration plants, but this is expensive, equipment is only available in modern plant, and only known pollutants are targeted. It may be some years before the long term effects of incinerator gases are known. Medical studies in the US have shown that high dioxin levels are linked with cancer, damaged immune systems, reduced male fertility and are considered dangerous to unborn babies (Ghazi, 1995(b)). Part of the problem is that many incinerators were built 20-30 years ago before tighter pollution controls were instigated. Many of these emit dioxins at rates many times higher than the UK Government currently deems safe for humans, although US studies suggest that there may in fact be "no safe threshold to protect against cancer" (Ghazi, 1995(a)). PVC is one of the materials which has been associated with the production of toxic fumes where there is partial combustion. The British Plastics Federation (BPF) claims that EC acid emission legislation has led to the use of gas scrubbers which will entirely eliminate dioxins from incinerator emission (BPF, 1992). Recent studies by Japan's PVC Association claim that there is 'no environmental problem with regards to incineration of PVC waste' (Japanese Chemical Week, 1990). The EC Directive on Incinerator Emission Control specifies tighter controls for incinerators to be in place by December, 1996. Facilities failing to meet these standards by this time will be required to be shut down. These measures will increase the cost of incinerating waste, as new equipment will need to be installed in most of the UK's incinerators in order to meet the new regulations.

Incineration is not strictly a method of disposal as it only reduces the bulk of the waste it treats, and the ashes must still be landfilled. This means that there would still be a need for landfill.

1.3.2 Closing the Loop

This category of waste management policy attempts to re-route some of the waste out of the chain before it reaches the disposal stage

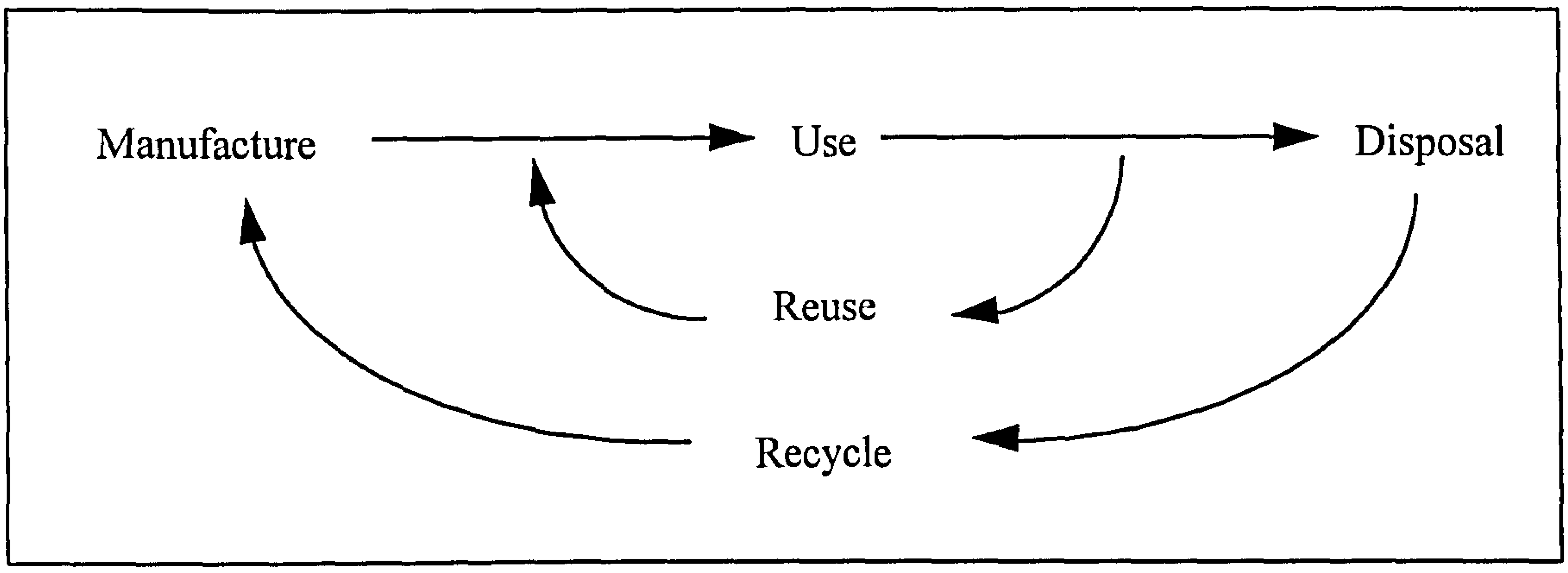


Figure 1.2 Routes to closing the loop

1.3.2.1 Reuse

This means that the package can be used a second time for the purpose for which it was designed without it being reprocessed in any way. Perhaps the best known example of this is the glass milk bottle. To make this option possible, products must be designed with reuse in mind.

1.3.2.2 Recycling

Recycling is not a new idea. Many materials, including plastics are recycled as part of the industrial processes which manufacture them. Any scrap or defective products are simply re-routed to re-enter the manufacturing cycle along with raw materials. For reasons that are discussed in later chapters however, post use recycling is far less common.

There are four different levels of recycling:

- *Primary Recycling* is where a product is recycled into the same product or a product with similar characteristics. The production of drinks cans from aluminium recycled from drinks cans is an example of this.

- *Secondary Recycling* is where a product is recycled to make a product with inferior characteristics. Recycling plastic bottles to make plastic timber products is secondary recycling.

- *Tertiary Recycling* is when basic chemicals or fuels are recovered from a product. The production of RDF is an example of tertiary recycling.

Quartenary Recycling is when the heat content of a product is recovered. Also known as energy recycling, this is associated with incineration. The heat produced by the burning of waste is used to drive steam turbines to make electricity, or used a direct heat for industrial or domestic premises nearby. Thus the original energy value used to manufacture much of the material is recouped. If metals are removed from the domestic waste stream, but paper and plastics left in, up to 100% of the energy used to manufacture the remainder of the waste can be recovered. Many polymers have higher calorific values than traditional feedstocks such as wood or coal (BPF, 1992). The incinerator at Edmonton, London is an example of a incineration operation with energy recovery. The electricity it generates is sold to the National Grid.

The higher the level of recycling, the more sustainable the process. Obviously, as Donella Meadows (Meadows, 1990) points out, it is all very well to make old soda bottles into new flowerpots, but there is a limited market for flowerpots. Taking a long term view, for recycling to work, the aim must be to concentrate on primary recycling, returning products to their original use. Also, many of the materials concerned are finite resources and tertiary or quartenary recycling processes, although they recover something from the original product, are not prolonging the lifetime of the resource.

According to W H Bentley (Bentley, 1990), the main benefits from recycling are:

- a reduction in the amount of land used for landfill and therefore landfill costs;
- energy savings (for example, 50% less energy is needed to recycle a tonne of plastics waste than to make a tonne of plastics from virgin materials);
- environmental damage caused by obtaining raw materials is reduced;
- the public is made aware that resources are finite.

There is also the obvious benefit of extending the lifetime of the resource.

One of the main problems with the introduction of large scale recycling, particularly of plastics, is that no infrastructure exists at present to support it. Recycling does not fit into the current waste management patterns. It requires domestic waste to be segregated and creates a flow of materials in the opposite direction to normal practice.

1.3.3 The Root of the Problem

The focus of this final category of measures is not on the disposal, but rather on the manufacture and design of products. Source reduction involves taking the problem back to its root and trying to minimise the production of waste in the first place, rather than trying to find ways to treat it once it has been created. These measures include new design practices which strive for minimum packaging and therefore waste. The problem with source reduction is that it is an extremely long term goal. Its potential cannot be realised quickly enough to avoid problems with declining landfill capacity.

1.3.4 Summary

None of the waste management practices described above is mutually exclusive, nor does any one of them hold the answer to every waste management problem. For example, neither source reduction nor recycling can eliminate the need for disposal entirely. What is clear is that the continuation of current waste management practices for domestic waste in the UK is unsustainable (Wright, 1990).

Until recently, UK waste management has largely concerned itself with waste disposal. There has been heavy reliance on landfill with some moves to increase the use of incineration over the last two decades. In the past the Government has seen its rôle as one of introducing standards which make the traditional options safer. The rôle of local government has been one of optimising the operation of these disposal routes and implementing cost effective and efficient disposal services. The promotion of recycling has been confined to interested groups like green charities and industrial bodies. It is not regarded as a central or essential waste management strategy.

In recognition of the problems with continuing the current waste management practices into the future, the UK government has introduced a recycling target as an interim measure to help gear the country up to meeting the pending deadlines of the EC Directive on Packaging and Packaging Waste. The UK target requires local authorities to recycle 50% of recyclables in the domestic waste stream by the year 2000 (DOE, 1990(b)). This represents a commitment to achieve a recycling level of around 25% of domestic waste over the next five years. In the UK domestic waste consists of the following fractions:

Kitchen Waste	30%
Paper	25%
Textiles	10%
Glass	10%
Metal	8%
Plastics	7%
Miscellaneous	10%

(APME, 1991)

As reported earlier, the current rate of recycling for domestic waste is thought to be around 5%, although this may vary by material. For example, a report by Professor David Pearce estimates that around a quarter of newspapers are recycled (CSERGE et al, 1995). RECOUP forecast that 4200 te of plastics bottles will be recycled in 1995, based on their figures for the first half of the year. This represents just over 1% of the plastics bottles in the domestic waste stream. Even if the Audit Commission's more optimistic estimate of a 5% recycling rate is accurate, the recycling industry as a whole will still need to increase its efforts by at least a factor of five over the next 5 years in order to meet the government's recycling target for 2000.

Recycling is currently being taken more seriously as a waste management strategy both because of the new practical and legal significance it begins to hold. Pressures on the existing waste disposal facilities and increased regulation from the EC mean that recycling cannot continue to be regarded as an 'add-on' service. It is no longer an option but must be fully incorporated into the waste management services of the future. Plastics waste recycling is perhaps the most interesting and challenging industry to study as it is the least established. Other materials, such as paper, glass and metals have much longer standing systems and infrastructures in place in the UK. Interestingly the EU legislation, which is discussed fully in Chapter 3, does not distinguish between the more and less established industries, simply setting the same targets for each material group regardless of the current level of activity. Post consumer plastics waste recycling has then the furthest to go in terms of achieving a stable system capable of meeting these targets. A feature of its relatively recent development in the UK is that there is little work done to understand and alleviate the problems that it faces. This combination of a new area for study and the possibility of making a significant contribution to an important area makes it an attractive field for research.

1.4 Current Waste Management Practice: A Stakeholder Analysis

The various routes for domestic waste that were outlined in the preceding sections, and depicted in Figures 1.1 and 1.2, are summarised in the more specific context of plastics in Figure 1.3 below. This Figure shows how plastics start out as virgin polymers, made from crude oil fractions by the Virgin Suppliers. They are sold to the Bottle Manufacturers as a feedstock for their processes. The resulting bottles are then filled with products by the product manufacturers themselves, or by a third party on their behalf. The packaged products are then sold on to retailers (wholesalers and other such intermediaries have been included in this group) who sell them directly to the Public. Once they have consumed the contents of the bottle the Public may then direct the packaging that is left in one of three ways.

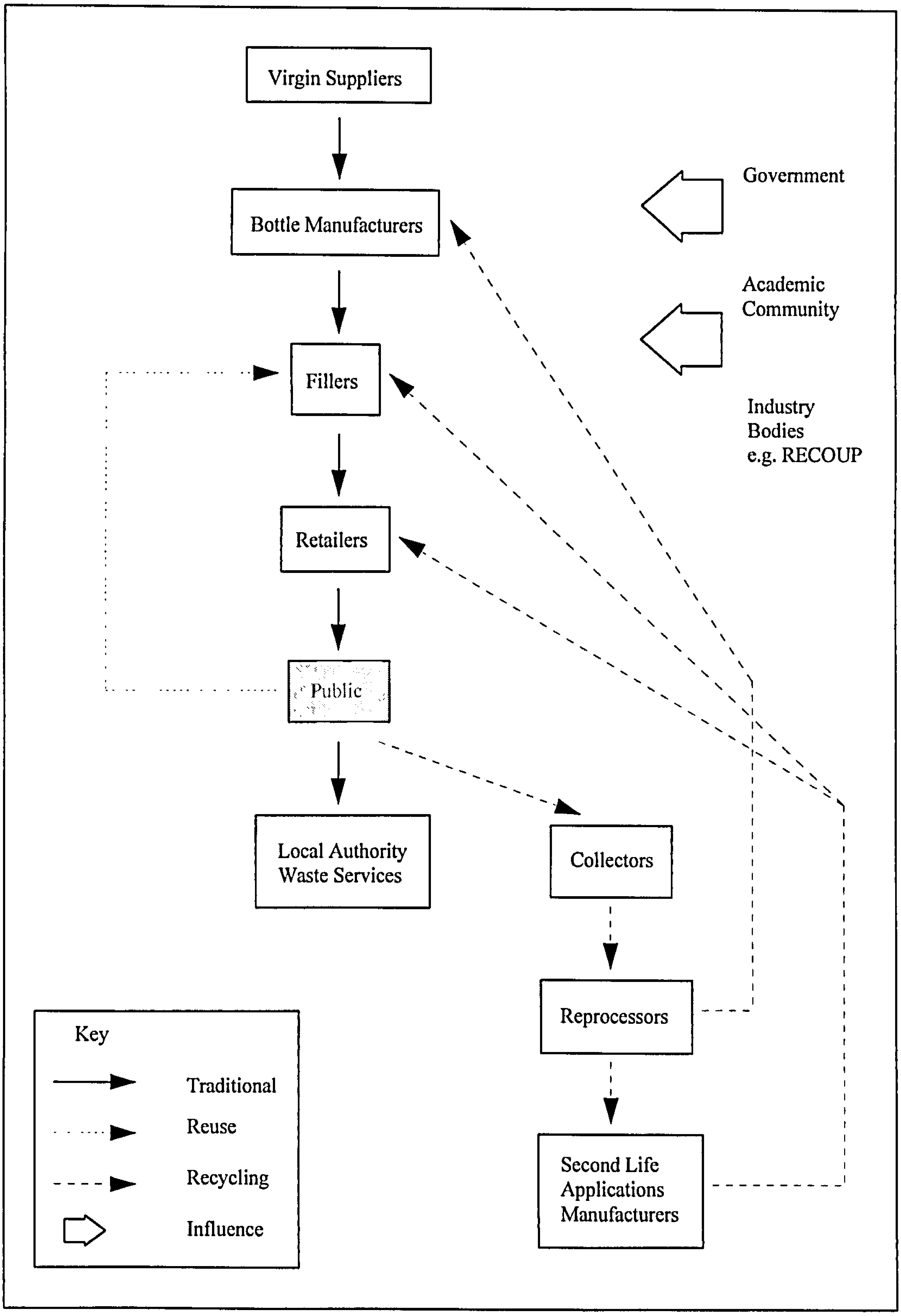


Figure 1.3 The Packaging Chain

The traditional route for packaging waste is, as outlined above, to dispose of it through the Local Authority Waste Services. The Public may also choose to reuse the packaging, either informally, by giving it an extended life within their own household, or formally, as shown below, by returning it to the filling stage of the process. The return of glass milk bottles is an example of this route. At the moment there is no such formal system for plastics bottles. The third option that may be taken by the public is to recycle their packaging. If they choose to recycle their packaging, it will be gathered by Collectors who will check and sort the material before selling it on to a Reprocessor. In the case of plastics bottles, the Reprocessor cleans and grinds the bottles, rendering them similar in properties and appearance to the virgin polymer. These recycled polymers can then be sold directly to the Bottle Manufacturers in order to make new bottles (primary recycling) or on to Manufacturers of Second Life Applications (secondary recycling). Often the products made by these Second Life Applications Manufacturers will be then sold to retailers to be sold on to Public, Public Sector or Private Sector consumers. There are however instances, represented by the other arrow on Figure 1.3 where the Second Life Applications Manufactures will extrude the ground polymers and produce plastic beads, mimicking the processes of the Virgin Suppliers, and sell these back to the Bottle Manufacturers as feedstock for their processes which will be almost identical in properties to their virgin equivalent.

Together, these parties and the relationships between them are known as the Packaging Chain. These processes are discussed in much greater detail in Chapter 2, but are mentioned here to highlight the many different views that can be taken of the activities of the post consumer plastics waste recycling process. For example, to Virgin Suppliers, recycled polymers can be seen as an alternative feedstock for the Bottle Manufacturers and therefore a threat to their market share. The Local Authorities, on the other hand, may welcome plastics being removed from the traditional waste stream as this will represent a lower volume of waste for them to process and thus reduce their costs. At the very least, the output of one member of the packaging chain is the input to another, giving each a very different perspective and set of views about changes to the existing practices which will be most closely concerned with the direct inputs and outputs of their own stage.

Even those parties who might be agreed that recycling is a better strategy than the current waste management practices will not necessarily do so for the same reasons. Possible purposes for promoting large scale recycling might include sustaining an existing feedstock, or creating a viable alternative to a current one, making money out of the collection process, reducing the current level of domestic waste that is landfilled (either for environmental reasons or to reduce operational costs), extending local opportunities for unskilled work, or a combination of these. The success of any attempt to increase the level of post consumer plastics waste recycling will be measured against these very different objectives by different members of the packaging chain.

Other bodies that have been included in Figure 1.3 are the Government, Industry Bodies and the Academic Community, as parties outside of the packaging chain that nevertheless have, or are trying to have, an impact on the way their business is conducted. These parties will also have quite different perspectives on the processes and problems of the packaging chain as they are not directly involved and therefore may take a systems level view of the processes.

These various bodies, as part of, or concerned with, the packaging chain, can be termed *stakeholders*. This term represents the fact that they have an interest in the process, recognising that these will not necessarily be identical or even similar (Freeman, 1984). In this case, there is quite a high degree of fragmentation of views due to the interdependency and difference of aims described above.

What is extremely interesting is the pivotal rôle enjoyed by the Public in determining the route taken by domestic waste. They are central members of the packaging chain, and yet are often not considered as part of it (e.g. RECOUP, 1993). From the point of view of a recycling industry, the importance of this decision making power of the Public cannot be over estimated. Without the Public's conscious, collective decision to support an alternative route for their plastics waste, their will be no raw material for the post consumer plastics waste recycling industry. An examination of Figure 1.3 will show that between each of the parties in the packaging chain, money changes hands for the supply and purchase of a resource. The transaction between the Public and their choice of disposal route for their waste is different in that there is no perceived cost for any of the options. This puts the post consumer plastics waste recycling industry in the unique position of not being able to purchase their feedstocks. Rather they must rely on the goodwill of the general public.

One of the ways of thinking about the various stakeholders in the plastics recycling process, is to compare them in terms of the interest they have in promoting plastics recycling and the power that they have to stimulate this growth. Figure 1.4 shows a graph which has the degree of interest increasing along the vertical axis and the amount of power increasing along the horizontal axis. These axes are divided up to create four segments which correspond to low interest, low power; low interest, high power; high interest, low power; and high interest, high power respectively. Each of the stakeholders has then been plotted on this chart to show the positions of power and interest that they have. This is not meant to be drawn to scale, it is merely intended to be indicative of their positions relative to one another.

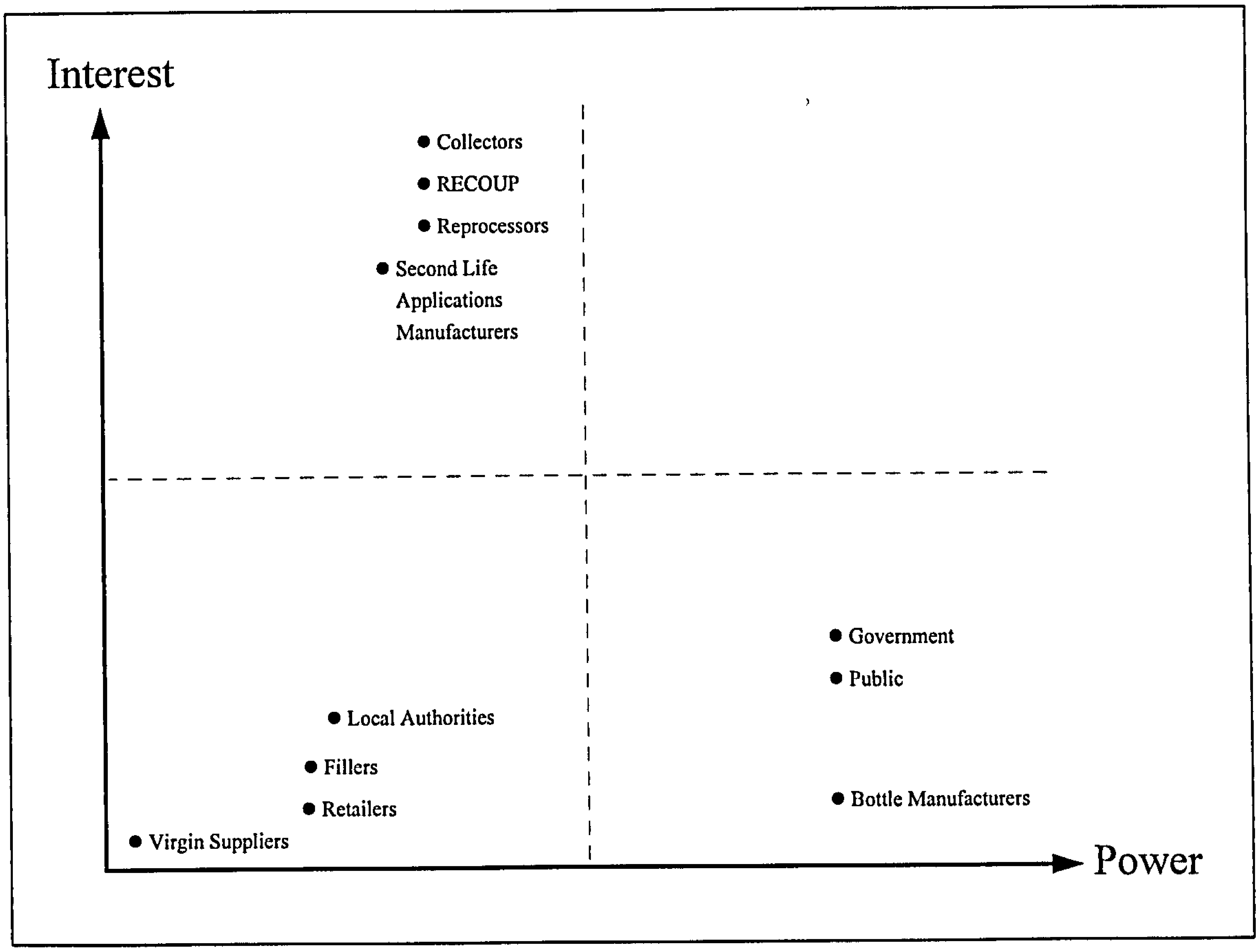


Figure 1.4 Stakeholder analysis of the plastics recycling industry

The Academic Community has not been included in this analysis as there is no uniform position taken on the issue of plastics recycling by this body. The Academic Community in general takes very little interest in the post consumer plastics waste recycling industry as a specific concern, nor of waste recycling as a wider issue. Since they also have little direct influence on plastics recycling practices, they must be consigned to the low interest, low power category. On the other hand, the existence and construction of this thesis must belie a very positive interest in the success of post consumer plastics waste recycling. The perhaps biased position of the author must therefore be declared to lie in the high interest, low power category.

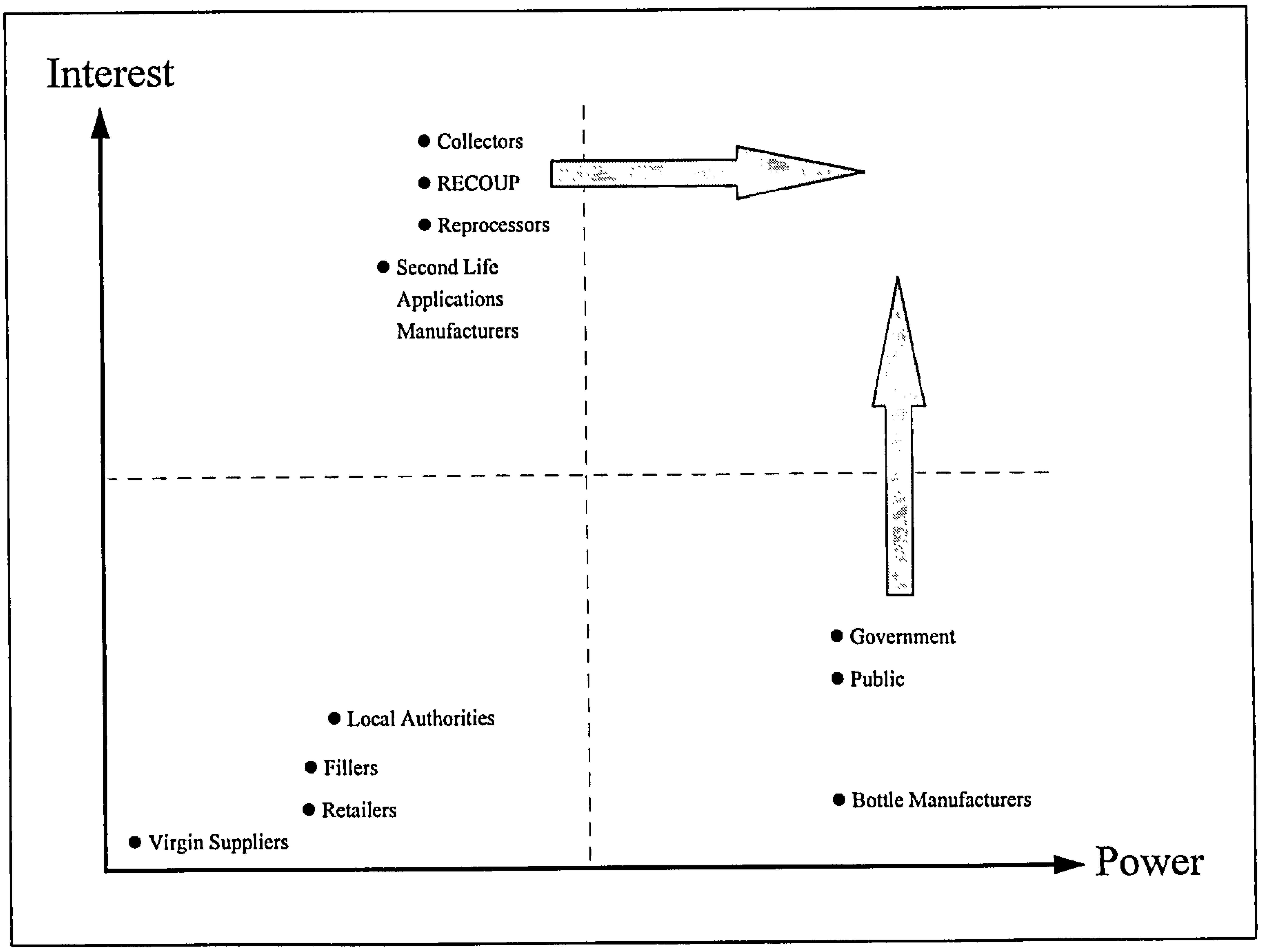


Figure 1.5 Creating powerful stakeholders with a lot of interest in plastics recycling

In order to make the large scale changes that a dramatic increase in plastics recycling from domestic waste implies, it is necessary to have a number of stakeholders who are empowered to make wide ranging changes and who also have a high level of interest in making them. Figure 1.4 shows an absence of stakeholders in the high interest, high power category. In order to create powerful, interested stakeholders it will be necessary to increase the power of those who already have a high level of interest, or increase the interest of those who already have the power to make significant changes, as shown in Figure 1.5.

In order to understand how this shift can be achieved it is important to examine the factors that are constraining the interest or power of these stakeholders. These factors may be termed barriers to recycling.

The power of the Reprocessors and the Second Life Applications Manufacturers is constrained by the market for recycled plastics. In other words, their effect on the growth of plastics recycling by increasing the prices they offer to Collectors, or the amounts of collected plastics that they purchase is, in turn, determined by the amount of recycled plastics bought by the Public and the Bottle Manufacturers. The power of the Collectors to increase their operations is, as discussed above, constrained by the contribution of plastics by the Public. Industry Bodies, represented by RECOUP here, are constrained by the level of interest and funding given to them by the members of the packaging chain. The interest of the Government, the Public and Bottle Manufacturers seems to be limited by the low importance they attach to recycling, and a general reticence to large scale change. The interest and the power of Local Authorities are both constrained by the Government through its policy and funding decisions.

As can be seen from even this brief consideration of the different viewpoints, aims and actions, the issues and parties involved are highly interrelated.

1.5 Aims and Structure of the Thesis

The following section describes the research process. It makes explicit the research decisions that have been taken and the context within which they were made. By doing this, it makes clear the influences and learning that has affected the research as it has progressed from proposal to thesis. This is done in order to help the reader understand the structure and content of the thesis. The following account is summarised in Figure 1.6 where the strands of study and interrelations between them can be seen more clearly than they can be presented within the constraints of a linear account.

1.5.1 The research process

The thesis was funded by a Science and Engineering Research Council Case Award. This means that a degree of funding was also provided by a company, in this case BXL Recovery Plastics, in return for a degree of influence over the research direction.

This research was begun directly after finishing an undergraduate degree in Management Science. The degree course was based entirely on traditional notions of Operational Research, included a large portion of mathematical and computer based techniques and was taught from a positivist viewpoint. As was indicated above, the thesis was one of a series overseen by Dr Rob Ball on different aspects of Waste Management. The task of this thesis was initially seen by the author as being the third of a set of theses on recycling different materials. In the way that the earlier theses had done, the general research aim was to construct and analyse models of plastics recycling systems. This was of particular interest to the industrial sponsors who were, at the time, considering further plastics recycling schemes in Central Scotland.

The first literature that was consulted for this study was that written and used by my supervisor. Due to a lack of theoretical literature on this subject and in line with Operational Research values about the practical relevance of research, the other main source of articles was practitioner journals. This combination of reading introduced the author to the ideas of survey work in the field and to the debate surrounding optimal recycling scheme design.

Partly then, in response to the influences of earlier work in the department undertaken by previous PhD students and by my supervisor, partly to answer the questions of my industrial supervisors, and partly to investigate new interests in the strengths and weaknesses of different recycling scheme designs, the quantitative survey which is fully described in Chapter 4 was conceived. The survey was conducted with 500 members of the public in two areas which both had operational schemes for the collection of plastics for recycling. The schemes were chosen as they had selected different methods of collecting plastics from the public. Through asking recyclers and non-recyclers their opinions, this chapter seeks to find out who is participating in recycling schemes, what their patterns of participation are (e.g. how often, how much, how far) as well as what they thought of the schemes, the act of recycling and plastics as a packaging material. It also aimed to compare these factors for the different approaches to scheme design.

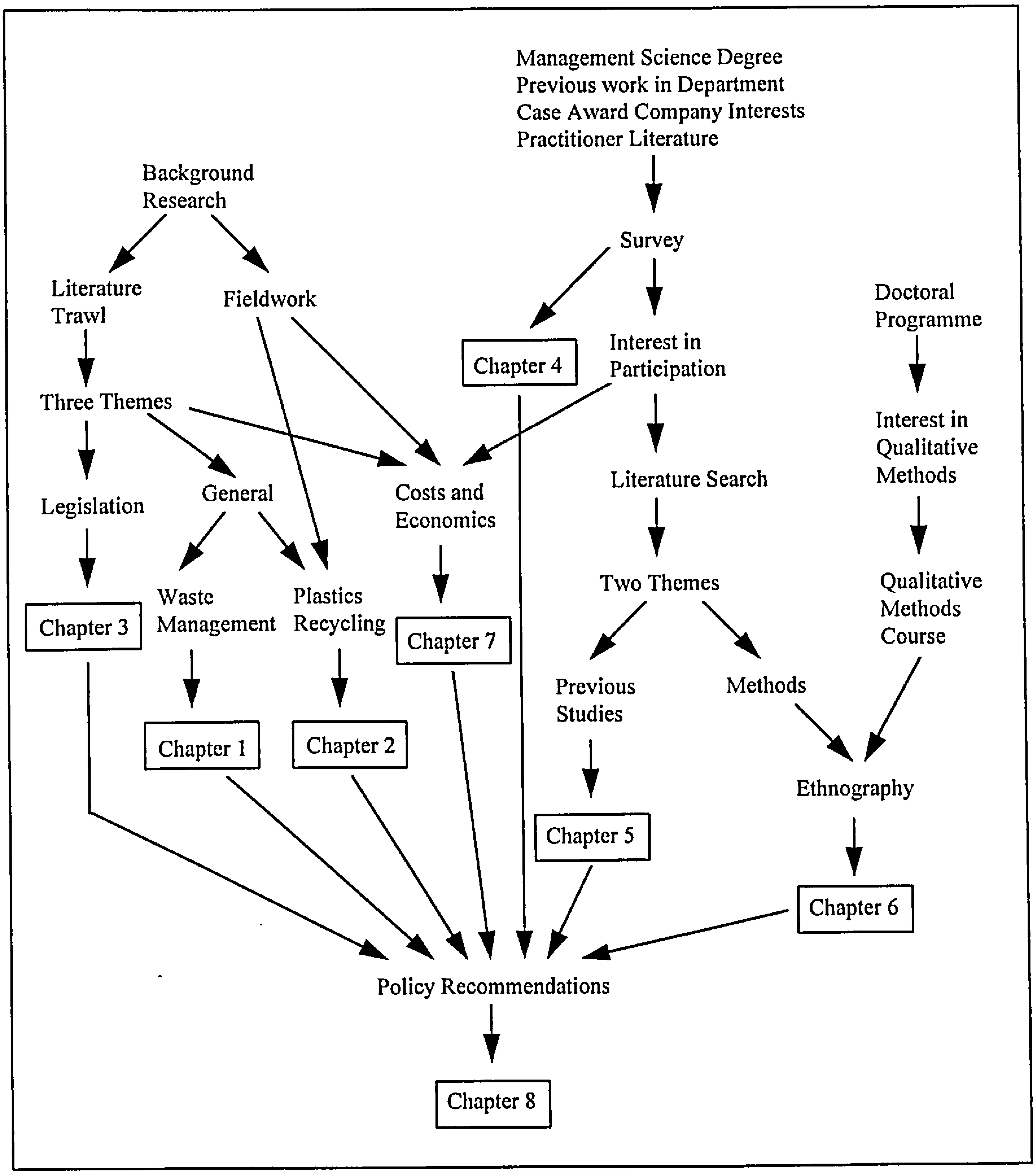


Figure 1.6 The doctoral research process

Having carried out this research, the critical rôle of the Public in successful post consumer plastics waste recycling began to become apparent. Through experience gained from the use of the research instrument described above, the difficulty of researching issues such as participation and motivation in general, and the unsuitability of quantitative survey in particular, was also made clear. These discoveries led to a move away from the idea that post consumer plastics recycling would be studied and modelled as a system, and issues of scheme design, to a new focus on the problems of participation.

This new focus was facilitated by the fact that the Case Award company, who were a wholly owned subsidiary of BP Chemicals, were closed down as part of a company-wide reorganisation around this time. The ties to the original industrial supervisors were therefore broken and the parent company had little interest in the future direction of the research.

The first task undertaken in the pursuit of understanding the participation issue was a literature search. This crucial factor in the success of a recycling scheme has often been overlooked in the literature. Later study found it similarly ignored by practitioners and in the legislation. Although there have been a few studies carried out recently in the UK (Ball & Lawson, 1990; Ball & Tavitian, 1992; Belton et al, 1994), the declared motivation behind recycling behaviour is taken as reported by individuals and is not treated as central. In the search for literature that addressed these issues more directly, the journals belonging to the field of psychology proved to be the richest source. They reported many, primarily US, studies which had used various intervention strategies and recorded their affects on recycling rates. This work is reviewed in Chapter 5.

During this work, the author was enrolled on a Doctoral Programme which aimed to teach research methods and methodologies to doctoral students from social science backgrounds. As part of this course, a session was presented on Qualitative Methods. These were well outside my range of experience as a traditional Management Scientist and raised questions about the suitability of different research methods for different types of research questions. These new ideas were both appealing in themselves and seemed to have much potential in terms of studying participation issues. To learn more, a course on Qualitative methods was taken. This provided support and advice for the next empirical study. The resulting ethnographic research is presented in Chapter 6.

In terms of the stakeholder analysis outlined above, this trio of studies featured in Chapters 4, 5 and 6 is most concerned with understanding how the interest of the Public can be raised to a degree that will move them into the high interest, high power quadrant of the stakeholder chart, as depicted in Figure 1.5.

This study was began with no previous knowledge of the fields of waste management or plastics recycling. As well as the course of study outlined above, what can only be described as a literature trawl was carried out in parallel. The intent of this was to provide background information and context for the empirical work. There is a general dearth of information relating to plastics recycling. Much of the information which does exist is often fragmented, not widely available, and is neither discussed by the research or practitioner communities, nor directed towards the bodies who could use their influence to change current practice. Where academic literature relating to recycling does exist, it is dispersed between several disciplines. One of the objectives of this thesis therefore became to both find and create more information relevant to plastics recycling and bring it together in order to inform policy making and encourage debate across disciplinary boundaries.

The trawl of the literature included visits to RECOUP and the library at SWAP which proved to be rich sources of information about plastics recycling. This strategy, combined with thorough searches of databases associated with various academic literatures uncovered quite a lot of information which had a wide range of mediums and concerns. There were three themes in this literature and information search that were of particular interest. The first of these was general information about the processes of waste management and recycling in general, and plastics recycling more particularly. The general literature is summarised in the first half of this chapter, whilst the plastics recycling literature is presented in Chapter 2.

What could be found about plastics recycling from a literature and information search was quite limited. In order to fill out the account of the industry and gain insight into the issues important to those directly involved in plastics recycling a programme of fieldwork was undertaken. This involved site visits to recycling schemes in operation in Glasgow and Peterborough, and a reprocessing operation, as well as a week of voluntary work at recycling schemes in Falkirk and Sheffield. This fascinating study resulted in first hand experience of the procedures and problems associated with post consumer plastics waste recycling. The information gained from the literature search and the experience of visiting and working with plastics recycling operations has resulted in the comprehensive description of the plastics recycling industry presented in Chapter 2. The stakeholders represented here are the Collectors, the Reprocessors, RECOUP, and the Second Life Applications Manufacturers.

During the initial literature trawl, one of the things that soon became apparent was that much more was being done in terms of plastics recycling outside the UK, and that this activity was often associated with legislation. A specific study of the different kinds of legislation in use was therefore undertaken. Perhaps one of the most significant events for the UK post-consumer plastics recycling industry in the last decade is the development of EC legislation designed to ensure minimum levels of recycling in member countries. The introduction of the European legislation is traced in Chapter 3. This legislation is much more demanding and comprehensive than that currently implemented by the UK government. In order to meet the targets specified in this legislation, the UK will require a much higher level of recycling than it currently achieves. One of the possible routes to obtaining this increase in recycling activity is through the introduction of more prescriptive legislation. Attention is therefore given to the policies that have been implemented in other parts of the world in order to study the experiences of other countries in this matter. As can be seen from the discussion of barriers to recycling above, the potential influence of Government policy and funding in this area cannot be under estimated. This study concentrates not so much on how the interest of the Government could be raised in order to make it a powerful and interested stakeholder, but explores the ways in which different actions by the Government might alter the constraints or stimulate the market forces associated with other stakeholders.

Another important theme that is found in the literature pertaining to plastics recycling, and perhaps more importantly, in the concerns of the practitioners, relates to the cost of recycling post-consumer plastics waste. Cost is a very contentious issue for plastics recyclers as a financial breakeven is currently the primary measure of their viability and almost invariably outside their reach. Within the literature there are a variety of different approaches to, and reports of, costs which are often conflicting. The final empirical study for this thesis set out to explore the full costs of recycling in an explicit way and, continuing the participation theme, look at the impact that participation rates have on the costs of recycling. This has been done through the building of financial models and is reported in Chapter 7. Using costs as a principal indicator of success is to assume that the principal aim of a plastics recycling scheme is to make money. This assumption is not representative of the goals of the individuals involved in post consumer plastics waste. In order to try to widen the definition of success, a number of other possible measures, related to other possible goals, are presented in the final part of this Chapter. This study is concerned with the view point of the Collectors.

A lot has been learned throughout the course of study described above, both about the research process and the subject of plastics recycling. Insight has been gained through several different, complimentary empirical studies, practical experiences and courses of reading. The results of these various courses of study have a practical significance in that they pull together existing knowledge, and also create new knowledge about different aspect of plastics recycling. These results are brought together and summarised in a policy framework with the hope of providing specific and appropriate advice to each of the stakeholders identified earlier, that they in turn may instigate the shifts in attitude and influence required to promote a higher level of post consumer plastics recycling in the UK.

1.5.2 Summary of aims

The focus of this thesis is on participation, the goodwill transaction between the Public and Collectors of post use plastics from the domestic waste stream. To better understand this relationship, in terms of the stakeholder analysis described above, it concentrates on the perspectives of the Public and Collectors.

In general terms, the aim of this thesis is to ascertain the current position of the plastics recycling industry and develop a set of recommendations for its development, aimed at realising the movements indicated in Figure 1.5 and thus encouraging sustainable waste management practices. One of its principal concerns is to highlight the crucial rôle of the Public and explore ways in which they can be encouraged to support plastics recycling.

In order to achieve this, the thesis takes a practical and empirical approach, aiming to ground the study in experience. By taking this approach, it hopes to understand the reality of plastics recycling so that it may provide practical advice and influence policy makers from an experiential rather than theoretical point of view. It is important to the author that the doctoral process should not be geared towards writing a big, dusty book. The study hopes to inform practice and make a difference to the ways that plastics recycling is carried out in the UK. It is undertaken with the hope of promoting the level of post consumer plastics waste recycling and thereby making a contribution to the reduction of the environmental impact of the current waste disposal methods favoured in this country.

Another of the aims of this work is to explore the issues around post consumer plastics waste recycling by studying the problems of the industry from a number of methodological viewpoints, and through more than one research method. As Denzin believes, "each method implies a different line of action toward that reality and hence will reveal different aspects of it, much as a kaleidoscope, depending on the angle at which it is held, will reveal different colours and configurations of objects to the viewer" (Denzin, 1970). This approach has proved particularly useful in a situation which has little previous work with which to compare the findings of this thesis, and has so many stakeholders with differing aims and views of the system.

As has already been stated, another aim of this thesis is to both present and create more knowledge about plastics recycling. Coupled with a vigorous dissemination strategy, it is hoped that this surfacing of information will help inform the disparate members of the packaging chain. The information presented in this thesis hails from many disciplines. The practical and theoretical are both represented. This is an intentional strategy through which it is hoped to provide a rich view of post-consumer plastics waste which transcends academic boundaries and the perspectives of individual stakeholders. This is most explicitly represented by the quantitative and qualitative approaches to the question of participation taken in Chapters 4 and 6 respectively.

1.5.3 Outline of Thesis

To summarise from the above account, the thesis contains, in the following order:

Chapter 2 - Current practice in plastics recycling

This chapter follows the variety of paths taken by plastic bottles from household waste to new product.

Chapter 3 - A review of legislation pertaining to plastics recycling

This chapter looks at the legislation which has been put in place to encourage and control the recycling of plastics from domestic waste. It includes summaries of European and US legislation as well as some of the approaches taken in various countries around the world.

Chapter 4 - Recycling behaviours, attitudes and perceptions in Glasgow and Falkirk: A quantitative study.

This chapter is based on the analysis of a structured questionnaire administered to 500 members of the public in Glasgow and Falkirk. The aim of the questionnaire was to discover how and why people were using the pilot schemes in these two areas.

Chapter 5 - Motivational aspects of recycling: A literature review

This is an exploration of the factors which affect participation in recycling programs. It summarises the work done, mainly by psychologists and sociologists, in this field.

Chapter 6 - An ethnographic study of plastics recyclers

In depth, unstructured interviews were carried out with plastics recyclers in order to find out how and why they recycled their plastic bottles.

Chapter 7 - Evaluating plastic recycling programs: Economics and participation

This chapter is a study of how much it costs to recycle post consumer plastics waste, and how those costs are affected by participation rates. It also looks at other ways in which plastics recycling can be assessed.

Chapter 8 - Conclusions and Recommendations

The conclusions of the various strands of research are summarised here in a policy framework. Recommendations are made for all bodies involved in the process of post consumer plastics waste recycling. Areas for further study are also outlined.

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Chapter 2: Current Practice in Plastics Recycling

2.1 Introduction

The aim of this chapter is to investigate the current state of the post-consumer plastics waste recycling industry in the UK. In order to assess the best way forward for the UK in terms of plastics recycling, it is important to evaluate the actions that are currently being undertaken. Only once the framework of current practice is fully known, can a practical system of improvement and development be evolved.

As has been discussed in Chapter 1, the location of this information is not a straightforward task. It is dispersed through many different media including the practitioner journals, papers given at recycling conferences, local and national newspapers, council newsletters and the publications of a number of companies and industry bodies. Although this makes the task of bringing relevant information together difficult, it must therefore also make it all the more important.

Much of the practical information contained in this chapter has been gleaned from a programme of field work undertaken in early 1993. This included visits to the Leeds, Peterborough and Glasgow recycling systems and Reprise in Liverpool, as well as work placements with the Falkirk and Sheffield schemes.

2.1.1 The growth of plastics recycling

The first instance of collecting post consumer plastics waste for recycling in the UK dates back over a decade. In April 1981, BPF launched an experimental scheme in Bradford to collect PET. This was known as the PET- A-BOX scheme, after the receptacles used for collection of the bottles (Incpen, 1982). 1990 saw the formation of RECOUP (1990(a)) (See Figure 2.1). RECOUP is a non-profit making, industry funded company. It is supported by companies who make, fill and sell plastic bottles. Its role is to co-ordinate, advise and help fund post consumer plastics waste recycling programs in the UK. At the time of its formation, there were around seven different collection schemes running in the UK.

RECOUP

Figure 2.1 RECOUP's logo

They were all small scale projects run by various members of the packaging chain. Table 2.1 below shows the location of these schemes and their associated 'sponsor'.

Location	Sponsor
Glasgow	BXL
Leeds	RECOUP
Liverpool	Reprise
Milton Keynes	RECOUP
Newcastle	Proctor & Gamble
Northants	Smiths Containers
Sheffield	British Soft Drinks Association
Sheffield	British Plastics Federation

Table 2.1 The locations and supporters of the first post consumer plastics recycling schemes in the UK (RECOUP, 1990(b))

In the UK, there are currently 130 collection schemes for post consumer plastics waste. These are situated all around the country. The schemes are mostly run by local authorities, although there are a handful run by voluntary or not-for-profit organisations. Together, these projects provide 1600 banks and kerbside collection for 365000 homes (RECOUP, 1995(a)).

All of these schemes have links with RECOUP and are aimed specifically at plastics bottles. Bottles have been chosen because they constitute a larger concentration of relatively uncontaminated polymer, in an easy to identify form. Without the work of RECOUP, the recycling of plastics from domestic waste would still be, to a large extent, theoretical in this country. RECOUP strives for an integrated approach which addresses the problems at all stages of the recycling operation, from streamlining collection and sorting technology to developing markets for the recycled materials and the products that are made from them.

Year	Tonnes Collected	Recovery Rate (as a % of bottles)	Recovery Rate (as a % of plastics)
1990	340	0.14%	0.04%
1991	900	0.36%	0.10%
1992	1500	0.60%	0.17%
1993	2360	0.94%	0.27%
1994	3000	1.20%	0.34%
1995	4200	1.68%	0.48%

Table 2.2 UK post consumer plastics bottles recovery rates (RECOUP, 1995(a))

Table 2.2 shows the recovery rates for post consumer plastics bottles since 1990. Although the recovery rate is clearly growing all the time, there is still a long way to go to make a significant impact on UK plastics waste.

2.2 Recycling Processes

The following sections outline the various different ways in which post consumer plastics wastes are processed by the recycling industry.

2.2.1. Collection

There are three main methods of collecting post-consumer wastes for recycling:

2.2.1.1. Bring Systems

The familiar bottle bank is an example of a bring system; containers are provided at various sites for members of the public to deposit their recyclable wastes. These containers are then serviced and the different waste types are combined centrally. Contribution is entirely voluntary and unmonitored. The public is responsible for the cleaning and separation of the deposited materials. There are many different variations in bank type throughout the country. Most of the schemes use orange as the chief colour of the bank, in order to promote a national consistency in bank identification. One of the most distinctive bank types is the Bertie Bottle Box (See Figure 2.2).

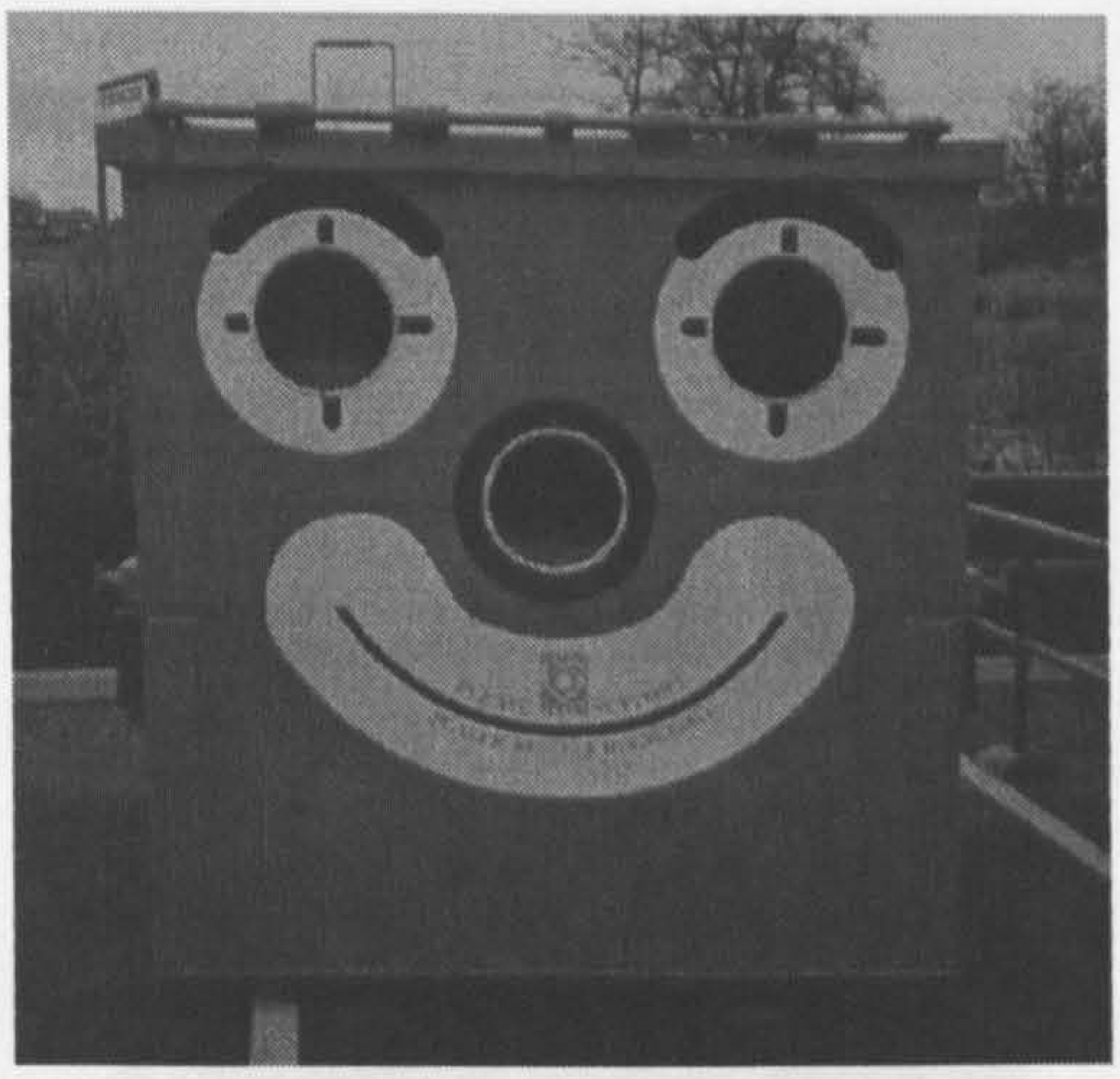

Figure 2.2 A Bertie Bottle Box

This was introduced in order to raise the profile of the scheme and appeal to children. The Bertie Bottle Box comes in 10 cubic yard and 8 cubic yard sizes. They are emptied using a specialised, front loading vehicle which compacts the bottles, once they have been collected (See Figure 2.3).

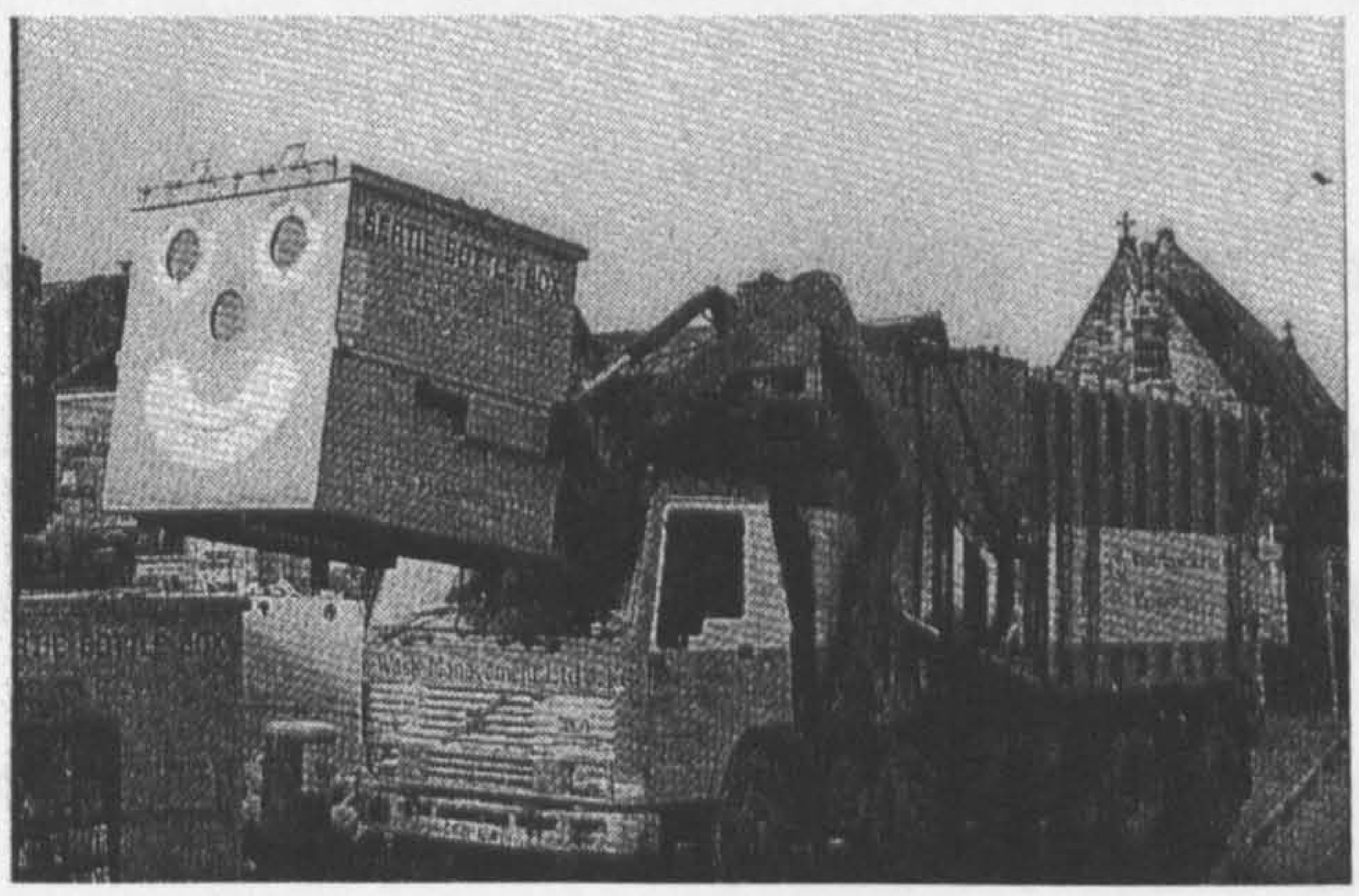

Figure 2.3 A Bertie Bottle Box being emptied

Figure 2.4 The GDCCD bottle-shaped bottle banks

Another bank type which uses a similar attention grabbing strategy is the bottle shaped bank utilised in Glasgow and Strathkelvin (See Figure 2.4). These banks are 5 Cubic metres in size. They are emptied from the bottom in a similar way to glass bottle banks (See Figure 2.11).

One of the latest bank types to be utilised in the collection of plastics bottles is the net cage (See Figure 2.5). These banks are split into three compartments, to allow the public to separate its plastics by polymer. The three sorts are PET, HDPE and PVC. Information is provided at site to enable the public to identify the different polymers. The different polymers and their characteristics will be discussed in detail later.

The nets themselves can be lifted out of the frame by tying up the ends and using an overhead lift to load the full net on to a HIAB vehicle (See Figure 2.6). The cage is then manually lined with another net, from the ground. This system is not automated, but can be efficient and entails less initial capital than many of the other systems because so much less specialised equipment is required. Another advantage of the net cages is that the nets provide the public with a visual prompt for sorting the polymers and thus aid the education process. This bank type comes in a number of different sizes.

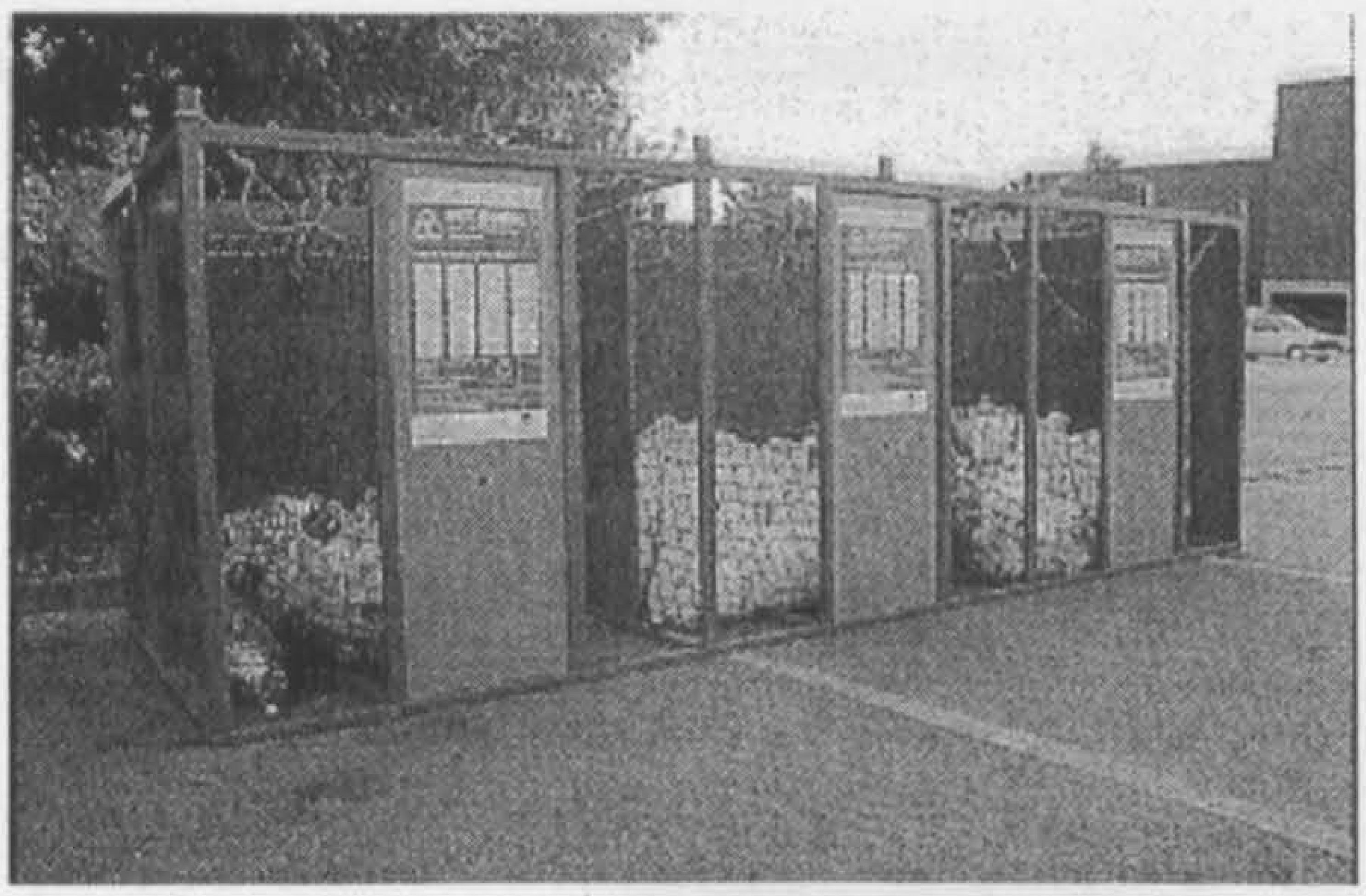

Figure 2.5 A set of net cages

Figure 2.6 A HIAB loading the nets full of bottles from a net cage bank

Banks also come in the form of wheelie bins. Figure 2.7 shows both of the most common types currently in use.. These are quite popular, and range from 100 litres up to 1100 litres, which is the most common size. Wheelie bins are generally emptied using a specialised vehicle which has an automated mechanism which lifts them up and empties them (See Figures 2.8 and 2.9).

Figure 2.7 Two common types of Wheelie bin

Figure 2.8 A large wheeliebin being emptied

Figure 2.9 One of the smaller types of wheeliebin being emptied

Some schemes have used banks which are very similar in shape to the bell-shaped glass bottle banks (See Figure 2.10). These generally have a capacity of around 2.5 cubic yards.

Figure 2.10 An example of an igloo-shaped bank for collecting plastics

Figure 2.11 An igloo shaped bank being emptied

They are emptied by lifting them up with a mechanical arm, or HIAB, and then opening the trapdoors at the bottom to allow material to fall out into a lorry, as shown in Figure 2.11.

Other schemes have utilised skips to serve as collection vessels for their plastics (See Figure 2.12). Again, there are a variety of different sizes used. The one pictured is one of the Sheffield banks which would have a plastic liner which would be removed manually, but others, which have open tops are removed with a specialised vehicle and tipped up at the central processing site before being returned to their collection site.

Figure 2.12 An example of a bottle skip

Not all schemes have chosen one bank type, but instead have varied the type of receptacle subject to factors such as return level or available space for each site or site type. Other schemes, like Sheffield have simply made use of what was most readily available or least expensive. This has led to the use of a number of different bank types. In order to achieve a degree of standardisation in servicing of these different bank types, a plastic liner has been utilised. The liners are removed and replaced manually. The full bags are then placed on the tail lift of a low loading vehicle and then packed on top of one another. The plastic liners are used throughout the processing of the bottles recovered by the Sheffield drop off scheme and are reused many times before they must be discarded.

2.2.1.2. Collect Systems

Here, recyclable wastes are sorted and stored in the household, often in one or more containers which have been provided by the scheme organisers. These containers are then left at the kerbside to be emptied, sometimes along with normal rubbish collections, sometimes by a separate collection. Again, participation is entirely voluntary and the public is responsible for the cleaning and sorting of recyclables.

Like the bring schemes, there is a degree of variation between schemes as regards collection receptacle. In Falkirk and Cardiff, for example, a green bag is distributed amongst the participating public and is later collected from the kerbside. The scheme in Falkirk has just introduced the collection of aluminium cans in the same bag as the plastics bottles. In Sheffield, on the other hand, all recyclables are stored in a blue box by the householder (See Figure 2.13) and sorted by the driver into a specialised vehicle which keeps the recyclables separate and can compact them at different rates (See Figure 2.14).

Figure 2.13 Putting blue boxes out for collection

Figure 2.14 The Sheffield collection vehicle

Milton Keynes works with a similar principle, but the materials are simply kept in different vats on the same vehicle (See Figure 2.15).

Figure 2.15 The Milton Keynes collection vehicle

Another variation in both bring and collect schemes is their scope. Kerbside schemes range from large scale, city wide operations such as Leeds and Milton Keynes which serve 80000 and 70000 households respectively, to smaller schemes, such as Worthing which collects plastics from 5500 homes.

2.2.1.3. Mechanical Processing

With this method, rubbish is collected from households as usual and then sorted mechanically to separate recyclables from the rest of the waste. Contamination is a big problem and highly sophisticated machinery is needed to detect, separate and clean recyclables. Often many processing and reprocessing stages are required to obtain a suitable quality of materials.

2.2.1.4. Other Options

As well as collecting mixed (sometimes called commingled) recyclables from the kerbside, it is possible to collect them in this way using a bank system. This is becoming popular in the US for a number of reasons. A mixed bank does not take up as much room as a series of separate ones. Many recycling centres can house three glass banks for clear, green and brown glass, up to two paper banks which hold different grades of paper, aluminium and/or steel drinks cans banks, and up to three plastics banks. This is not only taking up a great deal of space, but can also be regarded as an eyesore. A mixed bank would need to be serviced more regularly, but this would not necessarily affect the initial outlay of capital, rather provide a higher utilisation rate for the equipment. One of the main advantages of mixed banks is that less capital is required to start the scheme in terms of the banks which must be bought. In heavy residential areas, banks for commingled recyclables might be more easily sited than a recycling centre in its present form, not only due to its lower space requirements and greater aesthetic appeal, but also because the depositing of commingled recyclables is much quieter than, for instance glass alone (Eyre, 1993).

One of the options that is considered for other materials, but is dismissed for plastics is reuse. Since plastic cannot be sterilised at the same high temperatures as glass, it is often assumed that it cannot be reused. There is currently a pilot scheme being undertaken to wash and reuse injection moulded PP mushroom trays. This has so far demonstrated that the trays can be returned to the extremely high level of cleanliness required to preclude the many mushroom diseases. This research may well prove that, in some cases reuse of plastics is possible.

2.2.1.5 Summary

Of the 4200 te of post consumer plastics currently collected in the UK, approximately half is contributed by banks whilst the other half comes form kerbside schemes. More and more schemes are deciding to employ a mixture of both collection types. There are currently no examples of mechanical processing in the UK. This is partly due to the huge amount of capital required to start such a venture. Many of the schemes in the UK are still small scale or of an experimental nature, precluding mechanical processing as an option.

There has been much debate over which of these collection types is the best. Each has its advantages and disadvantages, its proponents and critics. Many experts advocate collection schemes due to the high participation rates that can be achieved (Sahm, 1990; Folz, 1991; Markowitz, 1991). Jeff Cooper, on the other hand, believes that kerbside schemes have become fashionable and are often adopted without proper evaluation of alternatives (Cooper, 1991). It is his belief that an intensive system of banks would be a better option. Elaine Lambert (Lambert, 1991) points out that these systems are not mutually exclusive and calls for them to be integrated. This seems to be the favoured design for RECOUP schemes at the moment. Such a large proportion of collect schemes also make use of collection banks to service flats, city centres or remote areas, that rather than categorise schemes as bring or collect, RECOUP now makes a distinction between Bring schemes and Kerbside/Bring schemes (RECOUP, 1995(a)).

2.2.2 Sorting

95% of the plastics which are used to make the bottles found in the domestic waste stream are made from three different polymers: Polyvinyl Chloride (PVC), Polyethylene (PE), which comes in high and low density types (HDPE and LDPE), although only the HDPE is used to any great extent in bottle manufacture, and Polyethylene Terephthalate (PET). The two other most common polymers are Polystyrene (PS) and Polypropylene (PP) (BPF, 1992) (See Figure 2.16).

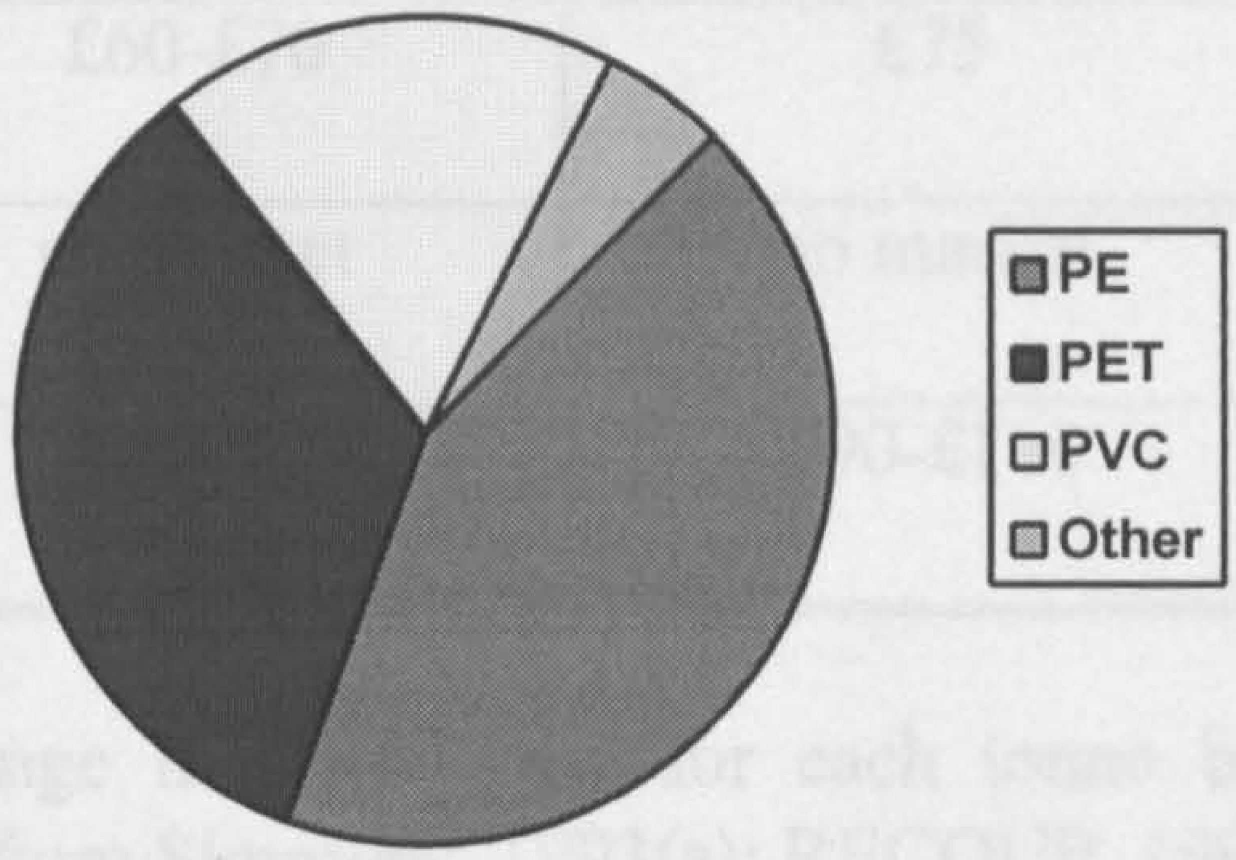

Figure 2.16 The proportions of polymers used for the manufacture of bottles

In most cases, these bottles are collected together and therefore must undergo a sorting process before they can be baled and sold. If polymers are not sorted, they will not fetch a very high price per tonne (see Table 2.3). This is because sorted polymers are of an increasingly high value to a greater number of processors. Sorted polymer can be used as a direct feedstock for a number of the reprocessing operations, with only a check sort required, rather than the time and expense of sorting from scratch. Therefore, sorting is in the interests of collectors. As the collection industry has progressed, more and more schemes have developed the facilities to sort their plastics. This is in response to the price differential set by reprocessors who are becoming reluctant to accept unsorted material (See Table 2.3).

Polymer	1990-1993 Prices	1994 Prices	1995 Prices
Mixed Polymers	£50	£25	£40
Coloured HDPE	no separate market	£75	£175
Natural HDPE	£100	£100	£120
Clear PVC	£60-£70	£75	£100
Coloured PET	no market	no market	£100
Clear PET	£100	£90-£110	£200

Table 2.3 The change in prices paid for each tonne baled bottles of various polymers over time (from Simmons, 1993(a); RECOUP, 1994; RECOUP, 1995(a))

One important stage in any sorting operation is the removal of items which cannot be recycled by the system. These are termed *contraries.* There are two types of contrary: plastic contraries and non-plastic contraries. Plastic contraries are often items which have been made from polymers which are not handled by a scheme or have contained products which will cause contamination further along the reprocessing chain. Much of this is caused by the over enthusiasm of members of the public who include as many plastic items as possible in the hope that they will be recycled, often despite clear guidelines. Non-plastic contraries are more common in bring schemes, where banks have been mistaken for glass recycling banks or used as litter bins. The removal of contraries is a straightforward exercise which can be done either as a negative (remove contraries from the rest of the items collected) or positive sort (take out all useful fractions, leaving the unwanted component to be collected as rubbish).

Sorting plastic bottles into their polymer types is not the complex operation that people imagine it to be. The three polymers which are collected can easily be identified by looking at the bottles. The most common method used to sort plastics bottles is manual sorting by production markings. The characteristics of the base of a bottle are used to tell the polymers apart. PET bottles are those bomb shaped, clear bottles which are used to store carbonated drinks. The base of these bottles is often petaloid in shape, or sports a base cup. The other feature of PET bottles is that there is a spot in the middle of the bottom of the bottle, as a result of the process used to manufacture them (See Figure 2.17).

Figure 2.17 RECOUP sticker for PET identification

The other clear polymer type is PVC. This is often used for still juice as well as for mineral waters. PVC bottles have a pinch mark, or "smile" on their bases (See Figure 2.18). If there is any doubt about whether a clear bottle is PET or PVC, simply putting a finger inside the neck will clarify this: The inside of the neck of a PET bottle is smooth, whilst in a PVC bottle, the relief of the screw thread can be felt.

Figure 2.18 RECOUP sticker for PVC identification

HDPE is the last polymer and this is used for washing up liquid, fabric conditioners and other household cleaning products. These are easily identified as they are opaque and often brightly coloured. HDPE bottles also have a straight pinch mark on the bottom, again caused by the manufacturing process (see Figure 2.19).

Figure 2.19 RECOUP sticker for HDPE identification

Manual sorting (See Figure 2.20) can be learned quickly and easily by those with no previous knowledge or skill. In Sheffield, the sorting team is a group of adults with severe learning difficulties. Many of them have previously been regarded as unemployable due to their handicaps, but they have proved themselves able to sort plastics with 95% accuracy level and above. Since none of them can read or write, a series of names has been given to the different sorts. They use the following system of identification with great success:

Pops	(PET soft drinks bottles, with petaloid bottoms or base cups)
Bubbles	(Other PET bottles)
Smiles	(PVC bottles)
Washups	(HDPE detergent bottles)
Milks	(HDPE milk bottles)
Yoghurts	(PS pots and cartons)

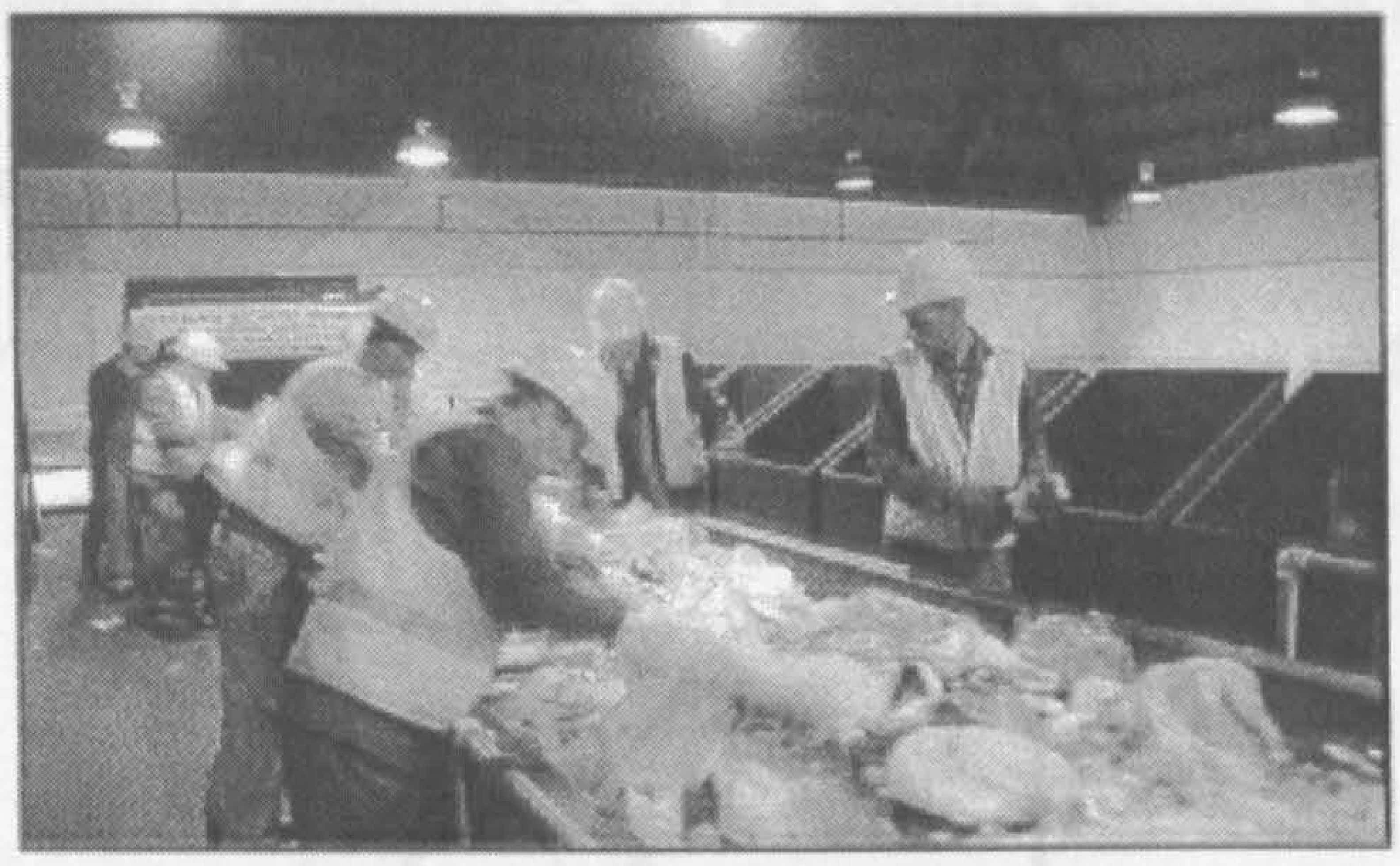

Figure 2.20 Manual sorting of polymers

As well as selecting all these different types, they also ensure that no green or brown PET bottles (for which there is currently no market) or ketchup bottles (which are laminated with a second polymer type) are kept, and that motor oils and butter and margarine tubs are thrown away, as these cause contamination at the reprocessing stage.

Falkirk operate a similar system, but for fewer materials. Amongst their team of sorters are some mentally handicapped students who are taking part in a work experience programme.

In order to speed up the sorting process, conveyor belts are often used, along with a series of bins or nets. Any such system is known as a Materials Reclamation Facility (or MRF). MRF design has recently been the subject of much research in this country by RECOUP. RECOUP has developed a basic MRF design which requires a low level of initial capital, but which is flexible enough to be changed easily as capacity increases. This is a particularly important consideration as many schemes start out at a pilot or trial level.

There has been a number of attempts to aid this sorting process by labelling the bottles, according to polymer. One of the most common is the SPI coding system, which hails from the US Society of Plastics Industries (RECOUP, 1993). The codes are shown in Fig. 2.21 below.

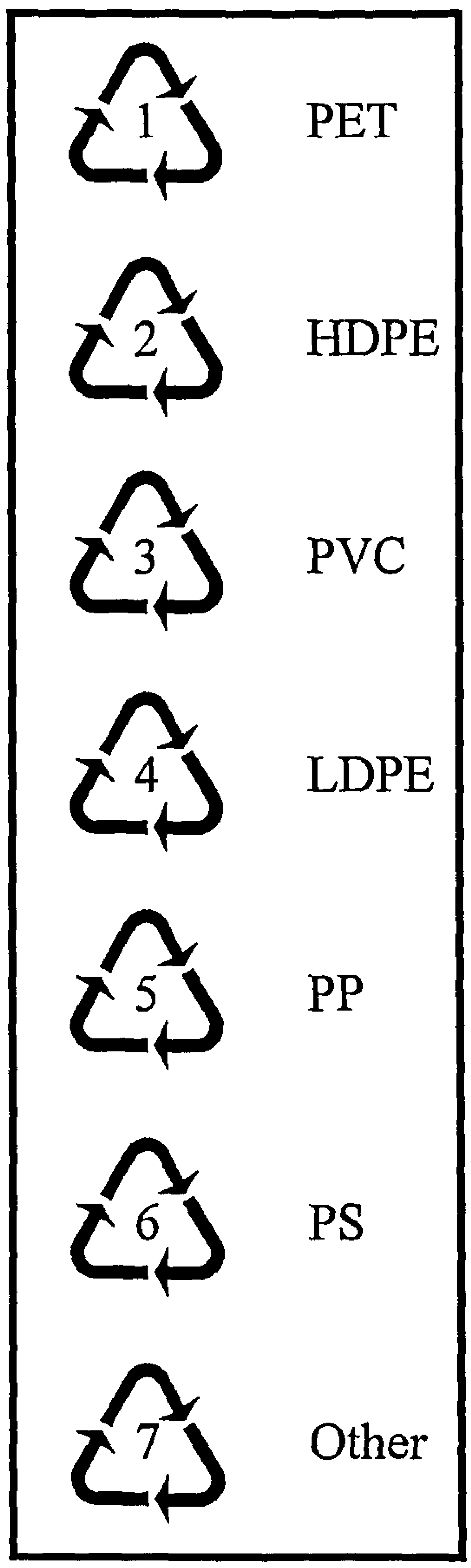

Figure 2.21 SPI codes for polymer groups

These codes are not yet universal, but certainly provide the basis for an efficient and accurate process. Some banks in the States have seven numbered compartments for the public to sort the different polymers into, in a similar way to the net cage previously discussed. This principle greatly reduces the time needed to sort each tonne of polymer and makes the whole process much more financially viable. Many people are sceptical about the ability of the public to sort by polymer type, but the scheme in Hemel Hempstead which is using the split net cages, has found that the general public is achieving a sort which is 80% accurate, with higher rates of success on manned sites (Simmons, 1993(a)). This scheme is not relying on any form of identifying code, but educating the public to recognise the production marks.

In Sweden, there is a system of colour codes to identify the different polymers. Again there are compartmentalised banks, but with different colours corresponding to the polymer types. This system seems to have a slight advantage over the SPI codes as colours are more easily recognised by the young, illiterate, or visually impaired.

2.2.2.1 Mechanised Sorting

There is a number of projects around the world which are concerned with automating and mechanising the sorting operation. Switzerland is currently piloting a system which involves printing bar codes on the bottles to identify the polymer. These can then be scanned and sorted automatically (Kenny & Bruner, 1992). RECOUP reports a similar system which intends to make use of different tracer dyes added to the various polymer groups (RECOUP, 1995(b))

Another method, currently under investigation by two UK engineers, involves the use of ultrasound. This method measures both the energy loss and the time taken by the ultrasound beam when it passes through the different polymers. The developers, Hull and Langton, believe that this system could provide a more accurate sort for polymers than is currently available to reprocessors and also be able to sort bottles when they are crushed together, allowing more compact bales to be used (Young, 1994).

The polymers can also be sorted by relying on the differences in some of the bottles' physical properties, such as density or melting points. This kind of sorting is used both to separate mixed plastics which have been baled together and as a final check for bales of single polymer.

The Reprise sorting plant operating in the UK is an example of this sort identification technique. It utilises X-ray technology to detect property differences in the ability of the different polymers to hold electrostatic charge. This technique will be described more fully in the reprocessing section below.

Researchers at the University of Southampton have developed a hand held device, not unlike a light pen, which can also identify various polymers using their ability to hold static charge as a guide to their identity. This uses a technology called triboelectricity which can predict the amount of charge that will be created when different polymers are rubbed against the head of the pen. The pen has a system of lights to show which family of polymers the tested polymer belongs to (Young, 1995).

Whichever technology is eventually employed to sort the plastics, it is clear that a pre-sort undertaken by the public would make the process more accurate and efficient. Educating the recyclers to recognise the individual polymers would not only save collectors and reprocessors both time and money, but also reduce the number of plastics contraries present in collected plastics. The reduction of contraries which have previously been collected, transported and sorted will help improve system efficiency.

2.2.3 Baling

Once bottles have been sorted into polymer type, they must be baled. This is done in order to compress the bottles and so make a more compact load for transportation. If bottles were not baled, they would not only be a lot less convenient to move around, but a great deal of money would be spent transporting air. Initially, reprocessors would accept a proportion of loose bottles, but now insist on their feedstock being delivered baled.

There are many different types of baler, ranging considerably in size and level of automation. The smallest baler is a batch baler, which is loaded and wired manually. This type can be loaded up with bottles and then the top is closed, allowing the bottles to be compressed either horizontally or vertically. The baler is then opened again and another batch of bottles is loaded in. Once the baler has compressed enough bottles to make a bale, wires are threaded around the outside of the compression compartment and pulled tight. The bale is then released, expanding until the give in the wires has been eliminated. Cardboard is often used to line the compression chamber at one end. This helps produce firm bales which do not break up. This is particularly important for the heavier polymers which do not squash as much as the other types and thus create a looser bale. Sheffield can bale up to 8 bales of bottles in this way in a working day.

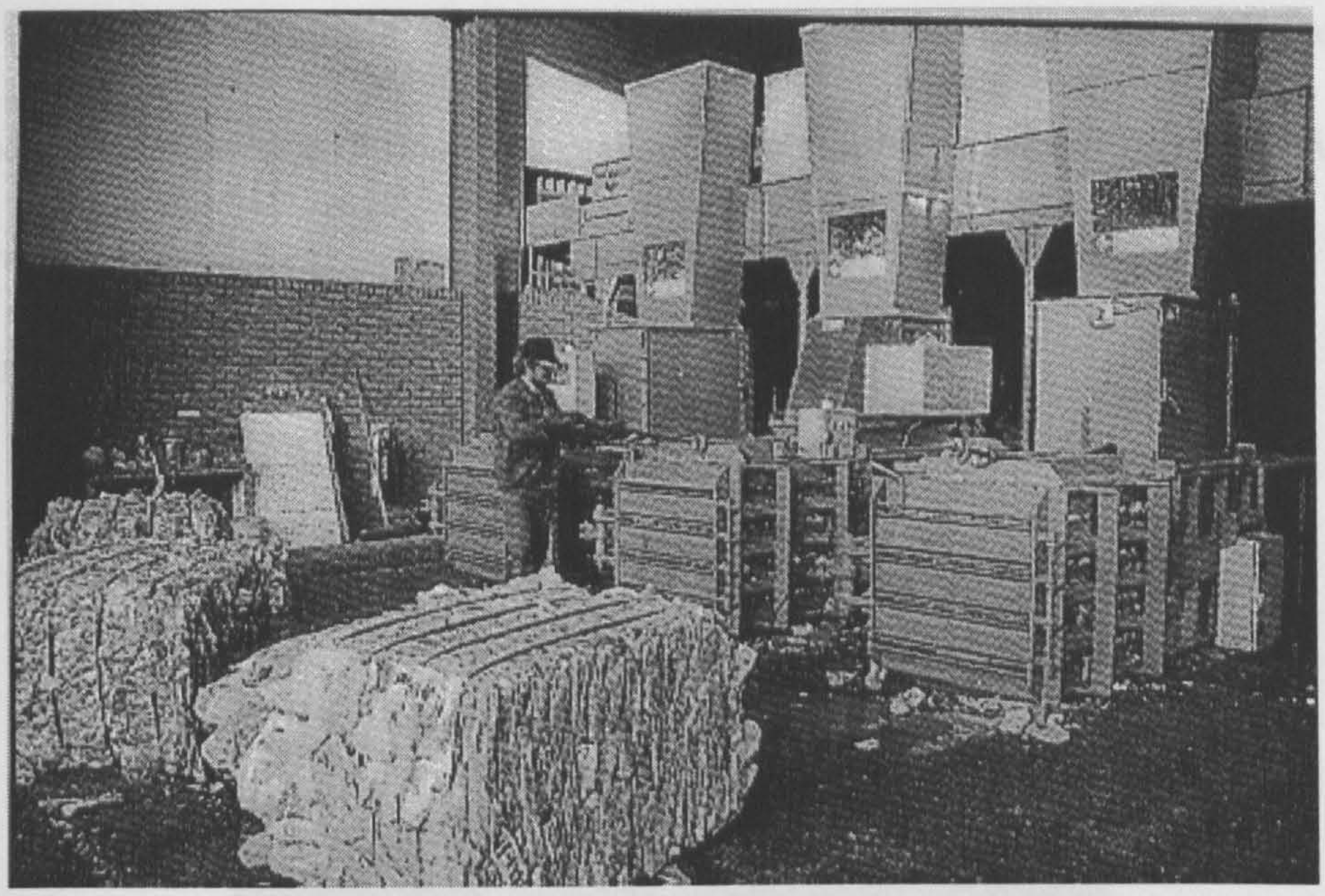

Figure 2.22 A semi-automatic baler in operation

A slightly larger amount of bottles can be baled if at least one of the processes is automated. In Falkirk, bottles can be loaded into a pit where a conveyor takes them to a feeding hopper. This in turn feeds the baler itself which comes to a halt once a full bale has been processed. An operator then wires the bale as before. A comparable system is shown in Figure 2.22. Glasgow has a fully automated baling system which also has a vertical feed, but the bales are wired automatically. This means that the plastic bottles can be processed much more quickly.

Each of the different polymers will produce a slightly different type of bale. Although all of the bales ought to be 1.2 by 1 by 0.8 metres in size, they vary quite considerably in weight. Both PE and PVC bales should be between 150 and 200 kg, whilst PET bales should be between 250 and 350 kg. These limits in bale density are set by the reprocessors and represent a degree of compaction which will allow the bale to be easily handled without disintegrating, but at the same time allow the individual bottles to remain intact and easily separated during reprocessing. For full bale specifications, see Appendix 1. Figures 2.23 and 2.24 show bales being stacked for storage, and loaded on to a lorry for their journey to the reprocessors.

Figure 2.23 Bales are stored until there is enough for a full lorry load

Figure 2.24 Bales are transported in bulk to the reprocessors

2.2.4 Reprocessing

In the Reprise plant in Liverpool, bales of plastic bottles which have arrived from collection schemes all over the country are loaded onto a conveyor belt where they are opened manually (Figure 2.25 shows a schematic diagram of the Reprise plant layout). Any obvious plastic or non plastic contraries are removed manually at this stage. This is done using a positive manual sort: in other words, bottles which the operatives recognise as being one of the three polymers required by the system are picked out and fed into the first processing stage, others are ignored. Any plastic scrap which results from this sort is landfilled. The bottles which are left first pass through a 'VinylCycle' separator, developed in the US by National Recovery Technologies Inc. As bottles pass through the separator, a static charge is created on the PVC fraction (Bell, 1990). This device then uses x-ray fluorescence to detect the charged chlorine content of the PVC bottles. Each time a PVC bottle is detected, the separator blows it aside with a sharp jet of air. The separated PVC bottles are then granulated down to fine flakes and washed in a friction washer. The friction washer agitates the plastic flakes in order to remove the dirt and labels. Most plastic bottle labels are only attached by gluing down the seam. This renders most of the flakes extremely easy to clean, but those which have been glued to the label, much more difficult, hence the need for the friction washer. The PVC flakes are then passed through a thermal drier. This constitutes 90m of tube, wound round and round itself through which the plastic flakes are propelled by hot air. The dryers are currently heated using propane gas, but Reprise hopes to make alterations to the plant in the future which will allow the incineration of plastic scrap produced by the process to fuel them. The water which is extracted by the thermal drier is returned to the hold tanks which are utilised to store the flakes between processing stages.

The remainder of the mixed plastics will consist of PE and PET. These are granulated together, mixed with water and fed into a hydrocyclone. This rotates the flakes at extremely high speeds, forcing the PE to the centre and the PET to the outside of its drum. The PE which has a specific gravity of 0.9 leaves through the top of the hydrocyclone, whilst the PET, which has a specific gravity of 1.408, and water leave through the bottom. The PET is then sieved to remove the water and both polymers are separately friction washed and thermally dried as described above. A manual quality testing regime is maintained on the resultant separated polymers. The plant is estimated to be 99.9% effective in the separation of the three polymers.

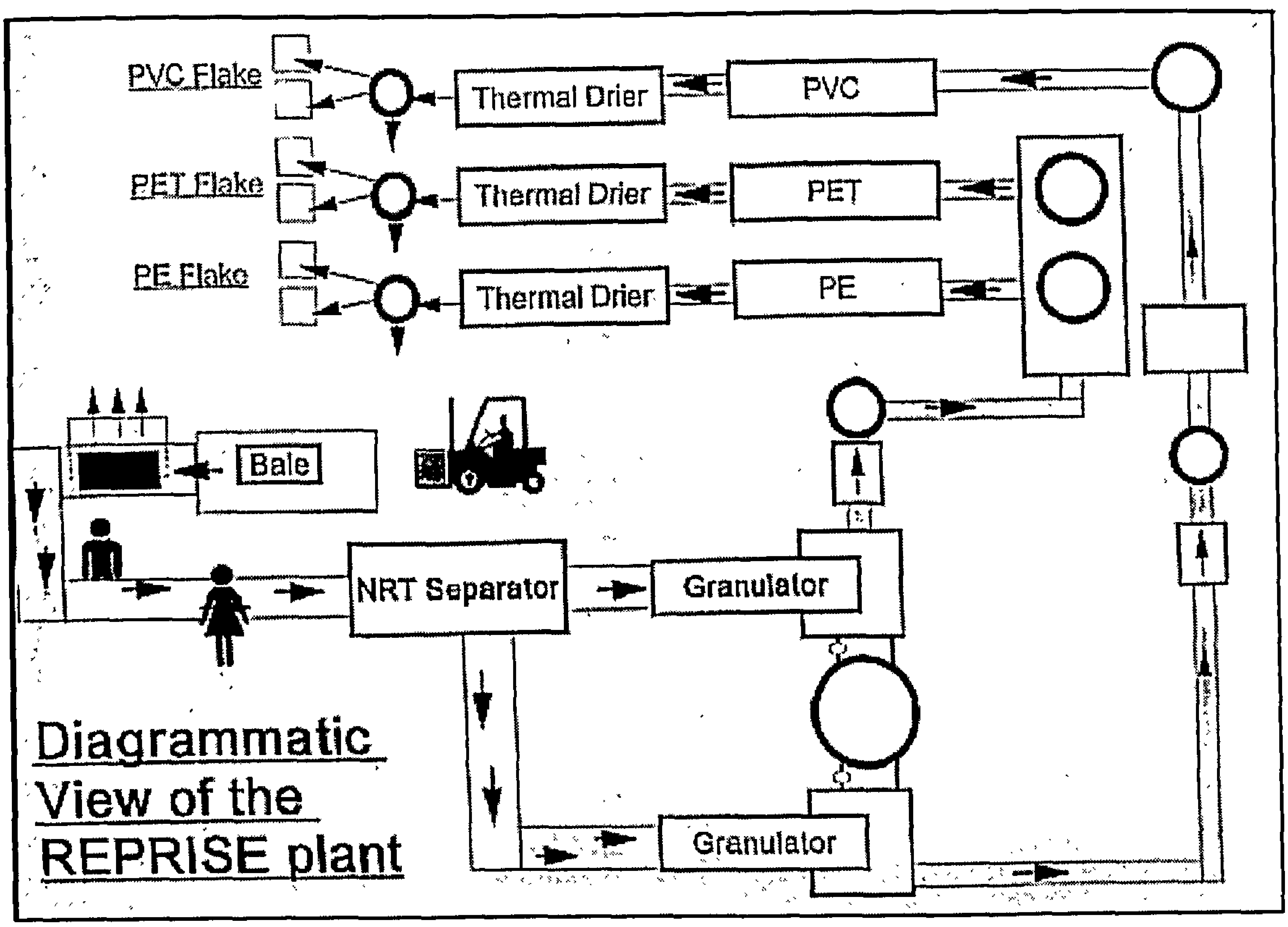

Figure 2.25 A schematic diagram of the Reprise reprocessing plant in Liverpool

The flakes which are produced in this way are sold on to manufacturers who utilise them as a whole or part replacement for virgin in their manufacturing processes. The plant can process a throughput of one tonne of polymer every hour. In comparison, the Sheffield scheme estimates that 5 sorters can manually sort 1.5 tonnes of mixed plastics each day (Sheffield Reclamation Ltd, 1992).

2.3 Second Life Applications

There is a whole range of second life applications for recycled plastics. Mixed plastics can be used to make moulded plastic sections which are intended to replace wood. These are used in fencing, signposts, garden furniture and many other similar applications.

If polymers are sorted, many more uses can be found. Recycled PET is used in the manufacture of fibre fill for duvets, sleeping bags and anoraks, industrial strapping, egg cartons, wall and floor coverings, and tufting for carpets and rugs. Recycled PE can be used in similar applications to the mixed plastics. It is also used in the making of new bottles for non-food use. This is often done by using it as a middle layer between two layers of virgin polymer (ENDS, 1991). Recycled PVC is often used in the making of drainage pipes, sewer pipes, electrical fittings and shoes.

On the whole, the process of recycling plastics is much cleaner and controllable than is widely believed. The one real problem faced by the recycling industry is that of market instability. The common polymers are commodities in the same way that tea and orange juice are. They are bought and sold in the context of a world market and so are subject to a great deal of fluctuation in their value. Polymer prices, like paper prices rise and fall in an unpredictable and uncontrollable way. This inherent instability is reflected in the prices offered for collected polymer (see Table 2.3 earlier) and makes it extremely difficult to build an industry. Markets do exist for recycled polymer, but when the price of virgin polymer drops below the level at which the recyclers can produce recycled material, no manufacturer will buy what they perceive to be an "inferior" product at a higher price.

In order to make the market environment more stable for plastics recyclers, the demand for plastic products must be altered to differentiate between products made from virgin polymer and those manufactured from post consumer plastics waste. If this could be achieved, and an independent demand could be created for products which include recycled polymer, then the peaks and troughs of virgin prices would not have nearly so strong an effect on the viability of the reprocessing industry.

Busby (1992) estimates that the current applications for recycled plastics can only absorb around 4500 tonnes (5%) of the 90000 tonnes of bottles found each year in the domestic waste stream.

There are a number of different measures which could help create this demand and break the vicious circle experienced by the recycling industry (see Figure 3.6). They include legislative measures like the implementation of standards for packaging which include a percentage of recycled material to be included as part of their specifications. Other measures include economic instruments such as VAT or other tax exemptions for the manufacturers and/or customers who choose recycled materials. The reverse tactic of putting tax on all products which contain virgin polymer could also be employed to this end. Although the UK government recognises the need to stimulate the demand for recycled plastics, it has chosen not to make any legislative or economic moves to aid this process. It believes that 'Market forces are the best way to deliver a sustainable approach for waste and recycling in the long term' (DOE, 1991).

Donella Meadows (Meadows, 1991) believes that the instability of the recycling markets is characteristic of any new market and should not be regarded as evidence that recycling will never be viable or stable.

Perhaps one strategy for increasing demand for products which contain recycled polymer from household waste would be to embark on an education campaign which aims to help both manufacturers and members of the public rethink their attitudes to recycled plastics. Often the specifications for raw materials are based on what manufacturers are used to using, or what they perceive to be acceptable to their customers, rather than what the application requires. The British Standards Institute (BSI) is one body who helps perpetuate this practice by specifying virgin polymer for applications where it would make no difference whether virgin or recycled materials were used. Rewriting some of the standards in terms of required properties rather than required materials could make a vast difference. BSI is reported to be "reviewing all standards to remove unnecessary discrimination against recycled material" (Marsh, 1993).

Plastics can be recycled, and still keep the properties that make them first choice for so many packaging applications. If recycling is undertaken properly, the recycled product is indistinguishable from the product manufactured from virgin polymer. Even PVC, which is the most difficult of the polymers to recycle keeps its properties when recycled over and over. One manufacturer said, that although he had never tried to discover an upper limit for this process, he had recycled the same PVC some 26 times without finding any deterioration in its properties. He believes that there is nothing to stop recycled polymer being used in any of the applications (excluding areas of critical performance) for which virgin polymer is currently used (McLaren, 1992).

One of the limitations on recycled polymer is that it cannot be used to make beverage or food containers (Forbes, 1990). This is not explicitly banned, but the EC Directive on plastics materials in contact with food stipulates a list of materials which may be used for this purpose and which does not include any recycled polymers (EC, 1993). This government inhibition is supported by another myth: that plastics cannot be completely sterilised by the recycling process. This is not strictly true, as plastics are reprocessed at 200 degrees centigrade. This is certainly sufficient to render all but the most poisonous garden chemicals (such as paraquat) inert. If screening methods for garden and agro-chemicals were developed, there would be no fear of product contamination from recycled plastics. It is believed by many in the recycling business that this inhibition is only held in place by lobbying from the larger petrochemical firms who stand to loose a great deal in sales of virgin polymer if it was lifted (McLaren, 1992). A new standpoint on this issue may be accelerated by the 1991 introduction of Coca Cola and Pepsi Cola bottles containing recycled PET in the US, challenging the unspoken FDA inhibition which was in place for so many years over there (Anon, 1991).

There is also a general feeling among those trying to or considering setting up recycling schemes that industry is not doing enough to help. In fact, this is no longer the case. Although many of the early schemes were regarded simply as public relations exercises, there is now real commitment in the shape of funding being realised by industry. RECOUP is the best example of this new commitment. It currently draws funding from 65 members from all parts of the packaging chain and sponsors elements of many of the UK plastics recycling schemes.

2.4 Conclusions

Plastics from domestic waste *are* being recycled in the UK. Many of the operations which exist are small scale or pilot schemes. Lambert states that "small scale operations will not achieve the 50% target" (Lambert, 1991). In order to up the scale of plastics recycling on a national level, more attention must be given to market development. The technology to collect and sort post consumer plastics waste has been developed to an extent where large quantities could be reprocessed. What is lacking is a demand for the products which use the reprocessed polymer as their feedstocks.

There has been tremendous advance in the technology and enthusiasm for plastics recycling. The Braintree scheme has even had its plastics recycling operation accepted under the BS5750. The whole process has come a long way from its humble and amateurish beginnings. In order for this progress to continue, much more research is needed into the systems and policies required for success.

There appears to be little consensus as to the best way to collect recyclables for reprocessing. It may well be that different areas have different collection requirements that cannot all be met by one universally optimal system.

One possible answer seems to be to combine methods, providing a flexible approach which recognises the strengths and weaknesses of each system. Although the current lack of standardisation may not cause operational concern, it does however affect the public image and national profile of the post consumer plastics waste recycling industry in the UK. There is a danger that the schemes will come across as unconnected, making UK efforts seem fragmented and small scale. Although most initial forays into plastics recycling by interested parties were largely unconnected and guilty of what SCP's operational manager for Action Recycle fondly refers to as 'jumble sale technology', RECOUP has played an important role in the unification of efforts, particularly in terms of research. This has prevented many reinventions of the proverbial wheel. What is needed now is an equally co-ordinated approach to education and promotion. Many of the bring schemes have adopted the 'Bertie' logo and the bright orange bank colouring as part of their promotion strategy. Universal agreement on these features as the basis of advertising for all UK schemes would help give the UK post consumer plastics recycling industry a national profile.

The technology is now becoming available which can produce the high levels of material homogeneity and the low contamination levels that are required by the sophisticated moulding plant that produces plastics products. The refinement of this technology, along with the re-education of manufacturers could provide substantial new markets for recycled plastics. If manufacturers and users of plastics learn to expect equal performance and comparable prices to virgin from recycled plastics, and see it as a sustainable choice rather than an inferior option, this would boost demand and create a market 'pull'. This would enable the industry to grow in size, providing manufacturers with the quality, price and supply reliability they require.

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Chapter 3: A Review of Legislation Pertaining to Plastics Recycling

3.1 Introduction

Until recently, the success or failure of recycling efforts has been left to the control of the market place. This has meant that much of the activity in this field has been unstable and has varied enormously, not only across national borders, but from town to town. Materials are only being recycled where the operation can be seen to be immediately and financially viable. Due to some of the difficulties outlined in previous chapters, this has meant that the recycling of domestic waste has been at a very low rate. Many countries have begun to introduce legislation in order to encourage or enforce the establishment of a recycling industry. This chapter describes the different types of legislation which have been designed to address some of the problems faced by recycling industries. The aim of this exercise is to provide a summary of the legislation, which does not currently exist, and to inform policy making by drawing on the experiences of other countries.

The effects of current policy in terms of its constraints on the recycling activities of many members of the packaging chain is discussed in Chapter 1. This piece of work looks at the possible ways in which a Government with a higher degree of interest in post consumer plastics waste recycling could exercise its considerable power to stimulate the growth of the plastics recycling industry (see Figure 1.5). The various policy strategies that are in place in other parts of the world are presented to this end, with a commentary on their context and the effects on recycling that they are linked with.

The information contained in this chapter is correct to January 1994, apart from the section relating to EC legislation, which is correct to September 1995. The frameworks described below have not changed significantly since these dates. All the instances of currency conversion to pounds sterling are approximate and intended as a guide. The exchange rates used in these calculations are given in Appendix 2.

3.2 Europe

There are two tiers of legislation currently operating in Europe; that of individual countries; and that of the EC. The next section will outline the waste management policies of each of the member states. Following this is a section dedicated to policies introduced under the auspices of the EC.

3.2.1 Individual Countries

Unless specified otherwise, the information on the progress of individual countries presented below was gained through presentation and discussion at RECOUP's 5th Regional Conference on Post-Consumer Plastics Recycling (Butt, 1992), and Cairncross (1992).

3.2.1.1 Belgium

The Belgians have proposed a bill (1990) on what they have termed Eco-Taxes. This states that from the 1st of January, 1994, all beverage containers will be taxed at 15 BF (31p) per litre, with a minimum tax of 7 BF (14p) per container. Containers which are refillable will be subject to a deposit of 3½-7 BF (7-14p) per container. Non-refillable containers will be exempt from this system of taxes if they are shown to achieve certain reuse and recycling rates. The recycling target starts at 12% in 1994 and rises in stages to 100% in 1998.

Several areas of the country already have voluntary agreements. For example, the Brussels and Walloon regions both have targets of 70% recycling of each of the packaging materials by the year 2000. Flanders is aiming for zero landfill for domestic waste by 1995. By the year 2000 they aim to be incinerating 42%, recycling 46% and have a 12% 'Quantitative Prevention' (source reduction) in their domestic waste.

3.2.1.2 Denmark

In 1991 the Danish Government passed a Environmental Protection Act. This piece of legislation requires all products to be designed to have as long a life as possible. They must also be recycled to their full extent and not cause pollution in their disposal.

In Denmark, 75% of waste is currently incinerated, 8% recycled and the remaining 17% is landfilled. By the year 2000, they aim to be recycling between 40-50% of their waste and incinerating the remaining 50-60%.

The Danes have already introduced taxes for the packaging of liquids, and refillable bottles are mandatory for all beverages intended for the domestic market. Any company importing beverages into Denmark must develop a system for either charging deposits, returning or recycling their packaging. There has also been an absolute ban on cans as a packaging medium for beverages (Hansen, 1986).

Another legislative step taken in Denmark was to introduce levies on incineration and landfill charges in order to support these targets. Landfill prices have been raised from 130 DKr (£14) to 195 DKr (£20) per tonne, with incineration charges rising form 130 DKr (£14) per tonne to 160 DKr (£17) per tonne.

3.2.1.3 France

The French have passed a Packaging Decree (1992) which aims to oblige industry to provide for or contribute to the recuperation of packaging waste in the domestic waste stream in order to reduce landfill requirements. This legislation covers all packaging waste at the household level. The specific targets the French Government has set are for 75% 'Valorisation' (recovery) of all packaging, with none of the individual materials at a rate of less than 60%. They also aim to increase the recycling rate of packaging waste by 50% from 0.9 million tonnes in 1992, to 1.35 million tones in 1996. Energy recovery from incineration is targeted to increase from 0.4 million tonnes to 0.7 million tonnes, an increase of 75%.

In order to achieve these targets, several measures have been introduced. One of these is a 'landfill tax' of 20 FF (£2.50) on each tonne of domestic waste. Another measure which is not directly government run, but rather government approved, is the formation of a private company called Eco Embellages. This is a service organisation which is industry run and is intended to work together with the local authorities to co-ordinate the process of recuperation of packaging waste. Within Eco Embellages, there are three companies, one for each of the main polymer types. Membership of this scheme is not compulsory as such, but non-members must set up their own government approved collection scheme or introduce a deposit system. This provision means that in practice, membership of Eco Embellages is essential, as individual collection systems would be prohibitively expensive.

The French local authorities remain responsible for the collection of domestic waste but will receive a government subsidy for each tonne of sorted packaging waste delivered for recycling, so long as it complies with their minimum quality specifications. These subsidies vary from 150 FF (£18.50) per tonne for glass, to 1500 FF per tonne (£185) for plastics and aluminium. By 1996, it is hoped that some 700 million FF (£86 million) will have been raised by these systems which will be used to subsidise 90 local authority contracts covering 10 million citizens, which is around a fifth of the population. The French legislation also includes a statement about the quality of end product which must be achieved. This has so far proved a unique inclusion in such legislation.

3.2.1.4 Germany

In Germany, a Packaging Ordinance (1991) is already in place which aims to oblige industry to take back and recycle packaging waste from the waste stream and to dispose of the residue. The ordinance covers primary, secondary and tertiary packaging, but excludes certain products such as pesticides and hazardous wastes. The targets (by weight) for achieving this are described in Table 3.1. The figures in the columns entitled 'Recycle' are not absolute, but refer to a percentage of the recovered material.

Material	1st September 1993		1st September 1995	
	Recover	Recycle	Recover	Recycle
Glass	60%	70%	80%	90%
Aluminium	30%	60%	80%	90%
Paper & Board	30%	60%	80%	80%
Plastic	30%	30%	80%	80%

Table 3.1 German targets for recovery and recycling

The Germans have also devised an organisation called Duales Systems Deutschland, or DSD. The obligations outlined above are waived for members of DSD. DSD is also responsible for selling the 'Green Dot' to the companies which use packaging to protect their goods (see Figure 3.1).

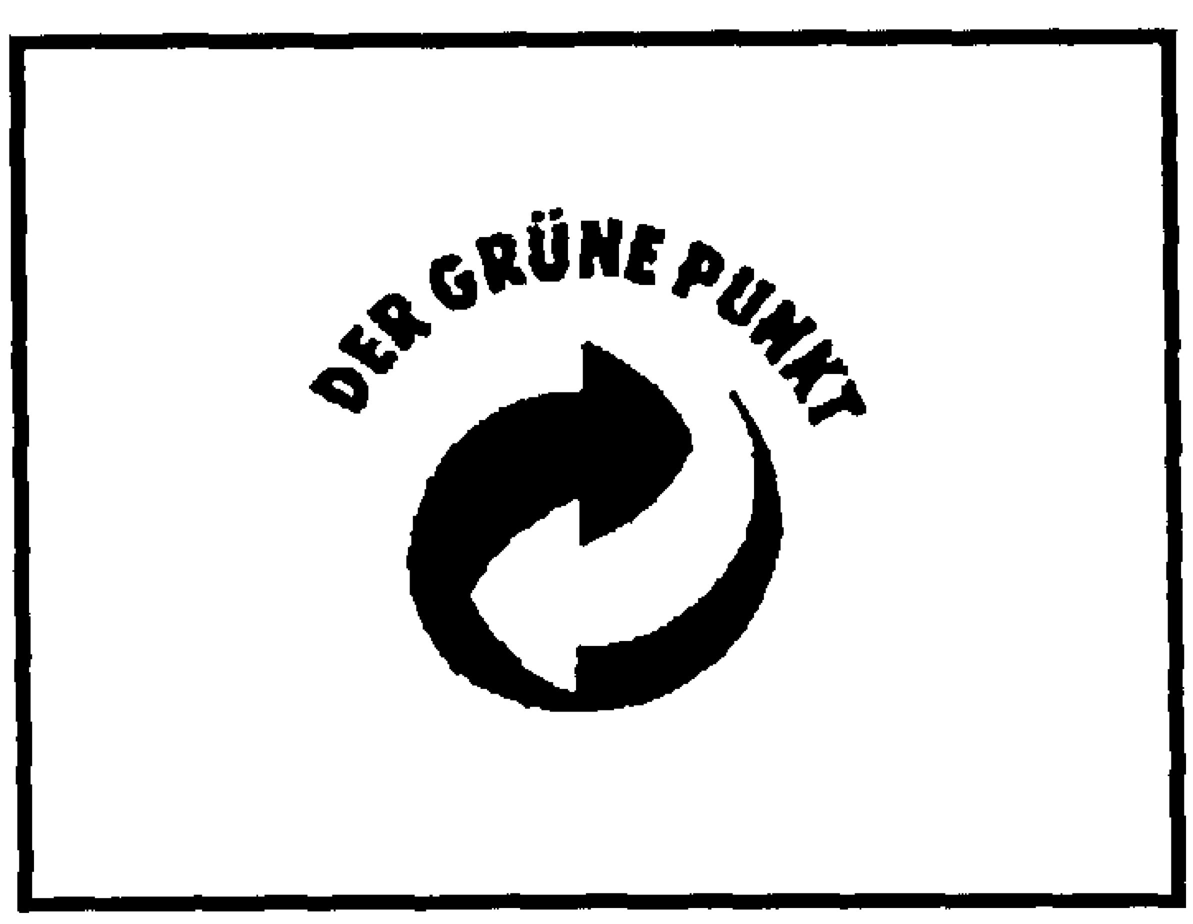

Figure 3.1 Germany's Green Dot

The Green Dot is a symbol which can be used to mark packaging and signify to the consumer that the packaging conforms to a minimum environmental specification (McHarry, 1993). DSD also contracts with waste management companies to collect and sort the packaging waste. The plastics that are recovered by this method are then sorted into four fractions:

Films
Cups, Trays, Blisters
Rigid Containers
Foamed Material.

These fractions are then offered to the recycling industry at nil cost.

A second organisation, VGK (Verwertungsgesellschaft Für Gebraunchte Kunststoffverpackungen, or the Society responsible for used plastics packaging) is responsible for guaranteeing the next step in the process. It sorts the plastics further into polymer types, washes and reprocesses them ready for reuse. VGK received 2 million DM (£850 000) capital funding, which was raised by compulsory donations from resin producers, converters and waste management companies (Micklitz, 1992).

3.2.1.5 Greece

Waste Management is a major problem in Greece, with 3500 unofficial tips compared with just 1400 official ones. The Government is currently still considering the introduction of some form of legislation.

3.2.1.6 Ireland

The Department of the Environment in Ireland has commissioned a study of the country's recycling potential. They have concluded that:

> recycling is likely to be limited to 70% of the recyclables (recyclables have been estimated to constitute around 60% of the total waste stream);
>
> in order to achieve a 30% recycling rate, a high degree of regulation will be required, and a 60% recycling rate would be "extremely difficult" to achieve;
>
> the EC target, proposed at the time of the study, of a 90% recycling rate would be impossible;
>
> the net cost of achieving a 25% recycling rate has been estimated at between I£70 and I£110 million (approximately equivalent to pounds sterling) each year. This sum is the cause of much concern.

As a result of this study, however, the government has committed itself to comprehensive waste management legislation.

3.2.1.7 Italy

The Italians have had laws in place to ensure the separate collection of liquids containers since the 1st of January 1990. Laws have also been introduced to set up 'Consortia' for each packaging material. All packaging manufacturers, importers and some of the users are required to be involved. This means working with local authorities to operate recycling schemes. Funding for these operations is raised by a mandatory levy, which for plastics is 10% of material price.

By the end of 1992, this legislation also required that 40% of the plastics containers covered by the law must be recycled. As part of this target, up to 20% incineration with energy recovery is permitted. Since April 1993, a tax has been imposed on any non-refillable containers which do not meet these recycling targets.

3.2.1.8 Luxembourg

Luxembourg has a Liquid Foodstuffs Bill. This outlines a system of mandatory deposits for refillable packages and taxes for non-refillable ones. This Bill is however currently in abeyance. If the Bill is withdrawn, an agreed 'Convention' will be followed in its stead. This is concerned with the minimisation of packaging, the promotion of refilling, reuse, recycling and the minimisation of the amount of waste disposed of. Its target is to 'recuperate' (i.e. refill and recycle) 70% of liquid food packaging by 1995.

3.2.1.9 Netherlands

The Netherlands operate a revised National Environment Plan (NMP+) which aims to recycle 60%, incinerate 40% and landfill 0% of the domestic waste stream. As part of this plan their Packaging Covenant (1991), which is an agreement between the Government and the 'Packaging Chain' has set further targets. The first is that by the year 2000, there will be no landfill or incineration (without energy recovery) of packaging waste. They also aim to reduce the weight of packaging put on the market in 2000 to around 10%

below the 1986 level. They wish to avoid over packaging and multi-packs (e.g. the packaging which wraps 12 PET bottles together). This sort of double packaging is generally for the convenience of, and removed by, the retailer. They also aim to rationalise the number of materials used to make each package and instigate design-for-recycling policies. This will include replacing one-trip packaging where at all possible, and requiring the packaging chain to take back 90% of non-reusable packaging and recycle 60% of it. They also want to reduce the heavy metals and solvent content in packaging. The Dutch Government has also made deposits mandatory on home and imported soft drinks packaging.

3.2.1.10 Portugal

Portugal's Environment Ministry has requested their 'Packaging Chain' to propose a pilot recycling scheme to be part funded by local authorities. It is arguing strongly against the current EC proposals which it feels will be too expensive to implement.

3.2.1.11 Spain

The Spanish government is currently considering a proposal to implement a system of voluntary agreement between industry and government quite similar to the French Eco Embellages, prior to the EC legislation being introduced. Packaging companies have agreed to accept materials sorted by the municipal authorities for reuse, recycling or energy recovery. This scheme will be financed by voluntary levies. Householders will be required to sort paper, board and other packaging materials separately from their waste (Rodriguez Molnar, 1992).

3.2.1.12 UK

The UK government has outlined a target of recycling 50% of the recyclables in the domestic waste stream by the year 2000 in its white paper *This Common Inheritance* (1990). Since recyclables comprise about 50% of domestic waste, this means that 25% of the total household waste must be recycled in order to meet this target. Although this may sound extremely ambitious, and certainly represents a significantly higher recycling effort than the UK are currently capable of, Cooper points out the fact that if domestic waste production continues to grow at its current rate, a 25% reduction by 2000 will simply mean that the amount of rubbish that is processed will remain at 1990 levels (Cooper, 1991).

The other main piece of UK legislation affecting recycling is the Environmental Protection Act (1990). This introduced a number of provisions which have an impact on the viability of recycling in this country. These include the payment of recycling credits for every tonne of waste that has been recycled which would otherwise have been landfilled. It also introduced Duty of Care legislation for the handling and treatment of hazardous wastes, making the landfill and transportation of waste more expensive (Ogilvie, 1991).

The Act also required each Waste Disposal Authority to produce a Recycling Plan, outlining the ways by which it intended to meet the government target of recycling 25% of the domestic waste stream by the year 2000. Of the plans submitted by local authorities in Scotland, only around 15% felt able to say that they would be able to meet the government target of a 25% recycling rate by the year 2000 (Letham, 1992).

The 2nd Year Report on the White Paper (1992), stated that the Government favoured the use of economic instruments to the introduction of regulations. To this end, several types of economic measure have been investigated in the UK. The report on Economic Instruments and Recovery of Resources from Waste concluded that charges on products or materials, changing responsibility for recycling from the waste collectors to the packaging producers and charges for waste collection and/or disposal were all worthy of more detailed consideration (DTI, 1992). The study of landfill costs and prices carried out by Coopers and Lybrand suggests that a landfill levy of £10 per tonne of domestic waste landfilled could raise £1.4 billion which could be used to support recycling (DOE, 1993).

In the light of the recommendations for plastics recycling in 1993, the Environment secretary created a Producer Responsibility Group (PRG). This group, made up of industry representatives is currently due to present its proposals for organising and funding packaging in the UK in order to meet EC targets. The industry representatives are however unlikely to be united in their support of any one strategy (Cowe, 1995). Proposals include the introduction of legal requirements for a levy on packaging products which would finance collection and recycling. The PRG advocates shared responsibility for these measures for all members of the packaging chain. UK legislation for packaging is expected to be announced in October 1995 and in force by 30th June 1996.

3.2.2 EC Packaging and Packaging Waste Directive

The first significant mention of recycling in EC legislation is in the 1975 Directive on Waste (75/442/EEC). Article 3 of this Directive calls for the "implementation of appropriate steps to encourage the prevention, recycling and processing of waste". During 1989, the EC decided that since, "the problems raised by waste are reaching such proportions...that waste management is now no longer purely a regional or national matter" (EC, 1989). From this concern for developing a community strategy grew a number of measures, including the Council Directive on Containers of Liquids for Human Consumption, known as the Beverage Container Directive (85/339/EEC). This has since been broadened to include all Packaging, as the Directive on Packaging and Packaging Waste. Even in its current form, it has had three drafts: Proposal Com(92)278, which was then revised in the light of the Council Opinion (C129, 1993) to Amended Proposal Com(93)416, and Common Position 94/C137/08, which was adopted by Council in December 1994.

This piece of legislation has been described as one of the, "most ambitious and wide ranging" of the EC Directives to date (Lewis, 1992). It is interesting to trace the aims of the various drafts of Directive:

85/339/EEC Beverage Container Directive

Purpose:

> "to provide for a series of measures relating to the production, marketing, use, recycling and refilling of containers of liquids for human consumption and to the disposal of used containers, in order to reduce the impact of the latter on the

environment and to encourage a reduction in the consumption of energy and raw materials in this field."

Member States to:

- draw up programmes for waste reduction
- develop consumer education
- facilitate refilling and recycling, including the development of effective retrieval processes and the extension of outlets.

The implementation of 85/339/EEC was described in Bulletin EC7/8-1992 as 'disappointing' in terms of the lack of similarity in the responses of the member states.

Com(92)278 and Com(93)416 Draft Directives for Packaging and Packaging Waste

One of the central aims of this directive is to harmonise the efforts to reduce the landfill of packaging waste that are being made in each of its member countries, whilst also striving to avoid obstacles to trade, and thus "Complete the Single Market". Its environmental target is to endeavour to "Reduce Environmental Impact" of packaging wastes.

Perhaps the most significant change embodied in this proposed legislation is the introduction of specific targets. The directive has two levels of target: an interim, and a permanent, target. The interim target states that all member states should develop plans to achieve 60% recovery of packaging waste, with 40% of this recovered material subsequently recycled. This target has no deadline but, like the permanent target it precedes, it covers primary (e.g. plastic bottles), secondary (e.g. cartons which held a dozen bottles) and tertiary (e.g. transportation packaging for these cartons) packaging from domestic, commercial and industrial sectors.

These measures have been given no specific time limit, but are designed to aid the implementation of the directive's principal target which is that within 10 years of this piece of legislation coming into force, "90% by weight of the packaging waste stream must be recovered and within this, 60% by weight of each material must be recycled".
The directive does however state that the recycling part of the target may be modified in the future if research shows that other recovery processes would lead to a greater overall environmental benefit.

Member states also have up to 5 years to put return systems in place for each of the materials used in packaging, and to ensure that these materials are being effectively reused or recovered. In order to aid this process, member states must also introduce a system of marking packaging within this same five year period. There will be markings to denote packaging which is reusable, and also that which is recoverable (See Figs 3.2 to 3.4). Marks will also indicate the material type of the packaging (adopting the nomenclature of the American SPI codes, see Figure 2.21 above) and how much of its content is recycled material. The actual details of this system have not yet been finalised, but once in place will simplify much of the sorting problem faced by recycling schemes. It may also curb the current trend for manufacturers to claim environmental superiority for their packaging as a part of a 'green' marketing campaign, whether or not a real environmental benefit exists.

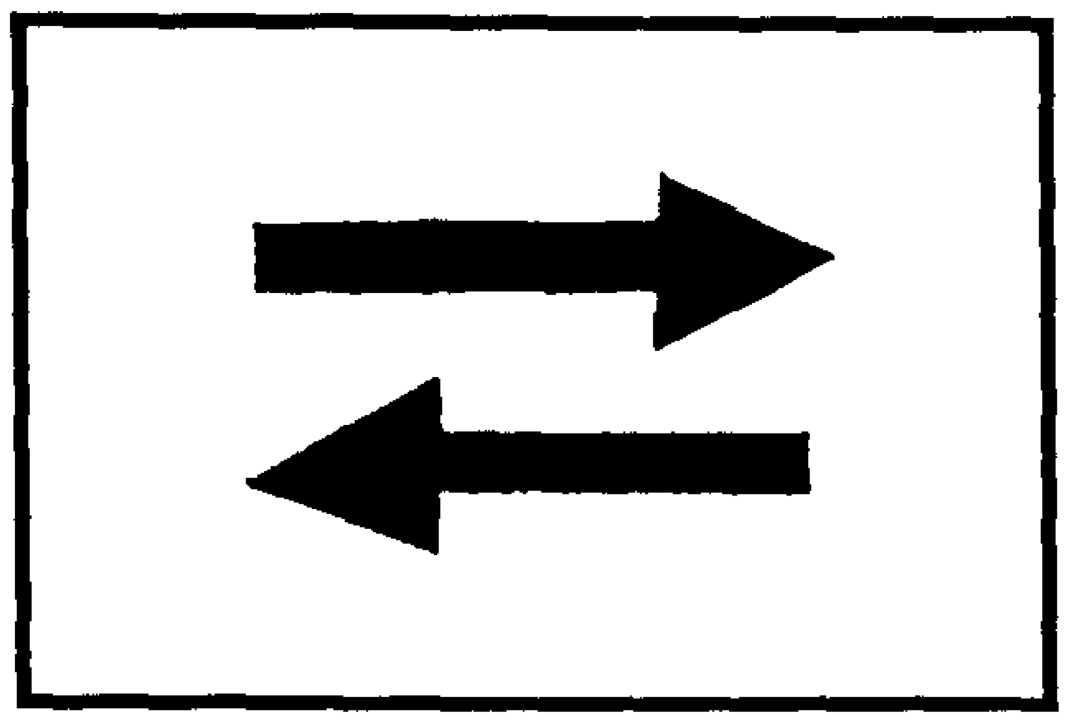

Figure 3.2 Mark used to denote reusable packaging

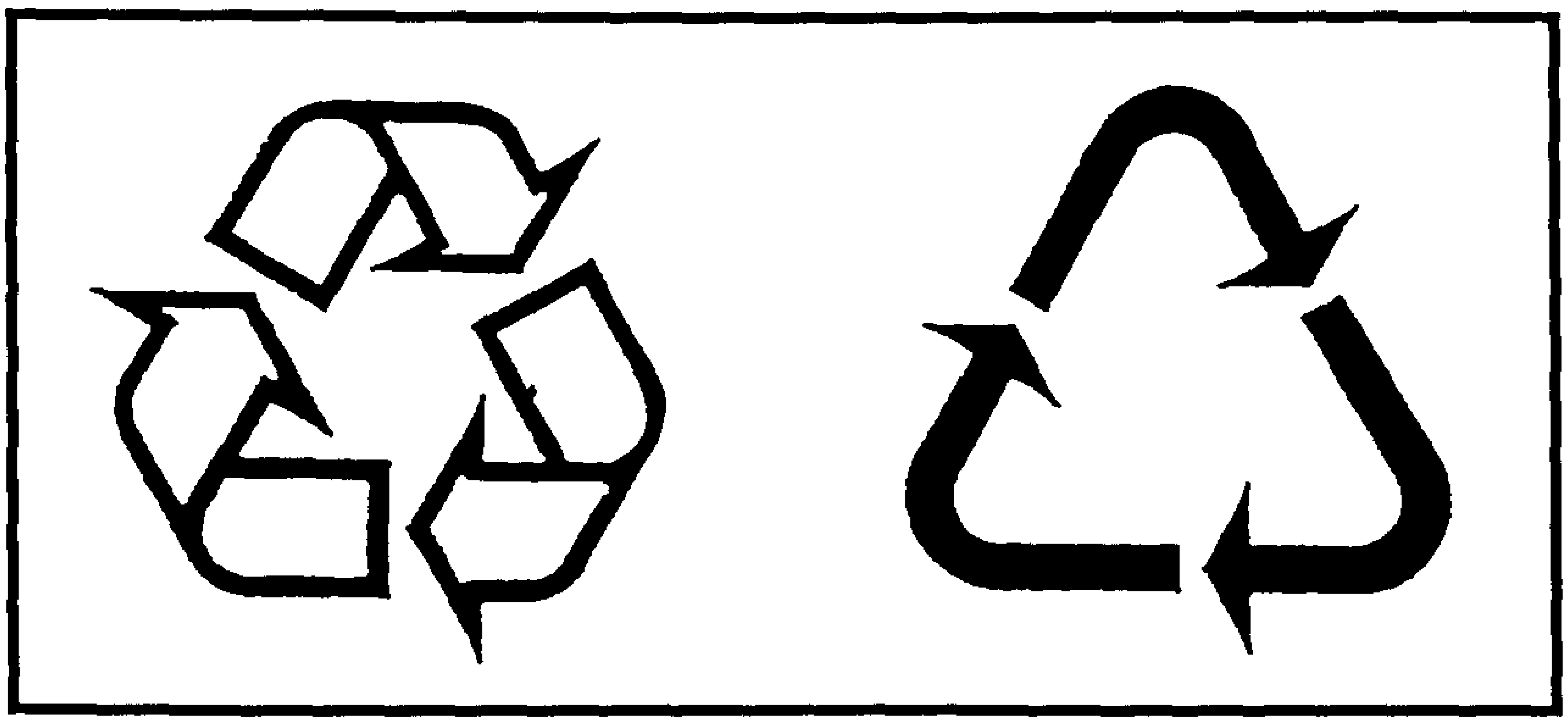

Figure 3.3 Marks used to denote recoverable packaging

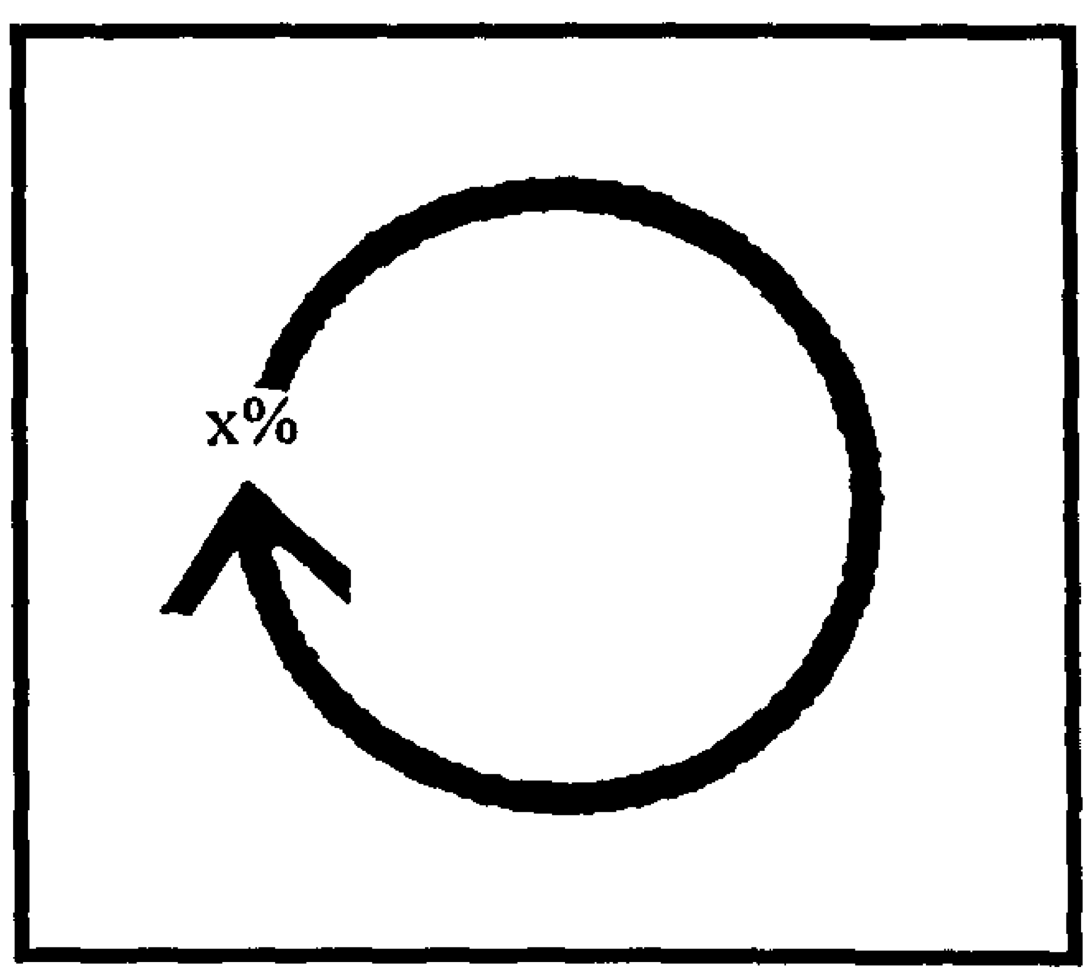

Figure 3.4 Mark used to denote packaging made partly or entirely from recycled materials, where x% = percentage of recycled material used in the manufacture of the product

The packaging producers themselves must also put more environmental thought into the way in which they produce their products. Under the directive, all packaging must conform to certain essential requirements, like using the minimum amount of material necessary in their manufacture, being designed for reuse and/or recovery and employ minimal amounts of noxious metals and hazardous substances in their production. Packaging which is intended for reuse must be designed to maximise its trippage, meet health and safety requirements and also be ultimately recoverable. Recoverable packaging design must ensure that a minimum percentage (yet to be specified) of the weight of each package can be reprocessed into marketable products.

There are also a number of measures which aim to achieve a higher degree of standardisation among the countries in the EC. The Commission believes that EC Standards should be developed for:

- dimensions and Shapes of packs for certain products;
- modular distribution packaging for Transport;
- product Specifications for the use of recycled materials;
- criteria and Methodology for Life-Cycle Analysis on packaging.

In order for these objectives to be achieved, the directive also outlines a number of requirements which will formalise the flow of information between countries. It requires that information systems be set up in such a way that detailed monitoring of progress towards the targets could be achieved. This includes the provision of economic data by all of the companies and countries involved. It would also allow the constant re-examination of the targets themselves, ensuring that they remain relevant and optimal. This flow of information will not stop at the door of governments or industrial institutions, but will be relayed to the consumer in the form of education and advice concerning the advantages of reusable and recoverable packaging. Information will also be provided to help explain and promote the marking systems in use. The different return systems in place for the disposal of each material will also be required to be explained to the public.

In order to aid the overall implementation process of this legislation, the directive requires each of the member states to develop management plans. These should outline how both the intermediate and final targets will be achieved, which measures will be adopted and include a justification of the plan itself. The economic instruments that are applied to implement any or all of the measures undertaken are left to the discretion of the individual countries.

94/C 137/08 Packaging and Packaging Waste Directive

The basic principles of the draft directives have been adopted into European law. The strategies advocated for return systems, the adoption of a common system of markings for products and the implementation of measures which promote information flow have all been transferred to the Common Position document. The main differences between the finalised Directive and its drafts lie in the definition and timescale of the targets. The new targets are for between 50% and 65% of packaging to be recovered form the domestic waste stream, of which 25% to 45% must be recycled. Within this, a minimum of 15% by weight of each material must be recycled. Member States must implement these measures in their national laws by July 1996 and achieve the targets by July 2001.

The targets have been reduced in scale in recognition of the less developed state of waste management policy in some member states. These modified targets are more in line with the current UK target of 25% of domestic waste recycled by the year 2000, lending legal backing to what was intended to be an informal goal. The reduction of the minimum of each material recycled from 40% to 15% will make the task of the plastics recycling industry less difficult, but perhaps also more realistic in terms of achievability. Nevertheless, the growth in the scale of post-consumer plastics waste recycling required over the next 5 years is not insignificant in terms of challenge to both the industry and the packaging chain who will be required to support it.

3.2.3 Summary

There are many different stages of development as regards waste management policy amongst the various member states of the EC. These range from the Greek belief that something ought to be done and the preliminary studies of the Irish and Portuguese governments to the decisive and far reaching legislation of countries like France and Germany. Somewhere in between these poles lies the UK legislative framework which is ready to set targets, but not to specify how these shall be met nor provide resources for their support.

These varying degrees of legislation reflect the amount of priority given to waste management issues by the respective governments. They also perhaps link to the amounts of landfill available, domestic waste produced, and packaging used by each of these countries. The affluence and stability of the country's economy may also be a significant factor here.

It is easy to see why one of the central aims of the EC directive is to harmonise the efforts of the various member states. A much higher jump in current practice will be required of some members than will be necessary for others. Both Portugal and Ireland feel that this jump will prove financially crippling to them. However, the directive does not simply provide targets for recovery and recycling, but considers many aspects of the wider issues of implementing such targets, which are still considered ambitious in many of the countries to which they will soon apply. However, the EC legislation attempts to close the loop, not just bringing packaging out of the waste stream, but returning it to its source and making the producer responsible for its redirection in a responsible way. At no point does the directive allow market forces to determine the fate of the packaging.

This is an important point, which has not been considered critical by countries like Germany and the UK. The effect of the introduction of the German legislation has been particularly chaotic. By the beginning of 1993, 360 000 tonnes of plastics had been collected. However, there were only markets for approximately 20% of the material collected. Since no German markets exist, some of the collected plastics (at least 50 000 tonnes) remains in storage, unprocessed. More has been shipped abroad and offered to processors at very low or zero cost. Not only are these options very expensive for the German packaging manufacturers, but the sudden glut of cheap or free plastics for reprocessing threatens to undermine the recycling efforts in the rest of Europe. It is very difficult to persuade reprocessors to pay for material which has been collected from the

UK public, for example, when they can have similar material from Germany for nothing. If recyclers cannot sell their materials on to reprocessors, the chain breaks down and many will be forced out of business.

One point on which the EC legislation does not seem to advocate harmonisation of policy is the use of economic instruments. This could cause further difficulties like those experienced by the Danes when their mandatory deposit bill was brought into force. This was regarded by some as a barrier to free trade between member countries. It seems that each case will be judged on its merits as far as financial measures are concerned.

The EC legislation, once implemented will certainly have a positive effect on the recycling industry. It addresses many of the problems currently faced by recyclers in this and other European countries. The introduction of such a comprehensive policy, combined with the research and funding capabilities of the EC has the potential to stabilise, harmonise and promote recycling throughout its member states. Perhaps the effect on the plastics recycling industry will be the most profound as it is the youngest and most fragmented of the recycling industries.

3.3 US Legislation

The United States are quite far ahead of the UK and Europe when it comes to environmental legislation. Some states have had laws in place to make deposits on beverage containers or the banning of certain kinds of waste from landfills mandatory for over 10 years. This may well have been driven by the acute landfill shortage they have begun to experience over the last decade (Kline, 1991). It is hoped that Europe can learn from both the experience and mistakes made in America without having to be forced into action by similar crises. The next section outlines the different kinds of legislation currently employed throughout the USA.

3.3.1 National Legislation

Much of the environmental initiative in the States has been driven, or at least fuelled by legislation. In the 1991 version of their annual summary of waste management practice in America, Glenn and Riggle said that, "In large measure, the dramatic increase in recycling and composting programs ... is a direct result of state waste reduction legislation" (1991(b)).

The 1991 Amendments of the Resource Conservation and Recovery Act laid out a set of priorities for consideration in the practice of waste management in the US. These were:

1. Use of Toxic Substances and Source Reduction
2. Recycling
3. Waste Treatment
4. Contained Disposal and Incineration.

The second priority was spelled out as "recycling of waste to the maximum extent consistent with market demand for recycled materials, and for the creation and strengthening of markets for recycled materials". In order to further explore this issue, a Product and Packaging Review Board was set up. This Board has members who represent industry, consumers and environmental groups as well as state and local governments. The recommendations made by the Board were for:

1. The initiation of a voluntary program to minimise packaging and to encourage the reuse and recycling of packaging materials;
2. The introduction of a labelling system which would identify the plastics resins used in products;
3. Standards for the design, volume, composition, reuse and disposal of product packaging and packaging materials;
4. The establishment of the following national goals for the municipal solid waste stream:

   10% reduction in weight by the year 2000;

   25% recycling by 1995;

   50% recycling by the year 2000.
5. The introduction of minimum recovery and utilisation standards for paper, glass, plastics and metals.

(Houston, 1991)

The other kind of legislation which affects recycling of plastics in the States is that which concerns the possible end products which may be made from recycled materials. Like the UK, there has been a general reticence to put recycled plastics in direct contact with food. There is no actual legislation in the US to ensure that this does not happen, instead the US Food and Drug Administration has simply never given approval to recycled substances. This leaves industry reluctant to experiment. In a report in Plastics News USA (1990), the FDA was said to be re-evaluating its position on recycled resin usage and the first acceptance of recycled plastics as beverage containers, which may have been accelerated by the plans of Coca Cola and Pepsi Cola to introduce beverage bottles containing recycled PET in the US in 1991, is reported soon afterwards (Anon, 1991).

Also on a national level, the American Environmental Protection Agency has set a target of recycling 25% of all solid wastes by 1992. The following section outlines the various pieces of state legislation that have been made with a view of meeting this target.

3.3.2 State Legislation

3.3.2.1 A Brief History

Such measures can be traced back a decade: the first piece of legislation of this kind was introduced in Oregon in 1983 in the form of their 'Opportunity to Recycle' Act (Curlee, 1989). This Act made providing recycling services for the citizens of the state a legal necessity. It was three years until any of the other states followed suit. In 1986, Connecticut passed legislation banning recyclables from their landfills and incinerators and also requiring municipalities to provide recycling facilities. Rhode Island passed similar laws, closely followed by New Jersey. These states both made it a requirement that recycling services were provided by the municipalities for both citizens and businesses in their states. Between the years 1987 and 1989, much activity was observed in this area. New York, Pennsylvania and the District of Columbia all passed laws making recycling mandatory for all citizens. Nine other states followed the lead of Oregon, passing laws which required the municipalities to provide recycling services. Six states went further and passed legislation which outlined goals for local governments to achieve in terms of waste reduction (Glenn & Riggle, 1991(b)).

By 1990, the pace had slowed, but legislation was still being made. Some states initiated bans on items like vehicle batteries, yard waste (garden refuse), and white goods from their landfills. Others began to put product taxes or fees on the sale of tyres. Wisconsin provided both the carrot and the stick by offering a wide range of incentives for recyclers whilst simultaneously banning a huge list of recyclables from their landfills. Legislation was moving away from its original recycling centred forms and placing a new emphasis on waste reduction, which included source reduction and composting targets as well as those for recycling. Both Indiana and Missouri passed laws in this year requiring that local governments plan for waste reduction when developing their solid waste plans. Typically, waste reduction goals ranged from 25% to 50% reductions in the waste stream by 1995 or later. 1990 also saw the first laws which made their environmental targets legal requirements, with Georgia, Indiana, Mississippi, New Hampshire and New Mexico introducing mandatory waste reduction goals (Glenn & Riggle, 1991(b)).

Overall, there seem to be three main ways in which recycling is encouraged in the US. The first is to set recycling targets. These average around 25%, but can be anything between 15 and 50%. The second type of encouragement is through the use of grants or other incentives to encourage the instigation of recycling initiatives. This is the approach taken by California, Minnesota, New Jersey and Pennsylvania. New York also had this kind of legislation in the early eighties. Many of the programs which went down this particular path have not been particularly successful. Many of them found themselves having to discontinue services once funding ran out, due to bad planning.

The third type of legislation makes local government responsible in some way. There are four general forms of legislation in this category:

1. Requirement for local government to pass ordinances which make source separation and recycling by both citizens and commerce mandatory for selected materials. Connecticut, District of Columbia, New Jersey, New York and Rhode Island all have this kind of legislation for all their municipalities. Penalties range from written or verbal reminders (Folz, 1991), to considerable on-the-spot fines (Schwab, 1988). Rhode Island was the first state to introduce a comprehensive mandatory recycling law which meant that all of its 1 million residents were obliged to recycle newspapers, aluminium, glass, metals, PET soft drinks bottles and HDPE milk bottles (Herz, 1988). Pennsylvania has similar legislation, but it applies only to municipalities with a population of over 5000. Enforcing these ordinances can be extremely expensive, especially for schemes which include commerce. A system of mandatory recycling for businesses is notoriously difficult to operate. Burlington, Vermont has tried to overcome these difficulties by giving commerce 9 months to set up recycling programs and providing a specially written 'How to' guide for businesses. They also run a scheme whereby they award a government 'Seal of Approval' to successful schemes (Fleschner, Crombie & Moreau, 1992);

2. Requirement for local government to provide citizens with recycling services. This kind of legislation has been passed in Oregon where all municipalities with a population of over 4000 must provide kerbside recycling schemes for the designated recyclables. Other states leave the actual form of service provision to the discretion of the individual governments;

3. Requirement for local governments to reach waste reduction goals. This sort of legislation often exists coupled with one of the forms described above. Alabama, California, Maryland, Minnesota, North Carolina, Vermont and Virginia all have laws which incorporate the provision of services and waste reduction goals. New Jersey and Rhode Island have policies which include waste reduction goals and the passing of ordinances to make recycling mandatory. Florida, Georgia, Illinois, Iowa, Louisiana and Ohio have legislation which supports waste reduction goals only;

4. Another legislation genre is that which compels local governments to include waste reduction components in their overall solid waste management planning. Twenty four states have this kind of legislation in partnership with their requirements to make recycling services available. Arkansas, Hawaii, Indiana, Michigan, Missouri and New Hampshire however, operate stand-alone planning programs.

These are the main types of legislation currently in use in the US (Glenn & Riggle, 1991(b)).

3.3.2.2 Policies for Attaining the National Objectives

Some of the policies employed in order to meet the demands of this legislation are outlined below.

3.3.2.2.1 Disposal Bans

These can be directed either at recyclable materials or at the more bulky and/or hazardous fractions of the waste stream. They basically disallow the landfilling and/or incineration of the listed materials. The first piece of legislation of this type was seen in Minnesota in 1984, with their ban of tyres from state landfills. There have been similar laws passed in 28 states since. These include:

- 26 bans on vehicle batteries;
- 16 bans on whole tyres and/or part tyres;
- 12 bans on yard waste;
- 8 bans on white goods;
- 7 bans on motor oil.

Amongst the states which have added some (or in some cases, many) recyclables to their lists, Massachusetts and Wisconsin are the only states to specify plastics, with bans on "single polymer plastics" and "foam polystyrene and plastic containers" respectively (Glenn & Riggle, 1991(b)).

3.3.2.2.2 Landfill Taxes

An extension of this idea is the introduction of landfill taxes. New Jersey, for example, has a tax of \$1.50 (£0.98) on every ton of waste which is presented for landfill. The proceeds from this measure are used to fund their program of start up grants for potential recyclers (Curlee, 1989). Landfill taxes can also be targeted very specifically at packaging materials. Massachusetts, for example has proposed a tax of 3¢ (2p) per layer of packaging on non-food products sold in the state (Curlee, 1989).

3.3.2.2.3 Mandatory Deposits

These entail having a scheme whereby consumers must return a product or product container to the retailer to redeem an agreed sum which was included in the original purchase price as a deposit. The most common items to be treated in this way are beverage containers and vehicle batteries. This sort of legislation has been operational in some states for over ten years. Often known as 'bottle bills', this type of legislation is popular amongst the public (Naughton, Sebold & Mayer, 1990). Most of the schemes will refund between 5 and 10¢ (3½-7p) on each container returned. For example, in Michigan, there was a law passed in 1978 which put a 5¢ (3½p) deposit on 'Certified Containers' (which could be reused by more than one company), 10¢ (7p) on all other containers except quarts and litres and a 20¢ (14p) deposit on quarts and litres. Retailers were required to refund these deposits if they stocked the same brand of product as the one being returned. This system was enforced by the introduction of fines of between $100 (£65) and $1000 (£650) per day for a violation of this law (Crosby & Taylor, 1982). In California, however the state government has taken a slightly different approach. It has a lower deposit level for containers, but employs more active state intervention. Each container initially had a redemption value of 1¢. If any container type had not reached a level of 65% redemption after a set period of time, then a further 2¢ were added to the deposit. In most schemes, retailers are required to sort and store the returned containers on their premises, and the beverage distributors are required to take these containers back to the manufactures, thus completing the backwards distribution chain in the image of the original pattern of distribution. In California however, legislation has been passed making retailers responsible for setting up recycling centres within half a mile of any supermarket which has a turnover of more than $2 million (£1.3 million). Another feature of this type of scheme is the collection of the deposits which are unclaimed by the public. In many schemes, this money is simply retained by the beverage industry. This can amount to huge sums of money. In 1988, one state estimated that this could be around $50 million (£33 million) each year. Some states, like New York and Massachusetts require distributors and bottlers to report how much these unclaimed deposits come to each year. In California, the beverage distributors pay a 1¢ 'tax' per bottle to the state and the state subsequently pays the redemption value to the customer through processors and recyclers. The state therefore retains the unclaimed deposits rather than the industry. This money is used to fund recycling projects. Another unusual feature of the Californian legislation is that it requires the recycling, not just the return of the containers it covers. Due to this difference, the state also made provision for subsidies payable to those obliged to undertake these new operations (Naughton, Sebold & Mayer, 1990).

Although Mandatory Deposit schemes are, "probably the best known state measures that have directly promoted plastics recycling" (Curlee, 1989), there is a fear that this will undermine recycling programs and that to be effective, resources need to be directed at either returnability or recyclability. Like many of the practices described here and elsewhere in this study, there is no need for them to be considered mutually exclusive (Clapham, 1985).

3.3.2.2.4 Limiting Strategies

These include attempts by a number of states to limit the kinds of plastics that can be used for packaging within their jurisdiction.

Product Fees

These operate like a tax on the sale of a product. Tyres are the most common object of such laws, with all of the twenty states which have this kind of legislation putting them at the top of their lists (Glenn & Riggle, 1991(b)).

Packaging Bans

These are a more extreme form of initiative similar to the Product Fees. They aim to reduce the impact of packaging by banning the use of plastics in certain applications. Suffock County, New York and Berkeley, California all have this kind of legislation in place. These laws are criticised by many and felt to be less effective than recycling programs (Curlee, 1989).

Other Restrictions

Massachusetts is considering restricting the manufacture of all packaging to polymers of a single family. Florida has introduced legislation stating that all carrier bags used in the state must be capable of degrading within 120 days. Other states have specified that some or all of the packaging used must be biodegradable. Missouri prohibits the sale of any non-biodegradable plastic packaging containers. Curlee (1989) points out that mixing degradable and non-degradable plastics imposes extreme restrictions on the recycling possibilities for plastics.

3.3.2.2.5 Financial Incentives

This type of incentive can come in several forms. In all, a total of 19 states operate this kind of legislation. Virginia, for example, has a system of tax credits for companies which recycle. Eleven states including California and Wisconsin provide low interest loans to help projects get off the ground. In a similar vein, Wisconsin, Colorado and Vermont have a system of grants, and Oregon has a system of tax credits (Curlee, 1989) to support such ventures, and pay for facilities and equipment. For example, Colorado has set aside $1 million (£650 000) for this purpose. In Burlington, Vermont the local authority has passed ordinances making recycling mandatory for all citizens and businesses in the city. This makes them eligible for a state grant which will cover around 80% of the capital costs of setting up such a city wide recycling system (Fleschner, Crombie & Moreau, 1992). In a similar vein Illinois offers grants to bodies who wish to set up, or expand, recycling programs (Darcey, 1987). Wisconsin and Virginia also operate tax exemption for companies involved in recycling (Glenn & Riggle, 1991(b)). New Jersey and Minnesota operate an incentive system for manufacturers who recycle tyres and plastics (Alter, 1987). Iowa offers tax incentives to those using degradable containers. These sorts of measures can be paired to produce greater effect. Minnesota, for example, has introduced taxes on vehicle registration, which are hypothecated to fund tyre recycling.

3.3.2.2.6 Procurement Initiatives

This is where local authorities develop purchasing policies that take environmental considerations as well as economic factors into account (Case, 1985). The most common commodities treated in this way are paper and paper products. Thirty four states have laws which ensure that recycled products are bought in preference to those made from virgin materials, often within a price range of around 10%. A further 3 states have 'executive orders' to this effect (Glenn & Riggle, 1991(b)). Michigan, for example has a policy of buying re-refined oil for its fleet of cars. Florida has named 155 commodities for preferential procurement. These are mostly paper and paper products like photocopy paper, hand towels, tissues and napkins, but the list also includes plastic products such as rubbish bins and some glass products. The Florida state government believes that this new set of priorities for buying procedures that has been introduced makes it necessary for staff involved in these decisions to be re-educated. Another state government which advocates this kind of legislation is Missouri. It has targeted recycled aluminium, retread tyres, compost and paper products. They also favour bin liners with 25% recycled material and recycling containers which contain 40% of recycled post-consumer plastics waste (DiPietro, 1991).

3.3.2.2.7 State Program Funding

There are several states that have dedicated sources of funding for their recycling programs. Thirteen states have disposal taxes on waste to raise funds, whilst two states have collection taxes on a basis of weight of refuse.

3.3.2.3 Some Examples of Poor Legislation

The legislative measures described above are all intended to improve environmental practices, but there are some cases which show the danger of thoughtless or unsupported legislation. A classic example is the case of the Minneapolis ban on all packaging which was not 'environmentally acceptable'. This was further defined as any packaging which could not be either returnable or recyclable. Within the area covered by this ban, however, facilities existed only to recycle paper, glass and metals. This meant that the ban was effectively outlawing around 14000 different items (all packaged in plastics) from the Minneapolis supermarket shelves. Needless to say, this would have been disastrous for the government, retailers, citizens and suppliers of Minneapolis. The crisis was averted by the city postponing the introduction of the ban for another year whilst the various packaging companies set up a state of the art plastics recycling facility so that their merchandise would be deemed 'environmentally acceptable'. Lodge and Rayport (Lodge & Rayport, 1991) state this as a prime illustration of the fact that legislation must be extremely well thought out, and should take into account the supporting role of commerce. The opposite scenario can equally result in chaos, as can be seen in McDonald's venture to separate and recycle their polystyrene packaging. The scheme was set up without regard to the system that would need to support it and as a result, it failed soon after its conception (Lodge & Rayport, 1991). A holistic view must be taken of the proposed system and government and commerce must learn to work with rather than against each other if effective recycling is to result.

3.3.2.4 Summary

The US has a wider range and higher level of recycling legislation than is currently found in either the UK or the rest of Europe. If nothing else, this shows a higher level of political priority for recycling issues. The US also has a higher average recycling rate. The Institute of Waste Management Conference Proceedings records levels of 10% and 17% for 1987 and 1994 respectively (1994). Whilst these levels are similar to those currently being achieved by some UK schemes, and EC members, the impressive thing is that this represents an average rate for most of a continent. There is no other example of sustained, consistent recycling at this level.

Table 3.2 outlines some of the legislation that has been implemented by the states which had the top ten recycling rates in 1991. Sources for the data presented in this table are Glenn & Riggle, 1991(a); Curlee, 1989; Wright, 1991; Herz, 1988; and Fleschner, Crombie & Moreau, 1992. If there is any pattern to be found in these data it must surely lie in the length of time many of these measures have been in place, their comprehensive nature, and the combination of positive and negative reinforcement policies that have been implemented

If a higher level of legislation represents a higher level of political priority, then a higher recycling rate must represent a higher level of public awareness and contribution. It would be extremely interesting to examine the effects of more legislation on public awareness and participation. Obviously, mandatory measures must have a causal effect on diversion and participation, but a comparison of other measures with their resultant recycling outcomes may give insight into the most productive legislation. The US with its combination of well established policies and range of policy types may prove a large but fruitful ground for studying the effects of policy interventions.

State	Recycling Rate	Legislation
Columbia	20%	Mandatory Recycling since the late 80's Goal to recycle 45% of domestic waste by 1994
Delaware	20%	Mandatory deposits introduced in 1979
Maine	16%	Mandatory deposits introduced in 1975 Product Fees on: Tyres, white goods, brown goods and vehicle batteries Goal to recycle and compost 50% of domestic waste by 1994 Loans for recycling initiatives
Massachusetts	16%	Disposal bans for vehicle batteries, tyres, yard waste, white goods, glass and metal containers, recyclable paper and single polymer plastics Mandatory deposits since 1981 Loans for recycling initiatives Disposal taxes for packaging Goals for 10% reduction, 25% recycling and 21% composting by the year 2000
Minnesota	22%	Loans and grants for recycling initiatives since the early 80's Goal for 35% recycling by 1993 Mandatory deposits on vehicle batteries introduced in 1989 Introduced the 1st US disposal ban in 1984; bans include vehicle batteries, tyres, white goods, motor oil and yard waste Product Fees on tyres
New Jersey	39%	Mandatory recycling since 1986 Goal of 25% recycling by 1990 Disposal ban on leaves Loans, and grants for recycling initiatives, and 50% tax credits for equipment
Oregon	20-25%	Introduction of 1st US recycling legislation in 1983 Disposal ban on vehicle batteries Tax credits for recycling equipment Mandatory deposits since 1971 Procurement policies of up to 5% higher than virgin for products containing 50% recycled industrial, or 25% post-consumer waste Product fees on tyres
Rhode Island	18%	Mandatory recycling since 1986 Mandatory deposits on batteries introduced in 1987 Goals of 15% recycling in 3 years Disposal ban on vehicle batteries Product fees on tyres, used motor oil, antifreeze and organic solvents
Vermont	15-18%	Disposal bans on vehicle batteries, tyres, white goods, and motor oil Goal of 40% recycling by the year 2000 Separate collection of plastics, coupled with a goal to recycle 45% of plastics Mandatory deposits in place from 1972 Grants for companies using recycled goods Goal for purchasing 40% recycled goods by 1993 A 5% packaging tax for firms who use less than 50% recycled packaging
Washington	28%	Mandatory deposits on batteries since 1989 Product fees on tyres Goal of 50% reduction, recycling and composting by 1995

Table 3.2 The top ten recycling states and summaries of their legislation

3.4 Other Countries

This section looks further afield than the west, at some of the policies that are being implemented in other parts of the world.

3.4.1 Taiwan

In its 1988 Solid Waste Management Act, the government of Taiwan made manufacturers and retailers responsible for the retrieval and disposal of packaging and containers that are non-degradable, not easily reusable, or had hazardous materials in their composition. It has also made fifteen categories of commercial products and materials subject to mandatory recycling and introduced the 'Ecomark' to denote an environmentally acceptable product. One of the packaging types originally regarded as unacceptable was PET soft drinks bottles. In order to meet the government challenge of "collect and recycle or abandon the package", a Waste PET Management Committee was set up. A collection system was developed which constituted some 700 colour coded drop off sites. This initiative was funded by the soft drinks bottlers. A processing plant was also built, with funds from the plastics producers. This plant has an agreement with the government to buy all reclaimed plastics from the collectors. In addition to this large scale provision of facilities, a scheme was launched to make payments to the country's 30 000 'scavengers' (people who collect rubbish to sell for scrap or reprocessing) for the recovery of recyclables. This system has been extremely successful, with 33% of PET bottles being recycled by 1990. The current goal is to achieve a 50% recycling rate for PET bottles. What is exceptional about this scheme is that it has shown itself to be profitable (Lodge & Rayport, 1991).

3.4.2 India

India is a good example of a country who has not needed the formal threats of legislation in order to adopt environmental practices. The Indian Government has no recycling legislation, but all reusable materials (including plastics) are sold by householders at a token sum to collectors who then sell it on to reprocessors. This infrastructure has not arisen from environmental concern, but from a national recognition that resources are scarce and should therefore be sustained when at all possible (Phadke, 1988).

3.4.3 Japan

Most of Japan's Municipal Solid Waste is incinerated. Source separation began, not as an attempt at resource conservation, but in order to remove objects from the waste stream which should not be incinerated. In late 1983, a recommendation report entitled *Basic Directives on the Future of Waste Management Policy* was made by the Japanese Government. As regards recycling, this report advocated "Promotion of Resource Recovery and Reutilization". Emphasis was placed on the recovery of energy from incineration, the use of high technology and the creation and development of markets.

Japan also has a system not unlike the UK's use of recycling credits which works on the following basis: If a registered civic group (e.g. a recycler) shows the municipal authority a voucher or procurement slip issued by a secondary materials dealer, showing that 'potential waste' has been recycled, then it is entitled to receive a refund of subsidy or some other kind of financial incentive, based on the weight of material recycled. This refund is usually in the region of 1 to 4 yen (2p) per kg of material. One of the Japanese municipalities has gone about this in a slightly different way. In Hiratsuka a 'public purchasing' system is in operation. This procedure works by offering a guaranteed price for recyclables. This means that the difference between the market price for these commodities and the offered guarantee will be met by the municipality. This scheme costs the local authority no more than the usual scheme of providing subsidies and provides a more stable market price for recyclables (Gotoh, 1987).

3.4.4 Egypt

In Cairo, a community of rubbish collectors, known as the Zabbaleen, recycle about 30% of the city's domestic waste. This represents about 80% of the total rubbish that they collect. Waste is separated and sold back to manufacturers or on to reprocessors. Plastics are sorted by polymer type and pelletised using "a machine similar to a Banbury mixer" (Bouverie, 1991). Some of the Zabbaleen complete the recycling process themselves by heating the pellets and making them into simple shaped goods like photo frames using injection moulding machines. The rest sell their pellets on to some of the 500 factories in the city who use recycled plastics in their production processes. The price that the Zabbaleen charge for their recycled plastics is approximately half that of virgin polymer. Recycled plastics can fetch between E£750 and E£1200 (£151 and £242) per tonne. This makes plastics the most valuable commodity that they trade in. It does however take a rubbish collector around two months to collect a tonne of polymer. All types of plastic are collected, including items such as polythene bags, and yoghurt cartons. These were originally considered too light to recycle, but after the rises in polymer prices in 1991, even films were being collected and sold for up to E£1200 (£242) per tonne.

Like India, no legislation has been imposed on this process, but rather an interest in plastics waste has arisen through the perception of their value by both the waste collectors and the industry involved.

3.5 Conclusions

There is a whole spectrum of legislative standpoints being taken on waste management around the world (see Figure 3.5). Figure 3.5 shows roughly where the legislation of some of the countries described above lie in their attitude to intervention. This is not drawn to scale, it is merely intended to be an indicative model.

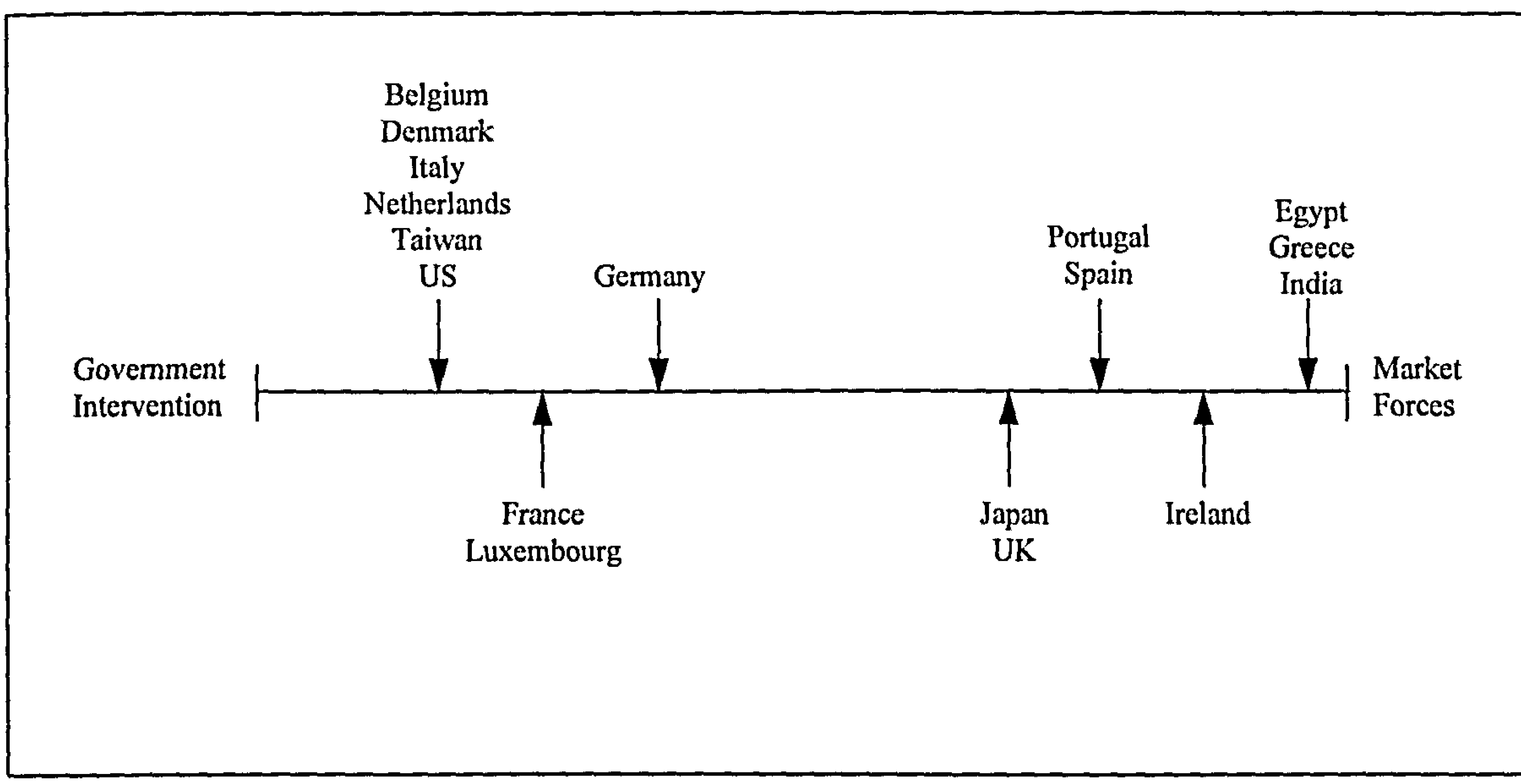

Figure 3.5 A spectrum of intervention policies

The only countries who have spawned recycling industries without the use of legislation which prescribes either financial or legal measures are those which have populations whose standard of living is low enough to appreciate the value of all resources. In the UK, where the public does not **need** to recycle its waste, it is unlikely that it will become widespread practice without the aid of legislation.

It is perhaps interesting to note that even in the US where legislation is well established, the highest recorded recycling rate is 39% for New Jersey, a level slightly lower than the current EC target (Glenn & Riggle, 1991). Perhaps this underlines the necessity of promoting legislation and funding at an equal rate; as David Busby of the US Environmental Protection Agency commented, "Legislation simply doesn't do what funding does...if it's not funded, it's not going to happen" (Darcey, 1988).

The important thing to learn from the introduction of different approaches taken elsewhere is that the legislation should apply pressure (whether legal or financial) to the correct part of the packaging chain, and make sure that the industry is viewed as a system so that the risk of introducing legislation which simply moves the problem to another part of the chain is reduced. For the UK to follow Germany's example of introducing measures that no industry infrastructure existed to support, for instance, would be disastrous. A better policy would be to aim at the market development end of the chain. This could be done by introducing a number of measures such as minimum recycled content required in packaging products. The other type of legislation which would have a similar effect, and perhaps would fit better with the present Government's intention to use economic indicators rather than legislation to regulate the market, would be to reduce the VAT rate on recycled polymers or products containing recycled material, or conversely, place a levy on virgin polymer or products utilising virgin polymer. The latter method may well prove the more effective for the recycling industry if the funds gathered in this way were hypothecated for the research and development of recycling. This would allow both ends of the process to be stimulated, replacing the vicious circle currently operating with a virtuous one (see Figure 3.6).

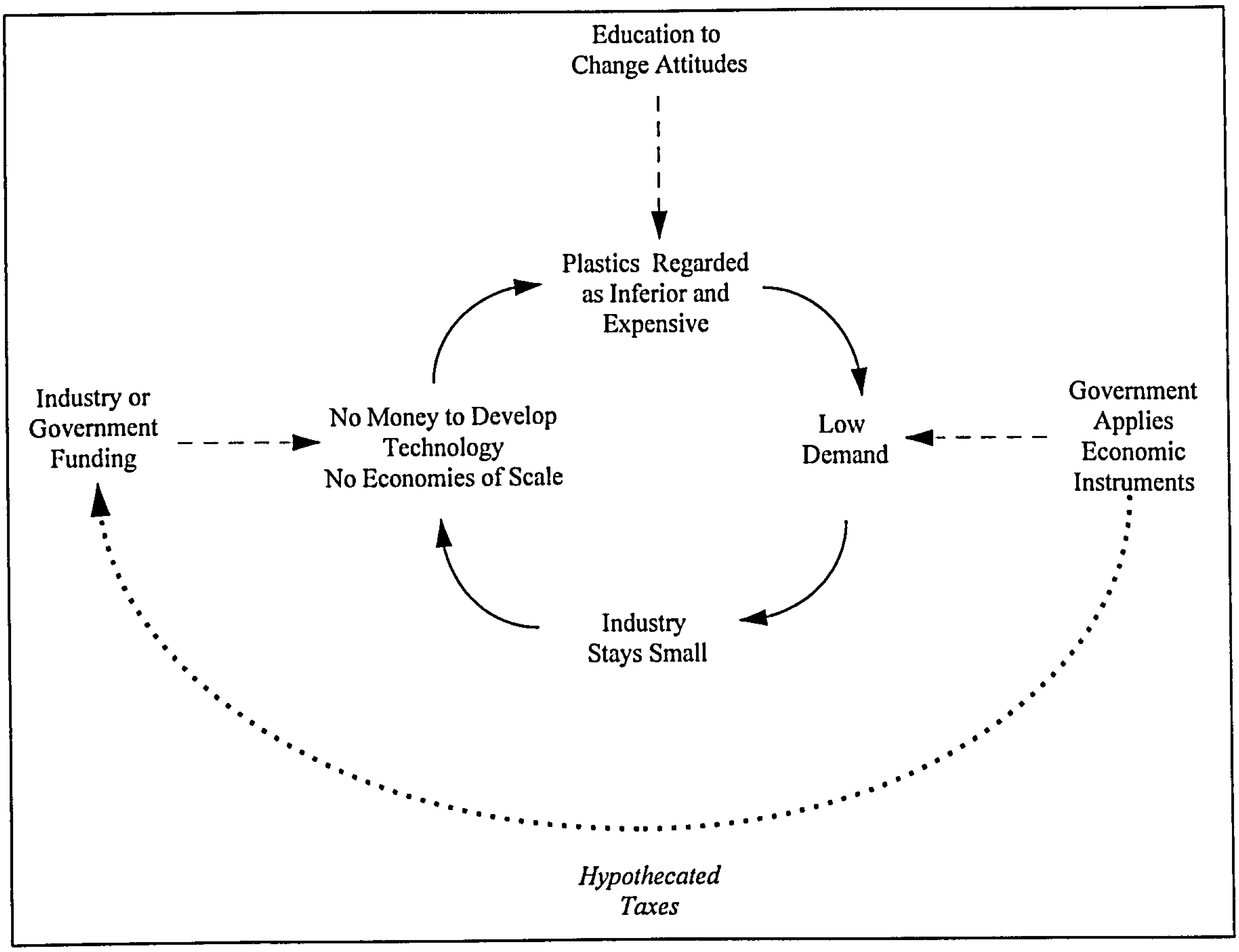

Figure 3.6 Breaking the vicious circle

In terms of the stakeholder analysis of Chapter 1, this strategy would have a profound effect on the levels of empowerment of several members of the packaging chain. Applying economic instruments to the relative costs of recycled and virgin polymers would render recycled polymers more attractive to Bottle Manufacturers both than they are currently and also in relation to their virgin counterparts. This would stimulate the use of recycled polymer either by directly making it a more competitive option for Bottle Manufacturers if the economic instruments were applied to the polymer, or by making recycled packaging more attractive to Fillers and Retailers, were they applied to the packaging products. By increasing the demand for recycled polymer, the Government would be creating larger and more varied markets for the Collectors, perhaps increasing the prices they are offered by Reprocessors in the short term, and allowing them to offer extended facilities to the Public in the long term, increasing the amount of plastics being diverted from the domestic waste stream, achieving greater economies of scale and providing the plastics recycling industry with a larger amount of raw material, stimulating growth. At the same time, as operations become more sophisticated and products containing recycled plastics become more widespread, the Public will witness that recycled plastics products are not of inferior quality. They will be made more aware of the recyclability of plastics through the growing number of schemes that are being provided and the increasing number of products that are being offered. Hopefully this increased awareness will have an effect on the Public interest and participation in post consumer plastic waste recycling schemes.

Should the Government also make use of the monies collected through these economic instruments to fund advances in plastics recycling schemes, both through funding schemes directly and by supporting Industry and Academia in their efforts to research improvements, this growth in the strength and extent of the infrastructure of the plastics recycling industry would be accelerated.

In terms of the shifts described by Figure 1.5, Government intervention of this nature would increase the power of the Collectors, Reprocessors, Second Life Applications Manufacturers, Local; Authorities, Industrial Bodies, and the Academic Community to grow the post consumer plastics waste recycling industry. It would simultaneously increase the interest of the Bottle Manufacturers, the Public, the Local Authorities, Fillers and Retailers in plastics recycling and recycled plastics products. In short, it may achieve the fundamental changes required to move plastics recycling in the UK on to a higher, more stable level of attainment.

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Chapter 4: Recycling Behaviours, Attitudes, and Perceptions in Glasgow and Falkirk

4.1 Introduction

As was discussed earlier, the main objectives of this thesis are to gather more information on UK post-consumer plastics waste recycling, to identify best practice, and to address issues of participation. This chapter represents the first empirical endeavour to begin to address these research aims.

As can be seen by the discussion in Chapter 2, one critical question that must be answered in order to design a scheme to collect plastics waste for recycling is which of the two basic collection methods to employ. Although there has been a number of contributions to the waste management literature concerning the behaviour and attitudes of UK recyclers, (Ball & Tavitian, 1992; Ball & Lawson, 1990; Belton et al, 1994) there has been no attempt to compare these factors for bring and collect systems. Post-consumer plastics waste collection provides an excellent opportunity to make more direct comparisons between these modes of collection as it can provide examples of both types. Following the research lines of earlier work, but adding an element of comparison, the aim of this chapter is to investigate the two main types of collection scheme: bring and collect. In pursuit of this objective, the focus now shifts from the operational viewpoint of chapters 1 to 3, to consider the bring and collect systems from the perspective of those who use them.

In order to study bring and collect systems in detail, two schemes were selected for use as case studies. The schemes chosen were a bring system located in the city of Glasgow and a collect system located in Falkirk District. The schemes are similar in that they are geographically close and that they both enjoyed initial industry sponsorship, but they differ in many aspects. The Falkirk system is run by a not-for-profit organisation, and serves the population of a small town and its surrounding villages, in an area with a positive recycling history. The Glasgow system, on the other hand, is operated by the local authority, within a metropolitan area with a notoriously low recycling record (see Appendix 12).

4.2 Objectives

The objectives of the study outlined in this chapter are:

i) to assess the behaviour of consumers concerning the use and disposal of plastics;

ii) to outline the public's perception of plastics, both in comparison with other materials and in regard to recycling;

iii) to ascertain the motivations (both positive and negative) behind these actions.

If this can be achieved, it will give much insight into the public assessment of these projects. Since participation in both schemes is entirely voluntary, and their success or failure largely depends on public participation, the views of the population they serve will be an important input into the planning stages of larger, more permanent schemes.

Although an element of comparison is intended by the inclusion of one bring and one collect scheme in the study, there is no attempt to systematically compare the findings of the two case study schemes. This is due to the host of other factors which may or may not contribute to any differences observed. These might include, for example, the recycling histories of the two areas, the different levels of car ownership, or the fact that one serves an urban population whilst the other is established in a town and its surrounding villages. Whilst comparisons are suggested in the text, the contexts of the two schemes vary too much to make any statistical comparisons meaningful.

4.3 Outline of Schemes

4.3.1 Glasgow

In March 1991, Glasgow District Council Cleansing Department launched a pilot scheme for the collection of post-consumer plastics waste. The aim of the scheme was to increase the range of materials which could be recycled within the city. Originally this initiative was sponsored by BXL, a plastics recovery firm based in Yorkshire. BXL was a wholly owned subsidiary of BP Chemicals. BXL hoped to discover a financially viable method of supplying waste HDPE for its reprocessing operation (for range of BXL products, see Appendix 3). The Cleansing Department in Glasgow had previously provided facilities for paper, glass and both aluminium and steel drinks cans to be collected for recycling. For each of these materials there was already deposit banks at various sites throughout the city. In line with the existing commitment to bring systems, the council introduced a number of banks for plastic bottles. These orange plastic banks (initially around fifty in number) were sited in residential areas, public areas such as car parks and also near shopping centres or supermarkets. Many of these banks were sited next to one or more of their existing recycling facilities, but some were positioned on new sites. The scheme was originally aimed at all packaging types, but after a short trial period it was decided to target plastic bottles only, due to the high contamination levels of other packaging types. The launch ceremony was attended by officials from both the District Council Cleansing Department and the sponsoring company. The ceremony was reported in both local and council publications (for examples of launch publicity, see Appendix 4). The scheme presented a considerable public relations opportunity for both the sponsors and the Council itself.

4.3.2 Falkirk

In July of 1991 another pilot scheme to collect post-consumer plastics waste for recycling was launched in Falkirk. This scheme was run by a voluntary organisation called Scottish Conservation Projects and sponsored by BP Chemicals. Scottish Conservation Projects already run a scheme backed by UK 2000 (Scotland), Falkirk District Council and Central Regional Council for collecting old newspapers from the people of Falkirk District. This system uses a kerbside collection system to gather old newspapers from each household. In the paper scheme, residents collect their newspapers in a blue reinforced bag and put them out to be collected by Scottish Conservation Projects once a fortnight. The plastics scheme was piloted on 15000 of the households already participating in the paper collection. A second green bag was distributed to these households along with a leaflet which explained the system, what its intentions were and why it was necessary. It also gave examples of some of the uses that the different kinds of recycled plastics could be put to (see Appendix 5). A calendar showing the plastics collection dates was also given to each household. Like the established paper system, collections of plastics were also fortnightly, working on the alternative weeks to the paper collection. The official launch of this scheme was reported in local newspapers and was also televised by STV (see Appendix 6). Scottish Conservation Projects hoped to upgrade the pilot scheme to cover the whole of Falkirk District, if a high enough tonnage of waste plastics could be collected by the scheme.

4.4 Method

In line with the nature of the research objectives, the method used for this study was a survey of members of the public using a structured questionnaire which was analysed using quantitative techniques. This technique allows, "the collection of information in standardised form from groups of people" (Robson, 1993). Another strength of the questionnaire as a research instrument is that it presents the opportunity to record a variety of information from a relatively large number of people in a short space of time (Patton, 1990). In order to meet the objectives outlined above both factual answers, which described the behaviour of the individual being interviewed, and opinions were recorded. In order to accommodate this strategy, the questionnaire included a mixture of open and closed questions. Due to the inclusion of open questions, the length of the questionnaire this wide range of objectives necessitates, and the problems associated with identifying respondent addresses for the Glasgow survey, it was decided to conduct the interviews personally, as a postal survey of this nature may well have been subject to very low response rates.

Interview strategies of this type are widely used in the social sciences to collect research information. Yin (1994) points out that the limitations of this kind of instrument include the introduction of bias due to poorly constructed questions, as well as the possibility of *reflexivity* which he defines as the interviewee responding to questions in the manner that s/he supposes the interviewer will want. Patton (1990) observes that interviewing in this way can have benefits such as giving a standardised question phrasing and topic coverage to each interview. This can promote the degree of comparability in the responses and facilitate data management and analysis. He goes on to qualify this by warning that these benefits must be balanced against the possibilities of over constraining the answers of the interviewee through the use of closed questions which anticipate the array and distinctions in the between answer categories in advance. The utilisation of a mixture of open and closed questions aimed to maximise the usefulness of respondent answers whilst minimising the potential limitations outlined above.

4.4.1 Questionnaire Development

The first stage of the project involved the design of a questionnaire to use with the Falkirk and Glasgow public. The initial aim was to construct one questionnaire for both schemes. This would allow comparisons between the two schemes to be made very easily. However, since the schemes are so fundamentally different this was found to be impossible without making compromises which would have greatly reduced the value of the information generated. Therefore the same structure was used for the questionnaires for both locations and, where possible the same questions were used. Where this could not be done, questions were asked in as similar a format as possible in order to facilitate comparison.

Both the questionnaires have four sections (see Appendix 7 for full Questionnaires).

Some of the questions outlined below were included at the request of BP or BXL in order to assess how accurate their ideas of the public's knowledge and perception of plastics were. Other questions were modelled on those utilised by previous studies (Ball & Lawson, 1990; Ball & Tavitian, 1992)

4.4.2 General

The first section is a general section which was answered by all survey participants. At this stage, the interviewers simply explained to participants that they were interested in recycling, without declaring a specific interest in plastics. This was done in order to eliminate any biases in their responses. The first part of the General section was used to find out how people rated plastics as an environmental hazard. Participants were asked to rank different materials (glass, plastic, paper and metal) in order of environmental damage for both their production and disposal. Plastics manufacturers feel that they have a reputation of employing more environmentally harmful materials and processes in their production than the producers of other materials. This question was intended to ascertain whether or not this was indeed a widely held belief. It was also thought that people may regard plastics as unnatural and that they may be concerned about the lack of biodegradability of plastics, causing them to rank it as a greater environmental hazard than paper glass or metal.

The respondents were then asked to say which of the materials they believed could be recycled and also which they thought would be the most easily recycled. This was to try to ascertain the extent of the public's knowledge or preconceptions about the materials and the recycling processes of each. Again, these questions were asked at the beginning of the questionnaire because it was important that the answers were not biased by the knowledge that we were interested in plastics. Some people commented that they were difficult opening questions, but their intention made their position necessary.

People were then asked which materials they recycled, if any. This was done in the same format as the previous question which asked which materials **could** be recycled, in order to allow a comparison between knowledge and actions. At this point, people were also asked to identify their recycling method for each material. These questions led to categorisation of the respondent as a 'user' or 'non-user' of the plastics collection scheme. They also show whether or not 'non-users' of these two plastics schemes are 'non-recyclers' or just 'non-plastics-recyclers'. It was thought that those who recycle one or more materials already would be more likely to recycle plastics.

Another concern was that people would think that the amount of plastics waste they produced was negligible and so not worth using the schemes. People were therefore asked to estimate how much of their total rubbish was plastic, in order to see how accurate their perception of the scale of the problem was.

The final questions in this section were concerned with reuse of plastics containers. It was felt that reuse may be a significant factor in keeping plastics containers out of the domestic waste stream and so prevent them from being recycled. One problem envisaged with reuse is that plastic containers may be used to hold garden chemicals which can lead to dangerous contaminants in the recycling system if they are later recycled. Therefore as well as asking whether or not people reused containers they were also asked where they reused them and what they did with them after reuse. This was to try to quantify this problem and see if specific information should be provided regarding garden chemical containers.

4.4.3 User

4.4.3.1 Questions Common to Both Schemes

Those people who indicated that they did recycle plastics in question 5 of the general section were then asked the questions in one of the two user sections. The first question put to the users of both schemes was intended to discover their main reason for using the scheme. The answers to this question were not prompted unless the respondent sought assistance or clarification. This was to avoid prescribing or biasing the respondents' answers where possible.

Users were also asked how often they used each scheme and approximately how many containers they recycled each time. These questions allow patterns of usage to be formed, and also calculations to be made of the average number of bottles deposited per household.

In a similar vein, users were asked what sort of plastics containers they recycled. This helps to find out what proportion of different types of containers were being deposited. This was instigated by a concern of the scheme operators that people would only identify PET and PVC drinks bottles as 'plastic bottles' but not realise that HDPE laundry liquid bottles, for instance, were also eligible. This worry was founded on the early experience with glass bottle banks. Soon after the launch of the United Glass bottle bank scheme, organisers realised that people did not recognise jam jars and other glass food containers as being eligible for recycling in a bottle bank. Subsequent publicity tried to counteract this and bring the public's attention to other kinds of glass containers in order to tap this previously unrecognised glass resource and boost recycling.

Another group of questions asked of participants in both areas related to the publicity associated with the two schemes. The first of those was intended to discover the most common way in which people initially became aware of the schemes.

Participation rates are a crucial factor in the success or failure of a recycling scheme (Ball & Tavitian, 1992: Ho, 1982). Examining the ways in which the scheme users (i.e. those for whom publicity is successful) were first made aware of the schemes should give some valuable insights into which types of publicity have been the most effective. Respondents were also asked if they thought there was enough publicity about the scheme and if any improvements could be made either to the publicity or to the scheme itself. The public evaluation of the publicity and the overall scheme is also important for the planning of the next stages of scheme implementation.

4.4.3.2 Questions Asked in Glasgow Only

Glasgow users were asked what would encourage them to recycle more plastic. This was designed as an open question, and was intended to test for convenience factors and also to see if they would mention kerbside collection or other schemes.

The environmental benefit from recycling plastics is negated if people make a special car journey to the deposit banks with their containers, due to the fuel consumed. The respondents were therefore asked when they used the banks, what method of transport they used to get there, and how far they travelled.

Distances travelled to the banks can also be used to establish spheres of influence of different site types. Glasgow users were also asked why they had used a particular bin. This also helped to evaluate sites as in many cases, the nearest bin to their homes was not the most convenient. In order to obtain a public evaluation of the sites, the respondents were asked where they thought the best type of site for the bins would be.

4.4.3.3 Questions Asked in Falkirk Only

Users in Falkirk were asked how clear they found the information given to them in the initial publicity leaflet. Closely following the instructions in this leaflet is important for the success of the scheme, so it must be accessible and easily understood. In order to further test this, the respondents were asked how they prepared their bottles for recycling. Falkirk users were also asked whether they found the collection timings to be suitable.

4.4.4 Non-User

4.4.4.1 Questions Common to Both Schemes

Those who do not currently recycle plastics answered questions from a non-user section.

The non-users were first asked a series of questions in order to determine their reasons for not recycling plastics. Firstly they were asked whether or not they believe that plastics can be recycled. Next, they were asked if they knew of any schemes to recycle plastics operating locally. It is important to assess the reasons behind non participation so that promotion strategies for the scheme can be better developed and targeted. If certain groups are identified who are unaware of the possibility or importance of recycling, then information could be provided in an appropriate format for them. It may be the case that people are aware both of the recyclability of plastics and of the local scheme, but find it inconvenient to participate or perhaps have no interest or belief in recycling at all. These people might also benefit from specially targeted literature. In order to find out if the non-users felt any particular identifiable shortfalls in the scheme, they were then asked what would encourage them to recycle plastics. Non-users in both areas were then asked why they believed plastics recycling schemes were being set up. This was again left as an open question to invite a wider variety of responses, including "don't know".

4.4.4.2 Questions Asked in Glasgow Only

The Glasgow non-users were asked if they would be prepared to use plastics banks for their plastics bottles, and how far they would travel to do this. They were then asked if they would prefer a kerbside collection of plastics, and if so, how often. These questions help to assess the factors which affect participation (e.g. convenience) but must be interpreted carefully since what people say they are prepared to do and their subsequent actions may vary significantly.

4.4.4.3 Questions Asked in Falkirk Only

The Falkirk respondents who lived in the pilot area for the kerbside collection were asked if they would prefer to use the plastics bottle bank system and how far they would be prepared to travel to do so. They were also asked whether or not they found the information leaflet clear. This was to find out if the complexity of instructions and information given was contributing to their avoidance of the scheme.

4.4.5 Classification

The final section of both of the questionnaires was a simple classification section. All respondents answered this section. It included questions about the age, gender and occupation (in order to allow social class to be approximated) and postcode of the interviewee. They were also asked how many people were in their household. This section allows the rest of the information to be grouped together in different ways in order to identify data patterns. This helps to distinguish 'group characteristics' of recyclers and non-recyclers of plastics.

4.5 Pilot Studies

An initial pilot study for the questionnaires was carried out at Stirling University with a group of 30 Open University students of various disciplines. Each person was asked to complete the questionnaire themselves rather than being interviewed. They were also asked to mark any part of the structure or phrasing of the questions that they found ambiguous or unclear. This initial test was done to ascertain the clarity of the wording and routing of the questionnaire.

As a more thorough test, the first day spent interviewing the public in both areas was regarded as a pilot day. These pilots resulted in some modifications being made to the questionnaires, but as the changes were minor in both cases, these responses (approximately 25 from each scheme) have been included in the final results.

4.6 Sampling and Timetabling

Due to time limits and lack of resources, it was not possible to take purely random samples of the Falkirk and Glasgow public. In Glasgow, for instance, a very large sample size would have been required for a significant proportion of scheme users to be found. Using the methods outlined below, samples were taken, stratified where necessary and random elements were introduced where possible.

A total sample size of 500 was chosen. This number was selected as a balance between keeping the task of data management within sizeable proportions and yet including a large enough sample to make statistical comparisons of breakdowns in the data meaningful (Easterby-Smith et al, 1991). The sample size used here was more ambitious that other studies in this field (Belton et al interviewed 422 members of the public (1994); Ball and Lawson interviewed 275 (1990); and Ball and Tavitian interviewed 214 (1992)) but it was felt to be important to record the opinions of as many recyclers as possible within the time and resource constraints of doctoral research.

Since it was anticipated that finding recyclers in Glasgow would be more difficult, as they would be more widely dispersed amongst the population in general (Hague & Jackson, 1987), a larger proportion of the interviews was planned for that area. In this way, 300 interviews was the target for Glasgow, with the remaining 200 being allocated to Falkirk respondents. An element of stratification was introduced by visiting a wide range of banks in Glasgow and by ensuring that each of the Falkirk beats was represented. This means that the survey covers a range of areas, sampling from a variety of Socioeconomic Groups and therefore selecting a respondent group which is more likely to be representative of the general population. Quotas of age, or gender were not used due to the increased timescale this would have imposed on the research. It was also felt to be inappropriate to introduce quotas in a field in which so little previous work had been done. It would be unwise to introduce detailed stratification criteria under these circumstances, on the basis of assumptions about findings, or about the characteristics of the population of recyclers, which may unwittingly introduce bias (Easterby-Smith et al, 1991).

4.6.1 Glasgow

In order to select interview sites from the list of total bin sites, a summary of the plastics returns from the scheme to date was obtained from the Glasgow District Council Recycling Officer. From this it was possible to put the banks into some sort of grouping according to the average volume of returns per month. It was decided to spend a day interviewing at each of the most successful banks (on the principle that users could be interviewed more efficiently at these sites) and make a brief visit to all the remaining banks to try to ascertain whether there were any obvious reasons for their lower returns. The decision criterion chosen to divide these two groups and hence create the sample was that a full day's interviewing would take place at each bank which collected a monthly average of 15kg or more of plastics. The dates spent interviewing at each of these sites was drawn at random. For a full site diary, see Appendix 8.

The Glasgow survey was carried out by standing at these various locations near the plastics recycling banks and selecting either every 5th passer-by or person using the plastics bank or any of the other recycling banks (if the bank was situated in a group along with paper and/or can and/or glass collection banks). If the 5th member of the public was unwilling to stop, the 6th was selected and so on until someone was willing to answer the questions. In order to minimise sampling bias, interviews were also carried out in the evenings and during the weekends. In this way a systematic random sample of 300 members of the public was taken.

4.6.2 Falkirk

The Falkirk collection scheme operates in five different areas of the District. These have been termed 'beats' and each represents a different collection round. Each of these beats was randomly assigned two days during which roads were randomly selected from that area to take part in the survey. The survey was then carried out by knocking on every second door in each of the selected streets in these areas. If there was no reply at a house, the next house was tried, and so on, until a respondent was found. The survey was also carried out in the evenings and at weekends as well as during the day and mid-week, in order to try to form as unbiased a sample as possible. A total of 200 people participated. For a list of areas visited, see Appendix 9.

4.7 Results and Analysis

Of the 300 members of the public surveyed in Glasgow, 117 were scheme users, whilst the remaining 183 were non-users. The proportion of users located was, as suspected, lower in Glasgow than in Falkirk where 144 of the 200 households included in the study were scheme users, leaving only 56 non-users.

The results were coded and analysed using the Lotus 1-2-3 computer package. Since very little of the data recorded was ordinal, one form of analysis was through the use of non-parametric, descriptive statistics. Other responses were categorised with respect to one of the classification criteria, or whether or not they recycled, or whether the scheme they were using was bring or collect. Once the results had been tabulated, any trends which became apparent were tested statistically in order to ascertain whether they were genuine or simply the result of chance. The Chi-Squared statistical test for independence was utilised in these cases, with a confidence interval of 95%. (A full explanation of this test can be found in Levin, 1981 and Speed, 1991).

Content analysis was used to group the answers given in response to open questions. This involves analysing the responses for themes and recording the frequencies with which these themes occurred. Although content analysis is basically a quantitative approach to the categorisation of qualitative data, it is a step towards the reduction of bias in that the questionnaire designer is not pre-empting the themes that will be chosen, or distinguished between, by the respondents, but rather allowing the categories to emerge from the data. Content analysis allows the answers to open questions in an otherwise structured questionnaire to be coded and analysed in a manner compatible with other responses. It also facilitates the comparison of responses across groups (Easterby-Smith, Thorpe & Lowe, 1991).

4.7.1 Recycler Characteristics

In the first part of the analysis, the various data collected in the classification section was related to the information about which materials were recycled by participants, in order to identify common characteristics and/or influencing factors amongst the recyclers. The first characteristic analysed was age. Table 4.1 shows a breakdown of plastics recyclers by age for Glasgow, whilst Table 4.2 shows a similar breakdown for Falkirk users.

Age Group	Number of Plastics Recyclers	Percentage of Age Group Interviewed
0-15	3	50.00
16-30	26	28.29
31-45	28	34.15
46-60	16	29.63
60+	44	64.71

Table 4.1 Glasgow users broken down by age group

Age Group	Number of Plastics Recyclers	As a Percentage of Age Group Interviewed
0-15	4	80.00
16-30	30	63.83
31-45	49	81.67
46-60	28	62.22
60+	33	76.74

Table 4.2 Falkirk users broken down by age group

From Table 4.1 above, it can be seen that in Glasgow there appears to be a larger proportion of plastics recyclers in the over 60 age group and also amongst those under 16 than there are in the other age groups. In order to test this difference statistically, a Chi-Squared test was carried out. At a five percent level of significance there is a difference in the proportions of recyclers in different age groups. As the total number of those under 16 is such a small proportion of those interviewed, the grouping is probably not a representative sample and therefore no positive inferences can be drawn from it. The over 60's however have a much larger group size and so it can be assumed that the high value of the Chi-Squared statistic can be attributed to the observed difference. It seems that the over 60's do in fact make a proportionally higher contribution to the Glasgow scheme than the other age groups. In Falkirk however, there is a much more even spread between the age categories. Statistically there is no difference. Since the Glasgow scheme requires more time and effort per participant, it is possible that age groups which generally have more time are more likely to participate. This can be tested by looking at a similar breakdown for socioeconomic groups. The information given by participants about their occupations proved too vague to enable them to be classified into precise socioeconomic groups. For the purposes of this study, four rough groupings, based on income and training, have been adopted in order to allow some basic analyses to be carried out.

Retired people, housewives/husbands, the unemployed, school children and students have all been grouped together in a 'low income' category. It is recognised that many of the people in this group (for example retired people with company pensions or housewives/husbands whose partners are in high income groups) would probably not belong to this group, but this is the best estimation possible with the information available. Group 2 includes the unskilled/semiskilled occupations; Group 3 skilled occupations; and Group 4, professionals. The full list of occupations allocated to each of the four groups can be found in Appendix 10. It could be assumed that the participants who are part of what has been termed Socioeconomic Group 1 (Retired, Housewives/husbands, Unemployed, School Children and Students) would have more 'leisure' time than those in the other groups. Therefore, if time is an important factor for contribution, then there should be a higher proportion of recyclers in Socioeconomic Group 1 than in the other groups. Looking at Table 4.3 for Glasgow, this does indeed seem to be the case.

Socioeconomic Group	Number of Plastics Recyclers	As a Percentage of Socioeconomic Group Interviewed
1	69	47.59
2	16	37.21
3	10	26.32
4	22	29.73

Table 4.3 Glasgow users broken down by socioeconomic group (see Appendix 10 for key)

A Chi-Squared test shows that this difference is significant at a 5% level. These results are echoed by Belton et al who found, in their study of recycling in Glasgow, that 38% of users were retired, with 44% being over 55 (Belton et al, 1994). Kharbanda (1991) reports that a Birmingham study also found a higher proportion of the 55+ age group amongst its recyclers. From Table 4.4, no such pattern emerges from the Falkirk data and a statistical test confirms that there is no significant difference.

Socioeconomic Group	Number of Plastics Recyclers	As a Percentage of Socioeconomic Group Interviewed
1	72	76.60
2	15	71.43
3	34	66.67
4	23	67.65

Table 4.4 Falkirk users broken down by socioeconomic group (see Appendix 10 for key)

Since Socioeconomic Group 1 is such a large group and covers a wide range of people, the category was further subdivided in order to give a more detailed picture. This meant dividing the participants in Group 1 into their original five categories of Retired, Housewife/husband, Unemployed, School Children and Students. The result of this subdivision can be seen in Tables 4.5 (Glasgow) and 4.6 (Falkirk).

Socioeconomic Group	Number of Plastics Recyclers	As a Percentage of Socioeconomic Group Interviewed
1.1	35	61.40
1.2	18	60.00
1.3	4	19.05
1.4	4	57.14
1.5	8	26.67
2	16	37.21
3	10	26.32
4	22	29.73

Table 4.5 Glasgow users broken down by socioeconomic group (with SEG 1 further broken down into its constituent parts) (see Appendix 10 for key)

Socioeconomic Group	Number of Plastics Recyclers	As a Percentage of Socioeconomic Group Interviewed
1.1	30	75.00
1.2	30	85.71
1.3	2	50.00
1.4	5	83.33
1.5	5	55.56
2	15	71.43
3	34	66.67
4	23	67.65

Table 4.6 Falkirk users broken down by socioeconomic group (with SEG 1 further broken down into its constituent parts) (see Appendix 10 for key)

For Glasgow, when Socioeconomic Group 1 is broken down into its constituent groups, it can be seen that the Retired, Housewives/husbands and School Children do in fact appear to have a higher percentage of plastics recyclers than any of the other groups, whereas the other constituent parts of Socioeconomic Group 1 have a similar or smaller proportion of recyclers to the other groups. Again, since the School Children form such a small part of the sample, their results are probably not representative. The Chi-Squared test shows that these differences are significant at a 5% level.

Falkirk shows no such differences. So this shows that although those who have more time, or perhaps simply less structured time, may be more likely to contribute to a plastics recycling scheme, perhaps the age of the person could also be a factor. This could be for a number of reasons which will be discussed later.

Another factor which may affect whether or not a household contributes to a plastics recycling scheme is the volume of plastics that it produces. It could be assumed that the higher the number of people in a household, the greater the volume of plastics waste it will produce. It is likely that the impact of extra members will decrease marginally, so that after a certain size of household an extra member will have little effect on the amount of packaging used. In order to test whether or not a higher volume of plastic will make households more likely to participate, a Chi-Squared test was carried out on Table 4.7 (Glasgow) and then on Table 4.8 (Falkirk).

Number in Household	Number of Plastics Recyclers	As a Percentage of Household Size Group Interviewed
1	27	45.00
2	33	39.29
3	26	37.14
4	18	33.33
5	5	27.78
6	6	66.67
7	1	25.00
8	1	100.00

Table 4.7 Glasgow users broken down by household size

Number in Household	Number of Plastics Recyclers	As a Percentage of Household Size Group Interviewed
1	12	92.31
2	43	68.25
3	32	69.57
4	40	75.47
5	11	61.11
6	5	100.00
7	1	50.00

Table 4.8 Falkirk users broken down by household size

At a 5% level, there was no significant difference in likeliness to contribute between the different household sizes in either area. This means that a household of seven people is no more likely to recycle than one of only three. This has implications for both the theory that people with more waste are more likely to recycle, as well as challenging the idea that every person is equally likely to recycle. Perhaps recycling would be the choice and responsibility of only one person in each household, regardless of its size. This might be particularly true of the traditional family unit. Further research to ascertain whether this is the case and identify that person would be valuable in the design of literature and publicity for future schemes.

4.7.2 Materials Recycled

Tables 4.9 and 4.10 show the collection methods used by recyclers in Glasgow and Falkirk. The overwhelming majority of Glasgow recyclers use the bank systems to recycle. A few of the interviewees stated that they had used a kerbside collection. This is possibly a temporary or local arrangement, or a reference to a long extinct paper collection in Glasgow. 50% of the recyclers in Falkirk only use the collection system, whilst 36% use banks of some kind as well as the collection schemes, and a further 4% use banks only. The banks mentioned may well be the glass banks provided in Falkirk town centre.

Collection Method	Number of Interviewees	As a Percentage of Interviewees
Banks	236	78.66
Kerbside Collection	2	0.67
Both	2	0.67
Other	2	0.67
None	58	19.33

Table 4.9. Methods of recycling in Glasgow

Collection Method	Number of Interviewees	As a Percentage of Interviewees
Banks	8	4.00
Kerbside Collection	99	49.50
Both	72	36.00
Other	1	0.50
None	20	10.00

Table 4.10 Methods of recycling in Falkirk

Material	Number of Interviewees	As a Percentage of Interviewees
Glass	200	66.67
Metal	138	46.00
Paper	195	65.00
Plastic	117	39.00

Table 4.11 Materials recycled in Glasgow

Material	Number of Interviewees	As a Percentage of Interviewees
Glass	72	36.00
Metal	23	11.50
Paper	171	85.50
Plastic	144	72.00

Table 4.12 Materials recycled in Falkirk

Users in both areas were asked which materials they recycled. The results are summarised in tables 4.11 and 4.12. Table 4.11 shows that glass and paper are the most commonly recycled materials in Glasgow, with metal next and plastics last. In Falkirk (see Table 4.12) the levels of recycling participation are much higher for paper and plastics, but much lower for glass and metal. These outcomes reflect the different emphases of recycling facilities in the two areas. In Falkirk, which provides a kerbside collection for plastics and paper, it is to be expected that these will be the most recycled materials. Glasgow, on the other hand, has not provided facilities which give preference to any of the materials. Here, glass and paper, the two materials with the most established collection schemes in this country are the most commonly recycled. This is probably in line with other cities providing bring systems for recyclables.

Another interesting question is whether those who recycle one material are more likely to recycle others. This was investigated, and the results can be seen in Tables 4.13 and 4.14. Since it is much more convenient for those in Falkirk to recycle paper and plastics, it is also interesting to see whether this has an effect on the recycling of other materials. Those who only recycled paper and plastics in Falkirk were therefore separated out and are shown in Table 4.15.

Number of Materials Recycled	Number of Interviewees	As a Percentage of Interviewees
0	58	19.33
1	38	12.67
2	68	22.67
3	68	22.67
4	68	22.67

Table 4.13 Numbers of materials recycled in Glasgow

Number of Materials Recycled	Number of Interviewees	As a Percentage of Interviewees
0	20	10.00
1	27	13.50
2	91	45.50
3	47	23.50
4	15	7.50

Table 4.14 Numbers of materials recycled in Falkirk

Number of people who only recycle Plastics and/or Paper	100
As a percentage of participants	50.00
As a percentage of recyclers	55.56

Table 4.15 Isolating those Falkirk recyclers who only use the schemes provided

The proportion of non-recyclers is twice as big for Glasgow as it is for Falkirk. In both areas, people are more likely to recycle two or three materials than just one. In Falkirk, most people recycle two or three materials, while recycling four materials is uncommon. Again, this reflects the provision of services in the District. Some 55% of those who recycle any material in Falkirk only recycle plastics and/or paper. This figure is lower than expected. A higher proportion only recycling materials included in the kerbside system would have indicated that the convenience of the scheme was a crucial factor. Since this was not the case, however, perhaps it adds weight to the theory that people who recycle one material are more likely to recycle others. In Glasgow, people are equally likely to recycle two, three, or four materials. The following tables show a similar analysis of plastics recyclers to discover whether those who recycle plastics are more likely to recycle other materials.

Materials Recycled	Number of Recyclers	As a Percentage of Recyclers
Plastics Only	4	3.42
Plastics and One Other Material	10	8.55
Plastics and Two Other Materials	35	29.92
Plastics and Three Other Materials	68	58.12

Table 4.16 Materials recycled in Glasgow (regrouped)

Materials Recycled	Number of Recyclers	As a Percentage of Recyclers
Plastics Only	3	2.08
Plastics and One Other Material	79	54.86
Plastics and Two Other Materials	47	32.64
Plastics and Three Other Materials	15	10.42

Table 4.17 Materials recycled in Falkirk (regrouped)

Again, Table 4.17 illustrates Falkirk's bias towards the two materials covered by the collection schemes. If it is assumed that since plastics banks are a relatively new addition to recycling facilities in Glasgow, and less people recycle plastics than other materials, and the recycling of other materials is more likely to affect the recycling of plastics, rather than the other way around, then the pattern for Glasgow (see Table 4.16) shows that the more materials that a household recycles, the more likely they are to recycle plastics.

These results could have important implications for the plastics recycling industry. Material about plastics recycling targeted at those who already recycle other materials may provide a new group of recyclers with a low marketing investment. It may also point to benefits for the various recycling industries launching joint publicity campaigns.

4.7.3 Plastics Recycled

The following tables show a breakdown of the sorts of plastics containers recycled (see Tables 4.18 to 4.21). The categories shown were developed from the various responses given by the interviewees. Packaging refers to films and trays (like those used to hold meats and pre-pack foods). Containers refer to items such as yoghurt and margarine tubs. Detergent bottles is a term intended to signify HDPE bottles which contain various cleaning products, such as laundry liquids, kitchen and bathroom cleaners and fabric conditioners. Since there is no limit on the number of different plastics mentioned by each interviewee, the percentages shown are calculated using the total number of responses, rather than the total number of respondents.

Containers Recycled	Total Times Mentioned	As a Percentage of total times mentioned
Drinks Bottles	94	45.41
Detergent Bottles	55	26.57
Containers	27	13.04
Bags	18	8.70
Packaging	12	5.88
Others	1	0.48

Table 4.18 Types of Containers Recycled in Glasgow

	Total Times Mentioned	As a Percentage of total times mentioned
Plastics Required	149	71.98
Plastics Contraries	56	28.02

Table 4.19 Types of containers recycled in Glasgow (Regrouped)

Containers Recycled	Total Times Mentioned	As a Percentage of total times mentioned
Drinks Bottles	125	54.59
Detergent Bottles	75	32.75
Containers	21	9.17
Packaging	5	2.18
Bags	3	1.31
Others	0	0.00

Table 4.20 Types of containers recycled in Falkirk

	Total Times Mentioned	As a Percentage of total times mentioned
Plastics Required	200	87.34
Plastics Contraries	29	12.66

Table 4.21 Types of containers recycled in Falkirk(Regrouped)

In both cases, PVC drinks bottles are the most commonly contributed. Both locations also put Detergent Bottles as the second most commonly contributed container. This shows that people are recognising HDPE bottles as eligible for recycling, and therefore there seems to be no 'jam-jar' effect for these containers.

Another important feature of the items deposited was the proportion of them which were required by the scheme, and how many were contraries. Plastics contraries (e.g. margarine tubs, yoghurt pots and plastic bags) were found to be slightly lower in Falkirk where specific information was supplied.

4.7.4 Plastics Recycling Habits

The Glasgow users contributed plastics to their scheme on average just under once a week. 71% of the Falkirk users put plastics out for every collection, 15% for every second collection (i.e. once a month) and the remaining 14% only occasionally.

In Glasgow, (see Table 4.22) 85% of people bring between 1 and 10 containers on each visit to the plastics bank. Over half of the users bring between 1 and 5 containers.

Number of Bottles	Number of Recyclers	As a Percentage of Recyclers
1-5	67	57.26
6-10	32	27.35
11-20	14	11.97
20+	4	3.42

Table 4.22 Average number of bottles taken to plastics bank on each trip by Glasgow users

Number of Bottles	Number of Recyclers	As a Percentage of Recyclers
1-10	79	54.86
11-20	57	39.58
21-30	7	4.86
30+	1	0.69

Table 4.23 Average number of bottles put out for each collection by Falkirk users

In Falkirk, (see Table 4.23) 94% of people put out between 1 and 20 containers for each collection, with over half recycling between 1 and 10 containers each fortnight. Since Glasgow's average contribution time was estimated to be weekly and Falkirk's collections are fortnightly, these figures can be seen to be roughly equal, with a slightly higher percentage of Falkirk users in the 11-20 band. These figures would indicate an estimated 25.73 bottles being recycled per participating household per month in Glasgow, compared with 17.58 bottles per household per month in Falkirk.

4.7.4.1 Glasgow Specific Habits

Table 4.24 shows when the Glasgow recyclers use the plastic banks. The overwhelming majority of people (71%) use the bins on the way to the shops. Many of the bins are sited in the car parks of local shopping centres or supermarkets. These are the Cleansing Department's preferred site types as they have high accessibility to much of the public. Residential areas are also favoured due to the relatively low car ownership levels in Glasgow (Belton et al, 1994).

When Bins are Used	Number of Recyclers	Percentage
On the way to shops	83	71.55
Special Trip	15	12.93
On the way to Other Activities	8	6.90
On the way to Work	8	6.90
Other	2	1.72

Table 4.24 When Glasgow users use plastics banks

Only 13% of respondents make a special trip to recycle their plastics. In order to see whether or not those who make special trips to put their plastics in the recycling banks use one particular site, or site type, the following table (see Table 4.24) was constructed.

It would seem from Table 4.25 that most of the Glasgow users who make special trips to bring their plastics containers to the banks are mostly users of the sites which are near local shops. The amount brought to the collection banks by those making special trips was also studied, to see if they contributed a higher volume of plastics, thus creating the need for a special trip. The average contribution of this group of users was 22.97 bottles per household per month, which is in fact slightly lower than the average for all Glasgow users.

Site Name	Number who Make Special Trips	Site Type	Number of Bins on Site
Woodlands Drive	4	Local Shops	2
Maryhill Co-op	3	Local Shops	7
Shawbridge Street	3	Local Shops	6
Knightwoods Shopping Centre	2	Local Shops	6
Broomhill Shopping Centre	1	Shopping Centre	5
Peckhams	1	Local Shops	2
Queensborough Gardens	1	Residential Area	2

Table 4.25 Breakdown of sites to which Glasgow users make special trips

All respondents travelled to the Glasgow plastics bins either on foot or by car. These transport types were split almost equally. The amounts of plastics brought and number of journeys made each month by those who came on foot and by car was analysed in order to see if those using cars would bring more plastics or come more or less frequently than those coming on foot. Car users made an average of 3.81 trips to the banks and contributed an average of 32.49 bottles per household per month, whilst pedestrians came on average 3.93 times per month and brought an average of 25.00 bottles per household per month. It seems that pedestrians contribute less to the schemes than those who come by car. Car ownership may indicate a higher income, which in turn could mean more packaged products and therefore more plastics waste. Convenience may also be a factor here. The average distance travelled by the Glasgow users was 1.78 km. The distribution of distances has a standard deviation of 2.80 km. However, when this figure is broken down further, it can be seen that those who travel to the banks on foot travel an average of 0.64 km (with a standard deviation of 1.88 km) whilst recyclers who travel to the banks by car travel an average of 3.12 km (with a standard deviation of 3.08 km).

As can be seen from the site diary in Appendix 8, a total of 32 bin sites were visited. Of these, only 28 appeared to have plastics recycling bins still on them. 5 of the bins had been heavily vandalised in the past, usually by being set on fire, or by breaking the trapdoor mechanism on the bottom of the bin. Of the 28 bins that were found, 15 had either no markings at all, or only a fragment of a sticker still attached to them.

4.7.4.2 Falkirk Specific Habits

Tables 4.26 and 4.27 show the responses of the Falkirk users to the question relating to their bottle preparation. Although only 10% of users correctly stated that bottles should be washed, tops and labels taken off and then put in the bag provided, it is likely that this question was as much a test of memory as good practice. It is quite possible that users refer to the leaflet when preparing bottles or even that the person questioned was not the 'bottle preparer' for that household. It can be assumed that to take labels off, bottles must be washed and vice-versa: if bottles are to be washed, the tops must be removed and it is likely that labels will come off during washing. On the whole, then, the instructions seem to be remembered and therefore (hopefully) followed quite well.

Preparation of Bottles	Total Times Mentioned	As a Percentage of total times mentioned
Put in Bag	143	99.31
Wash	112	77.76
Take Tops Off	61	42.36
Take Labels Off	18	12.50
Other	7	4.85

Table 4.26 Bottle preparation stages mentioned by Falkirk users

Preparation	Number	Percentage
Put in Bag	23	16.08
Wash then Bag	56	39.16
Take Tops Off then Bag	7	4.90
Wash, Take Tops Off, then Bag	39	27.27
Wash, Take Labels Off, then Bag	3	2.10
Take Tops and Labels Off, then Bag	1	0.70
Wash, Take Tops and Labels Off, then Bag	14	9.79

Table 4.27 Bottle preparations of Falkirk users

4.7.5 Reuse of Plastics

Participants were asked to estimate what proportion of their plastics waste was reused, recycled and thrown out. The following tables summarise the results. The trends in these tables show that people are more likely to reuse between 10 and 20% of their plastics (e.g. 23% of Glasgow users reuse 10%, 7.67% reuse 20% etc.), whereas they are likely to either bin or recycle the other 80 to 100% (e.g. 12% of Falkirk users recycle 90% of their plastics, whilst 51% recycle all 100%).

Approximate Percentage	Percentage Who Reuse	Percentage Who Bin	Percentage Who Recycle
10	23.00	2.67	1.67
20	7.67	1.00	1.00
30	4.67	2.33	0.67
40	0.33	0.00	0.33
50	7.67	4.67	6.00
60	0.00	0.00	0.00
70	1.00	1.67	1.67
80	2.00	7.33	4.00
90	0.33	11.67	4.67
100	3.33	34.67	18.33

Table 4.28 A breakdown of how much of their plastics waste Glasgow respondents reuse, bin and recycle

Approximate Percentage	Percentage Who Reuse	Percentage Who Bin	Percentage Who Recycle
10	31.50	3.00	0.50
20	5.50	1.00	0.50
30	2.50	1.50	0.50
40	0.50	0.00	0.00
50	0.00	1.50	1.50
60	0.00	0.00	0.50
70	0.50	1.50	1.50
80	0.00	1.50	4.00
90	0.50	4.00	12.00
100	0.00	21.50	51.00

Table 4.29 A breakdown of how much of their plastics waste Falkirk respondents reuse, bin and recycle

The following analysis is concerned with where plastics containers are reused. The patterns are fairly similar for both schemes (see tables 4.30 to 4.33).

Where Container Reused	Number of Reusers	As a Percentage of Reusers
House	88	63.77
Garden	16	11.59
Both	34	24.64

Table 4.30 Where Glasgow respondents reuse their plastics containers

Disposal After Reuse	Number of Reusers	As a Percentage of Reusers
Bin	73	52.90
Recycle	34	24.64
Reuse	30	21.74

Table 4.31 How Glasgow respondents dispose of their plastics containers after reuse

Where Container Reused	Number of Reusers	As a Percentage of Reusers
House	51	62.96
Garden	14	17.28
Both	16	19.75

Table 4.32 Where Falkirk respondents reuse their plastics containers

Disposal After Reuse	Number of Reusers	As a Percentage of Reusers
Bin	73	53.28
Recycle	34	24.82
Reuse	30	21.90

Table 4.33 How Falkirk respondents dispose of their plastics containers after reuse

Number of people who reuse in garden and then recycle	12
As a percentage of those who reuse	8.00
As a percentage of those who reuse in the garden	24.00

Table 4.34 Identifying the extent of the hazard of contamination with garden chemicals for Glasgow

Number of people who reuse in garden and then recycle	8
As a percentage of those who reuse	9.76
As a percentage of those who reuse in the garden	26.67

Table 4.35 Identifying the extent of the hazard of contamination with garden chemicals for Falkirk

The percentage of plastics waste recycled is higher in Falkirk than in Glasgow. In both areas (see Tables 4.34 and 4.35) around a quarter of those who reuse their plastics containers in the garden, subsequently recycle them. Since some of the garden chemicals pose significant contamination problems for reprocessors, it may be worth making it clear in the promotion literature for collect systems and on the banks for bring systems that containers which have been in contact with these substances should not be recycled.

4.7.6 Motivation

This section examines the motivations of the public to recycle (or not to recycle) plastics.

Reason for Using Scheme	Number of Recyclers	As a Percentage of Recyclers
Waste Reduction/Environment	64	54.70
Conserve Resources	38	32.48
To have less rubbish in household bin	12	10.26
Other	3	2.56

Table 4.36 Reasons for Glasgow plastics recyclers using scheme

Reason for Using Scheme	Number of Recyclers	As a Percentage of Recyclers
Waste Reduction/Environment	87	60.42
Conserve Resources	35	24.31
To have less rubbish in household bin	11	7.64
Other	11	7.64

Table 4.37 Reasons for Falkirk plastics recyclers using scheme

Tables 4.36 and 4.37 show participants' reasons for using the schemes in Glasgow and Falkirk respectively. Approximately 85% of both schemes' users gave answers which had environmental or conservational themes, with the majority mentioning the environment. Many respondents however required prompting at this question and stopped the interviewer as soon as the word 'environmental' had been read. This may be used to some extent as a vague, umbrella term which in some cases is not fully understood nor thoroughly considered. There may also be a degree of reflexivity present in these answers (Yin, 1994). This was perhaps, a badly phrased question.

The reasons given by the non-users in both areas for not recycling their plastics are shown in tables 4.38 and 4.39.

Reason for Not Recycling Plastics	Number of Non-Recyclers	As a Percentage of Non-Recyclers
No Local Facilities	87	47.54
Didn't Know Plastics Were Recyclable	36	19.67
Inconvenient	32	17.49
No Interest in Recycling	18	9.84
Unnecessary	5	2.73
Other	5	2.73

Table 4.38 Reasons for Glasgow non-users not recycling plastics

Reason for Not Recycling Plastics	Number of Non-Recyclers	As a Percentage of Non-Recyclers
No Local Facilities	26	44.64
Inconvenient	16	28.57
No Interest in Recycling	5	8.93
Didn't Know Plastics Were Recyclable	5	8.93
Unnecessary	4	7.14
Other	1	1.79

Table 4.39 Reasons for Falkirk non-users not recycling plastics

The tables above show that the responses to this question largely indicated knowledge gaps. Approximately 70% of non-users in Glasgow (see Table 4.38) either did not know that plastics could be recycled or did not know that local facilities were available to allow them to do so. The huge majority of the Glasgow interviews were carried out next to the plastics recycling bins indicating that not only have promotion strategies had little impact, but also that in some cases the bins themselves are not sufficient advertisement for the scheme. In Falkirk, a similar proportion of non-users did not know of local facilities, (see Table 4.39) but only half the amount of people were unaware that plastics can be recycled compared with Glasgow.

4.7.7 Reasons behind the schemes

The next four tables show the reasons that the users and non- users in both areas felt were behind the set up of the two schemes.

Reason Behind Plastics Collection Schemes	Total Times Mentioned	As a Percentage of total times mentioned
Environmental benefit	49	32.89
Recycling	20	13.42
Reduce Waste	18	12.08
Profit For Reprocessors	12	8.05
Resource Conservation	12	8.05
Reduce Litter	10	6.71
Public Pressure	8	5.37
Plastics Not Biodegradable	7	4.70
Others	7	4.70
Help the Economy	3	2.01
Company Image	2	1.34
Technology	1	0.67

118 People did not express an opinion

Table 4.40 Reasons Glasgow users felt schemes were being set up

Reason Behind Plastics Collection Scheme	Total Times Mentioned	As a Percentage of total times mentioned
Environmental Benefit	55	30.90
Profit for Reprocessors	27	15.17
Recycling	24	13.48
Reduce Waste	23	12.92
Plastics Not Biodegradable	17	9.55
Resource Conservation	14	7.87
Company Image	5	2.81
Others	5	2.81
Public Pressure	4	2.25
Reduce Litter	3	1.69
Help the Economy	1	0.56
Technology	0	0.00

Table 4.41 Reasons Falkirk users felt schemes were being set up (15 People did not express an opinion)

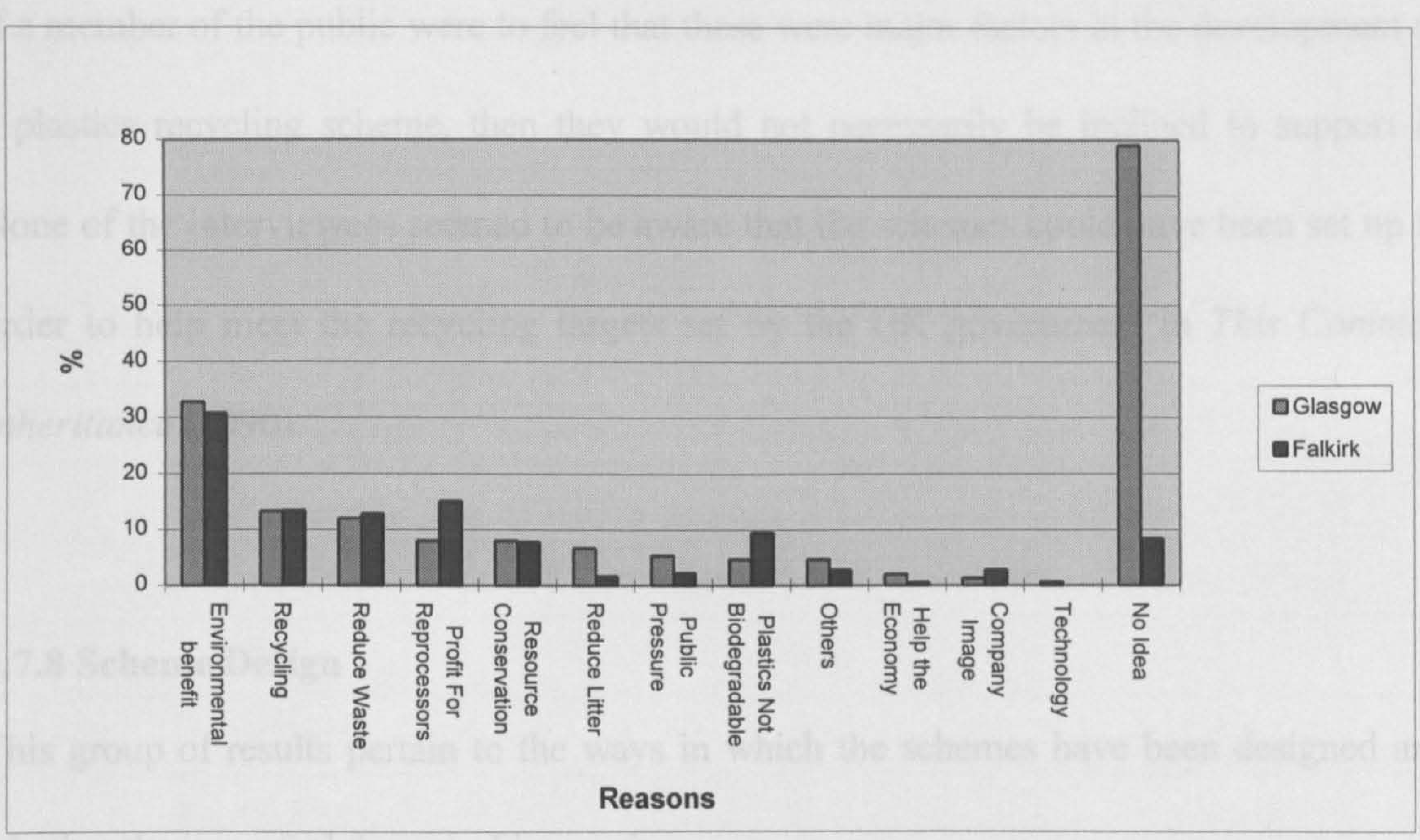
Reason Behind Plastics Collection Scheme	Total Times Mentioned	As a Percentage of total times mentioned
Environmental Benefit	64	28.83
Resource Conservation	25	11.25
Reduce Waste	23	10.36
Profit for Reprocessors	22	9.91
Plastics Not Biodegradable	21	9.46
No Idea	20	9.01
Reduce Litter	13	5.86
Recycling	12	5.41
Public Pressure	8	3.60
Others	7	3.15
Help the Economy	3	1.35
Company Image	2	0.90
Technology	2	0.90

Table 4.42 Reasons Glasgow non-users felt schemes were being set up

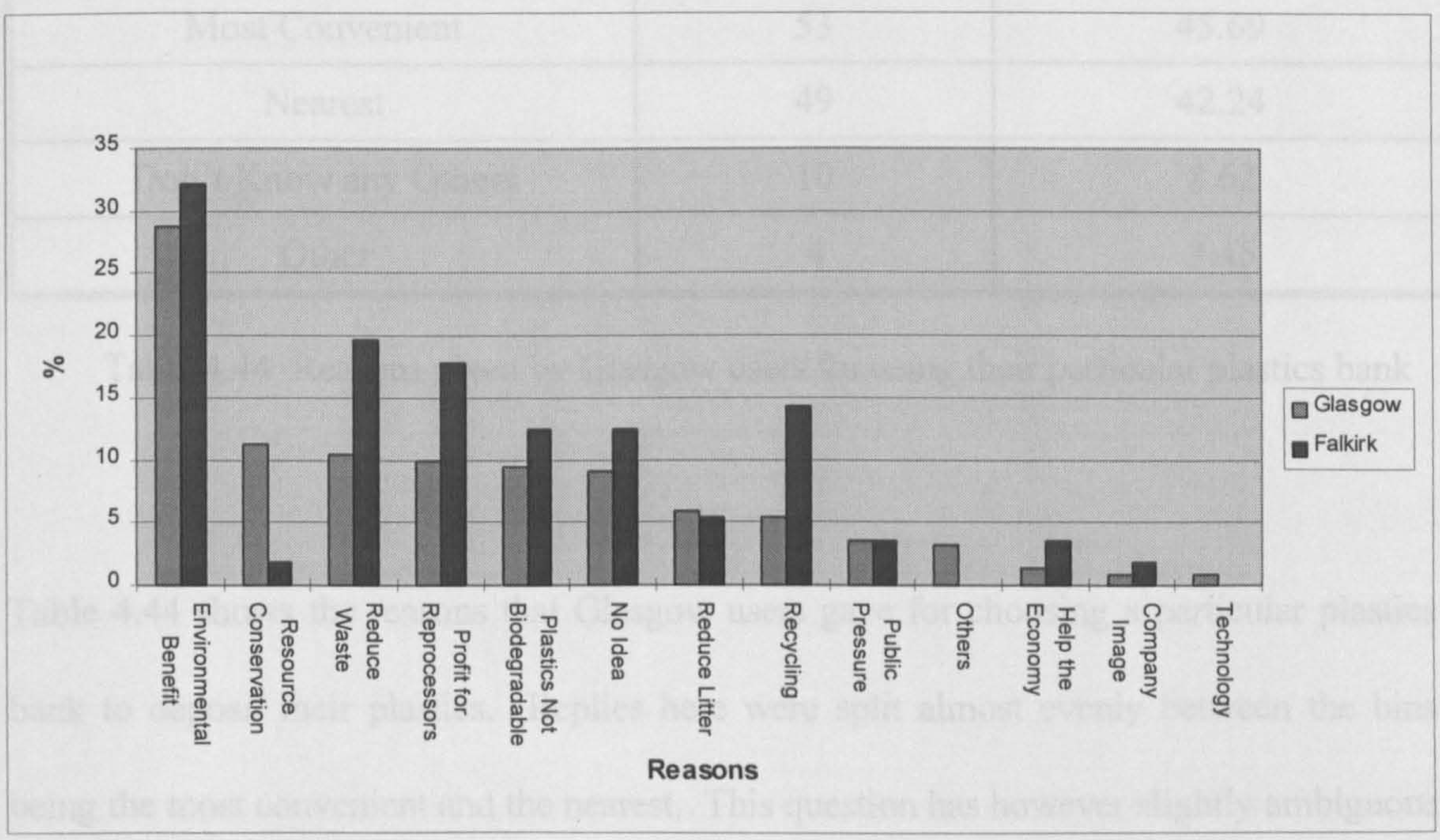
Reasons Behind Plastics Collection Scheme	Total Times Mentioned	As a Percentage of total times mentioned
Environment	18	32.14
Less Waste	11	19.64
Monetary	10	17.86
Recycling	8	14.29
No Idea	7	12.50
Plastics Not Biodegradable	7	12.50
Litter	3	5.36
Economy	2	3.57
Public Pressure	2	3.57
Resources	1	1.79
Company Image	1	1.79
Technology	0	0.00
Others	0	0.00

Table 4.43 Reasons Falkirk non-users felt schemes were being set up

33% of the Glasgow users felt that the scheme had been set up for environmental reasons. This was also the most popular response amongst Falkirk users (31%). A similar proportion of non-users in both Glasgow (29%) and Falkirk (32%) also gave 'environment' as the main reason for schemes being set up. See Graphs 4.1 and 4.2. Again, this may simply be a 'buzzword'. It is also quite interesting to note that quite a proportion of the reasons given were quite cynical, with around 9.5% of Glasgow users, 18% of Falkirk users, 11% of Glasgow non-users and 20% of Falkirk non-users believing that the schemes had been set up either for financial gain or to bolster the sponsors' company images.



Graph 4.1 Reasons users thought that collection schemes for plastics were being set up



Graph 4.2 Reasons non-users thought plastics collection schemes were being set up

If a member of the public were to feel that these were major factors in the development of a plastics recycling scheme, then they would not necessarily be inclined to support it. None of the interviewees seemed to be aware that the schemes could have been set up in order to help meet the recycling targets set by the UK government in *This Common Inheritance* (1990).

4.7.8 Scheme Design

This group of results pertain to the ways in which the schemes have been designed and whether the users feel they need improving.

Reason for Using Particular Bin	Number of Recyclers	As a Percentage of Recyclers
Most Convenient	53	45.69
Nearest	49	42.24
Don't Know any Others	10	8.62
Other	4	3.45

Table 4.44 Reasons given by Glasgow users for using their particular plastics bank

Table 4.44 shows the reasons that Glasgow users gave for choosing a particular plastics bank to deposit their plastics. Replies here were split almost evenly between the bins being the most convenient and the nearest. This question has however slightly ambiguous wording as on many occasions the nearest bin will be the most convenient and vice-versa.

Following on from this, the Glasgow respondents were asked what type of place they thought would make the optimal bin site.

Best Site Type	Total Users	As a Percentage of Users
Shopping Centres	71	53.38
Local Shops	21	15.79
Residential Areas	18	13.53
Others	9	6.77
Car Parks	8	6.02
Public Places	6	4.51

Table 4.45 Bin sites considered best by Glasgow users

53% of the Glasgow users said that they felt that either supermarkets or shopping centres made the best bin sites. A further 16% replied that bins ought to be sited next to local shops. The biggest distinction here is probably the method of transport used to reach the sites, with the bins next to local shops being visited on foot and plastics being taken to bins near shopping centres by car. Many people seemed simply to advocate the site type that they themselves used, Asda shoppers preferring supermarket car parks, and those with bins near their homes opting for sites in residential areas. Surprisingly few people seemed to object to the bins being sited in residential areas.

When asked about the collection frequency, 93% of the Falkirk users said that the fortnightly collections were fine. Most of the others were in favour of more frequent collections.

As well as asking users about different aspects of their schemes, they were also asked to suggest any improvements that they felt could be made.

Suggested Scheme Improvements	Number of Suggestions	As a Percentage of Suggestions
Already Do All They Can	55	44.00
Information	18	14.40
More Bins	14	11.20
Kerbside Collection	11	8.80
Other	7	5.60
Having More Plastics	6	4.80
Labelling	4	3.20
Local Facilities	4	3.20
Feedback	4	3.20
Nothing	2	1.60

Table 4.46 Suggested improvements to Glasgow scheme by scheme users

Suggested Scheme Improvements	Number of Suggestions	As a Percentage of Suggestions
Other	26	18.18
Better Information	12	8.39
Bigger Bags	11	7.69
Increased Collections	11	7.69
Reliable Service	5	3.50

Table 4.47 Suggested improvements to Falkirk scheme by scheme users

Suggested Scheme Improvements	Number of Suggestions	As a Percentage of Suggestions
Local Facilities for Plastics Recycling	70	36.08
More Bins	39	20.10
Provision of a Kerbside Collection	28	14.43
Others	25	12.89
More Information	23	11.86
Provide Feedback about Scheme Progress	4	2.06
Bottle Labelling	3	1.55
Recyclers paid for Recyclables	2	1.03

Table 4.48 Suggested improvements to Glasgow scheme by non-users

Suggested Scheme Improvements	Number of Suggestions	As a Percentage of Suggestions
More Information	12	21.43
Others	5	8.93
Provision of a Kerbside Collection	3	5.36
Recyclers Paid for Recyclables	1	1.79
Include a Wider Range of Plastic Waste	1	1.79

Table 4.49 Suggested improvements to Falkirk scheme by non-users

Percentage of people who suggested an improved service of some kind	34.54
Percentage of people who suggested more or improved information	15.46

Table 4.50 Improvements suggested by Glasgow non-users regrouped

On the whole, the people of Falkirk seem to be content with their scheme. The categories used here were developed from interviewee responses. All suggestions which were only given by one respondent have been categorised as 'other' The high proportion of 'other' improvements shows that there is no real pattern to these suggestions. The scheme users wish to be able to contribute more types of plastics and/or a wider range of materials. Some of the Falkirk users would like to have more information relating to their scheme.

Although they are not as qualified to make suggestions about scheme improvements, it is also interesting to discover what non-users feel should be done to improve the scheme in their area, as this may give a degree of insight into their reluctance to join. These results are summarised in tables 4.48 and 4.49. Only 5% of non-users in Falkirk replied that they would recycle plastics if there was a kerbside collection in their area. This reflects well on the Falkirk system, as presumably the other 95% of non-users realise that this service is available. In Glasgow, 36% of non-users wanted local facilities, indicating that there is a much lower awareness of the recycling scheme than in Falkirk. The most common suggestion for improvement by Falkirk non-users was an increase in information relating to the scheme. More bins, more information and a kerbside collection were top of the list of suggestions from the Glasgow non-users. As can be seen from Table 4.50, amongst the non-users of the Glasgow scheme, about 50% want either a service improvement of some kind or increased/improved information. Most of the suggested improvements relate to factors which are under the control of the scheme organisers.

Non-users from both areas were asked whether they would be prepared to contribute to a bring or collect system. 93% of Glasgow's non-users said that they would be prepared to use a plastic bottle bank and travel 2.73 km to do so, with a standard deviation of 3.62 km (Again, this depicts a difference between the intentions and actions of the public as Glasgow's users only travel an average of 1.78 km). 94% said that they would be prepared to sort their waste for a kerbside collection and they would require a weekly collection. When Falkirk non-users were asked if they would prefer to use a plastic bottle bank they were equally split. Those who would rather use a plastic bottle bank said that they would travel an average of 2.45 km (with a standard deviation of 2.19 km) to do so.

Many of the suggestions for improvements have advocated refinements to the systems which would be associated with a larger scale of operation. These include more bins, more types of plastic included, a wider range of materials included and more information. It is frustrating for recyclers to be part of a pilot scheme which must work its way up the learning curve. The schemes should perhaps consider implementing some form of feedback to encourage its participants.

4.7.9 Scheme Publicity

A crude test of the success of the publicity campaigns surrounding the two schemes is to find out what proportion of non-users know of the existence of the scheme in their area (see tables 4.51 and 4.52).

Aware of Collection Scheme	Number of Non-Recyclers	As a Percentage of Non-Recyclers
No	142	77.60
Yes	41	22.40

Table 4.51 Awareness of collection scheme of Glasgow non-users

Aware of Collection Scheme	Number of Non-Recyclers	As a Percentage of Non-Recyclers
No	26	46.43
Yes	30	53.57

Table 4.52 Awareness of collection scheme of Falkirk non-users

54% of Falkirk non-users and 22% of Glasgow non-users were aware of plastics recycling schemes in their area. Perhaps the nature of the Falkirk scheme itself would make it more likely to be noticed by those living within the collection areas. The higher proportion of non-users knowing about the scheme may however be partly explained by their leaflet campaign. Although this approach seems to have been more successful in terms of raising awareness, it has not necessarily provided motivation to recycle. These tables could suggest that if a Glasgow resident knows about the recycling scheme then they are more likely to use it than would be the case in Falkirk.

Tables 4.53 to 4.56 show a breakdown of how respondents were first made aware of the scheme in their area. Users and non-users have been separated in order to highlight any differences in the sources of their initial awareness.

Source of Initial Awareness	Number of Recyclers	As a Percentage of Recyclers
Saw Banks	92	78.63
Publicity Campaign	22	18.80
Word of Mouth	3	2.56
Other	0	0.00

Table 4.53 Sources of initial awareness amongst Glasgow users

Source of Initial Awareness	Number of Non-Recyclers	As a Percentage of Recyclers
Saw Banks	34	82.93
Publicity Campaign	4	9.76
Word of Mouth	2	4.88
Other	1	2.44

Table 4.54 Sources of initial awareness amongst Glasgow non-users

From tables 4.53 and 4.54, it can be seen that in Glasgow, nearly 80% of users were first made aware of the scheme by seeing the bins themselves. This result is similar to that produced by Belton et al who found, in their 1991 survey of Glasgow's recycling facilities, that 84% of recyclers were made aware of the schemes they used by seeing bins (Belton et al, 1994). Practically all of the rest of the users interviewed were made aware by the Council's publicity campaign. Of the non-users in Glasgow who were aware of the scheme's existence, seeing the bins was an equally important method of raising initial awareness. A smaller proportion of non-users saw the publicity campaign and still fewer heard about it by word of mouth.

Source of Initial Awareness	Number of Recyclers	As a Percentage of Recyclers
Leaflet	137	95.14
Word of Mouth	6	4.17
Saw Collections	0	0.00
Other	1	0.69

Table 4.55 Sources of initial awareness amongst Falkirk users

Source of Initial Awareness	Number of Non-Recyclers	As a Percentage of Recyclers
Leaflet	19	63.33
Word of Mouth	6	20.00
Saw Collections	5	16.67
Other	0	0.00

Table 4.56 Sources of initial awareness amongst Falkirk non-users

In Falkirk, the leaflet distributed by Scottish Conservation Projects was responsible for 95% of initial awareness of scheme users. The remainder saw the collections taking place. The non-users were also largely made aware of the scheme by the leaflet. 20% of them however realised that the scheme existed through word of mouth and the remaining 17% saw the collections.

Respondents were also asked whether they felt that there was enough publicity about their scheme, and what sort of improvements, in terms of publicity, they might suggest. Again, the results have been presented separately for users and non-users.

Sufficient Publicity?	Number of Recyclers	As a Percentage of Recyclers
No	90	76.92
Yes	27	23.08

Table 4.57 Satisfaction with publicity amongst Glasgow users

Suggested Publicity Improvements	Number of Suggestions	As a Percentage of Suggestions
Advertising	25	15.65
Free Newspaper	18	15.65
Television Advertising	14	12.17
More Bins	13	11.30
National Press	10	8.70
Leaflets	9	7.83
Other	26	22.61

Table 4.58 Improvements to publicity suggested by Glasgow users

Sufficient Publicity?	Number of Recyclers	As a Percentage of Recyclers
No	92	63.89
Yes	52	36.11

Table 4.59 Satisfaction with publicity amongst Falkirk users

Suggested Publicity Improvements	Number of Suggestions	As a Percentage of Suggestions
Free/Local Newspaper	31	27.43
Television Advertising	21	18.58
Advertising	16	14.16
Poster Campaign	12	10.62
Leaflets	10	8.85
National Press	2	1.77
Other	21	18.58

Table 4.60 Improvements to publicity suggested by Falkirk users

Only 23% of Glasgow users thought that there was enough publicity about their scheme. The suggestions that they made for further advertising varied from television and the national press to local shops carrying posters and a leafleting campaign. In Falkirk, 36% of users felt that publicity was adequate and although they also suggested a wide range of media for further publicity, a more local theme seemed to pervade suggestions with 27% opting for local newspaper coverage.

The Falkirk respondents were also asked how clear they found the information and instructions in the leaflet that they received from Scottish Conservation Projects. 95% of users and 72% of non-users found it clear. 22% of non-users did not read the leaflet and only 5% found it unclear. The clarity of the instructions does not therefore appear to be one of the factors contributing to their decision not to use the scheme.

4.7.10 Comparing Awareness with Actions

In order to examine the relationship between plastics recycling awareness and action, matrices were constructed in the following way. First, every participant is given a score out of four: one point for each material they were aware could be recycled from domestic waste (see Table 4.61 for example).

These scores can then be added up to obtain the 'total awarenesses' of the respondents. The average awareness per person can then be found by dividing this total by the number of respondents. The total awareness can also be compared to the total possible awareness, which would be four times the number of respondents, representing the case where everyone was aware that all of the materials could be recycled. This ratio is expressed as a percentage.

	Aware can be recycled				
Interviewee	Glass	Metal	Paper	Plastic	Total
1	✓		✓		2
2					0
3	✓	✓	✓		3
4	✓	✓	✓	✓	4

Table 4.61 An example of part of an awareness matrix

Awareness matrices were constructed for both areas and compared with participation matrices, calculated in a similar way, but based on the number of materials actually recycled by each respondent. Once this had been done, the process was repeated for plastics awareness and participation alone. The results of these calculations are shown in Tables 4.62 to 4.69.

Total of Awareness Matrix	1073
Average Awareness Per Person	3.58
As a Percentage of Total Possible Matrix	89.42

Table 4.62 Awareness of recyclability of all materials in Glasgow

Total of Participation Matrix	650
Average Participation per Person	2.17
As a Percentage of Total Possible Matrix	54.17

Table 4.63 Participation in the recycling of all materials in Glasgow

Total of Plastics Awareness Matrix	229
Average Awareness per Person	0.76
As a Percentage of Total Possible Matrix	76.33

Table 4.64 Awareness of recyclability of plastics in Glasgow

Total of Plastics Participation Matrix	117
Average Participation Per Person	0.39
As a Percentage of Total Possible Matrix	39.00

Table 4.65 Participation in the recycling of plastics in Glasgow

Total of Awareness Matrix	729
Average Awareness Per Person	3.65
As a Percentage of Total Possible Matrix	91.13

Table 4.66 Awareness of recyclability of all materials in Falkirk

Total of Participation Matrix	410
Average Participation per Person	2.05
As a Percentage of Total Possible Matrix	51.25

Table 4.67 Participation in the recycling of all materials in Falkirk

Total of Plastics Awareness Matrix	184
Average Awareness per Person	0.92
As a Percentage of Total Possible Matrix	92.00

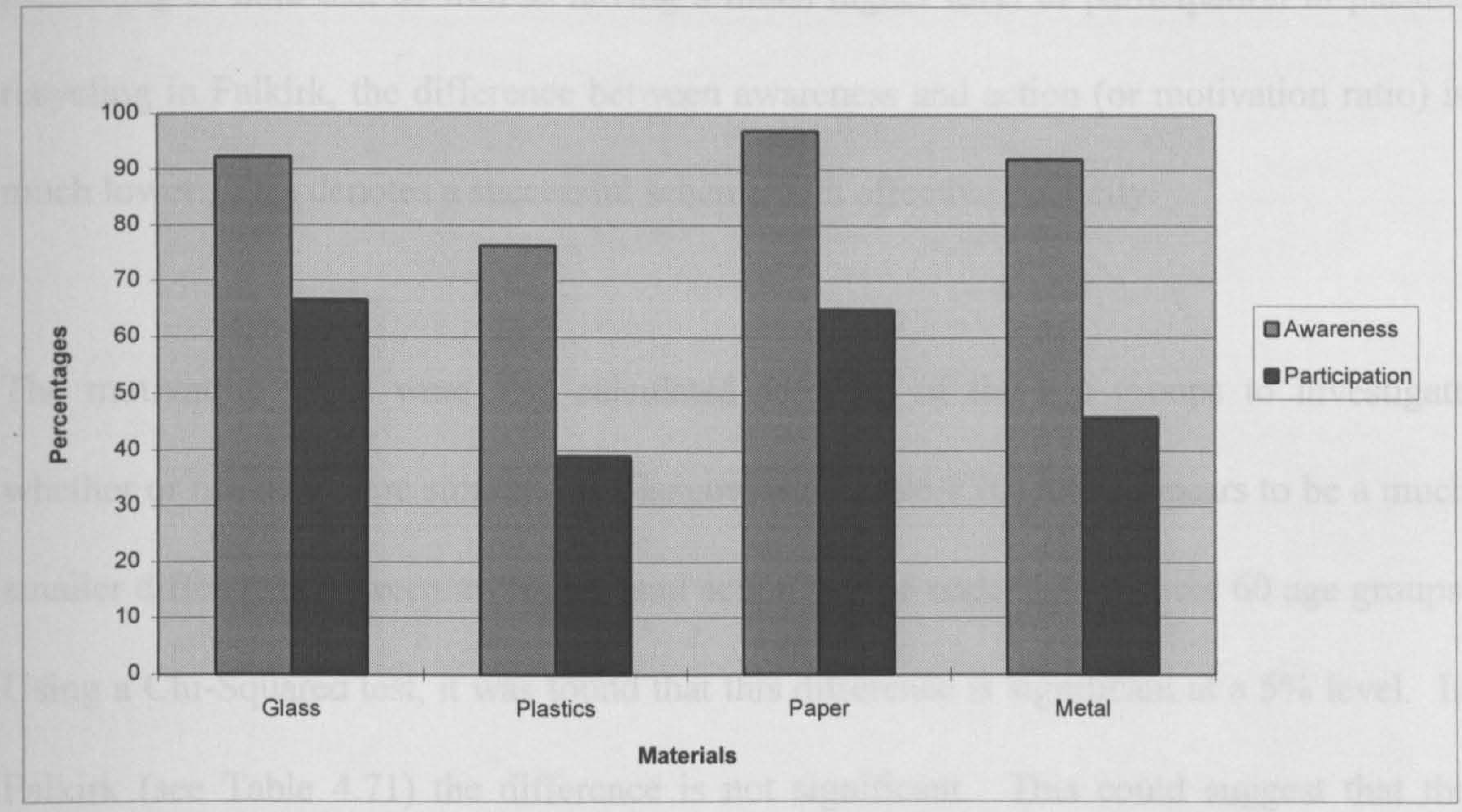
Table 4.68 Awareness of recyclability of plastics in Falkirk

Total of Plastics Participation Matrix	144
Average Participation Per Person	0.72
As a Percentage of Total Possible Matrix	72.00

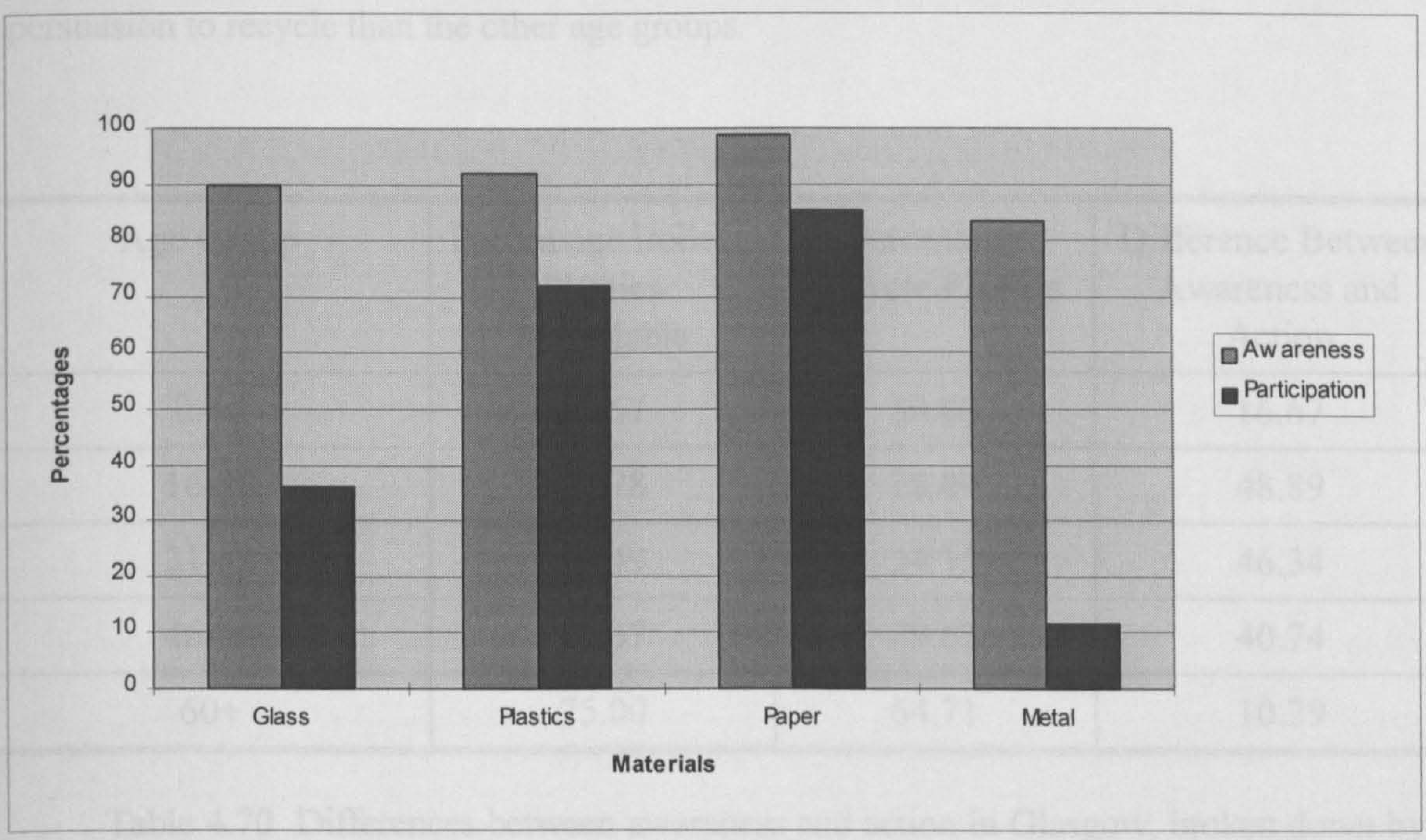
Table 4.69 Participation in the recycling of plastics in Falkirk

The level of awareness of the recyclability of all materials was similar in both areas, with the Glasgow respondents having a level of 89% and the Falkirk respondents marginally higher at 91%. This represents an average awareness of 3.58 and 3.65 respectively. This shows that the average interviewee was aware that at least three of the materials could be recycled from domestic waste. Awareness of the recyclability of plastics was 76% in Glasgow and 92% in Falkirk. This difference could indicate that the Falkirk scheme has had a higher impact on the awareness of the recyclability of plastics than the scheme in Glasgow.

The levels of participation in the recycling of all materials were also similar in Glasgow and Falkirk, with levels of 54% and 51% respectively. These levels represent the respondents recycling an average of 2.17 materials in Glasgow and 2.05 materials in Falkirk. The distributions of participation which have contributed to these similar composite participation levels are however, very different. The participation level for



Graph 4.3 Awareness compared with participation for Glasgow respondents



Graph 4.4 Awareness compared with participation for Falkirk respondents

plastics was found to be 39% in Glasgow and 72% in Falkirk. Graphs 4.3 and 4.4 summarise the differences between awareness and action for each of the materials. It is interesting to note that as well as having a much higher level of participation in plastics recycling in Falkirk, the difference between awareness and action (or motivation ratio) is much lower. This denotes a successful scheme with effective publicity.

The motivation ratios were also calculated for each of the age groups to investigate whether or not they were similar. In Glasgow (see Table 4.70) there appears to be a much smaller difference between awareness and action for the under 16 and over 60 age groups. Using a Chi-Squared test, it was found that this difference is significant at a 5% level. In Falkirk (see Table 4.71) the difference is not significant. This could suggest that the nature of the bring system and publicity associated with it are more successful in motivating the 60+ age group, or that the 60+ age group require less convenience and persuasion to recycle than the other age groups.

Age Group	Percentage Believe Plastics Recyclable	Percentage Recycle Plastics	Difference Between Awareness and Action
0-15	66.67	50.00	16.67
16-30	77.78	28.89	48.89
31-45	80.49	34.15	46.34
46-60	70.37	29.63	40.74
60+	75.00	64.71	10.29

Table 4.70 Differences between awareness and action in Glasgow, broken down by age group

Age Group	Percentage Believe Plastics Recyclable	Percentage Recycle Plastics	Difference Between Awareness and Action
0-15	100.00	80.00	20.00
16-30	91.49	63.83	27.66
31-45	91.67	81.67	10.00
46-60	88.89	62.22	26.67
60+	95.35	76.74	18.60

Table 4.71 Differences between awareness and action in Falkirk, broken down by age group

It could be argued that the more people in a household, the greater the chance of knowing about and/or participating in recycling projects might be. Therefore the same procedure was carried out for the number in household to see if the motivation ratio would vary between households of different sizes.

Number in Household	Percentage Believe Plastics Recyclable	Percentage Recycle Plastics	Difference Between Awareness and Action
1	75.00	45.00	30.00
2	69.05	39.29	29.76
3	77.14	37.14	40.00
4	81.48	33.33	48.15
5	77.78	27.78	50.00
6	100.00	66.67	33.33
7	100.00	25.00	75.00
8	100.00	100.00	0.00

Table 4.72 Differences between awareness and action in Glasgow, broken down by household size

Number in Household	Percentage Believe Plastics Recyclable	Percentage Recycle Plastics	Difference Between Awareness and Action
1	100.00	92.31	7.69
2	90.48	68.25	22.22
3	97.83	69.57	28.26
4	88.68	75.47	13.21
5	83.33	61.11	22.22
6	100.00	100.00	0.00
7	100.00	50.00	50.00

Table 4.73 Differences between awareness and action in Falkirk, broken down by household size

In Glasgow (see Table 4.72) there was no significant difference and in Falkirk (see Table 4.73) there was similarly no distinction.

The next factor tested was whether the differences between awareness and action varied between the socioeconomic groups. In Glasgow (see Table 4.74) Socioeconomic Group 1 has a lower motivation ratio than the other groups. In Falkirk (see Table 4.75), the differences are less overall but particularly low in Socioeconomic Group 4.

However, when this is broken down further (see Tables 4.76 and 4.77) it seems that the smallest differences are found amongst the Retired, Housewives/husbands and School Children in both areas. Socioeconomic Group 4 is still prominent in Falkirk. The low motivation ratio of the retired group echoes the findings for the 60+ group analyses earlier.

The smaller differences between awareness and action for Housewives/husbands and School Children suggest that the publicity has also been successful for these groups. Although the numbers of school children interviewed in each area are too low to enable any conclusions to be drawn from this result, it is encouraging to find that they have a low motivation ratio, as they represent the next generation of recyclers.

Socioeconomic Group	Percentage Believe Plastics Recyclable	Percentage Recycle Plastics	Difference Between Awareness and Action
SEG 1	74.48	47.59	26.90
SEG 2	83.72	37.21	46.51
SEG 3	76.32	26.32	50.00
SEG 4	75.68	29.73	45.95

Table 4.74 Differences between awareness and action in Glasgow, broken down by socioeconomic group.

Socioeconomic Group	Percentage Believe Plastics Recyclable	Percentage Recycle Plastics	Difference Between Awareness and Action
SEG 1	94.68	76.60	18.09
SEG 2	95.24	71.43	23.81
SEG 3	94.12	66.67	27.45
SEG 4	79.41	67.65	11.76

Table 4.75 Differences between awareness and action in Falkirk, broken down by socioeconomic group

Socioeconomic Group	Percentage Believe Plastics Recyclable	Percentage Recycle Plastics	Difference Between Awareness and Action
1.1	71.93	61.40	10.53
1.2	83.33	60.00	23.33
1.3	71.43	19.05	52.38
1.4	71.43	57.14	14.29
1.5	73.33	26.67	46.67
2	83.72	37.21	46.51
3	76.32	26.32	50.00
4	75.68	29.73	45.95

Table 4.76 Differences between awareness and action in Glasgow, broken down by socioeconomic group (with Socioeconomic Group 1 broken down further into its constituent parts)

Socioeconomic Group	Percentage Believe Plastics Recyclable	Percentage Recycle Plastics	Difference Between Awareness and Action
1.1	92.50	75.00	17.50
1.2	100.00	85.71	14.29
1.3	75.00	50.00	25.00
1.4	100.00	83.33	16.67
1.5	88.89	55.56	33.33
2	95.24	71.43	23.81
3	94.12	66.67	27.45
4	79.41	67.65	11.76

Table 4.77 Differences between awareness and action in Falkirk, broken down by socioeconomic group (with Socioeconomic Group 1 broken down further into its constituent parts)

4.7.11 Perception

This section concerns the determination of the public's perception of plastics.

The first task that was set for all of the respondents was to rank the production processes of glass, plastic, paper and metal from the most damaging production to the least damaging process. The results are summarised in Tables 4.78 and 4.79 and graphs 4.5 and 4.6.

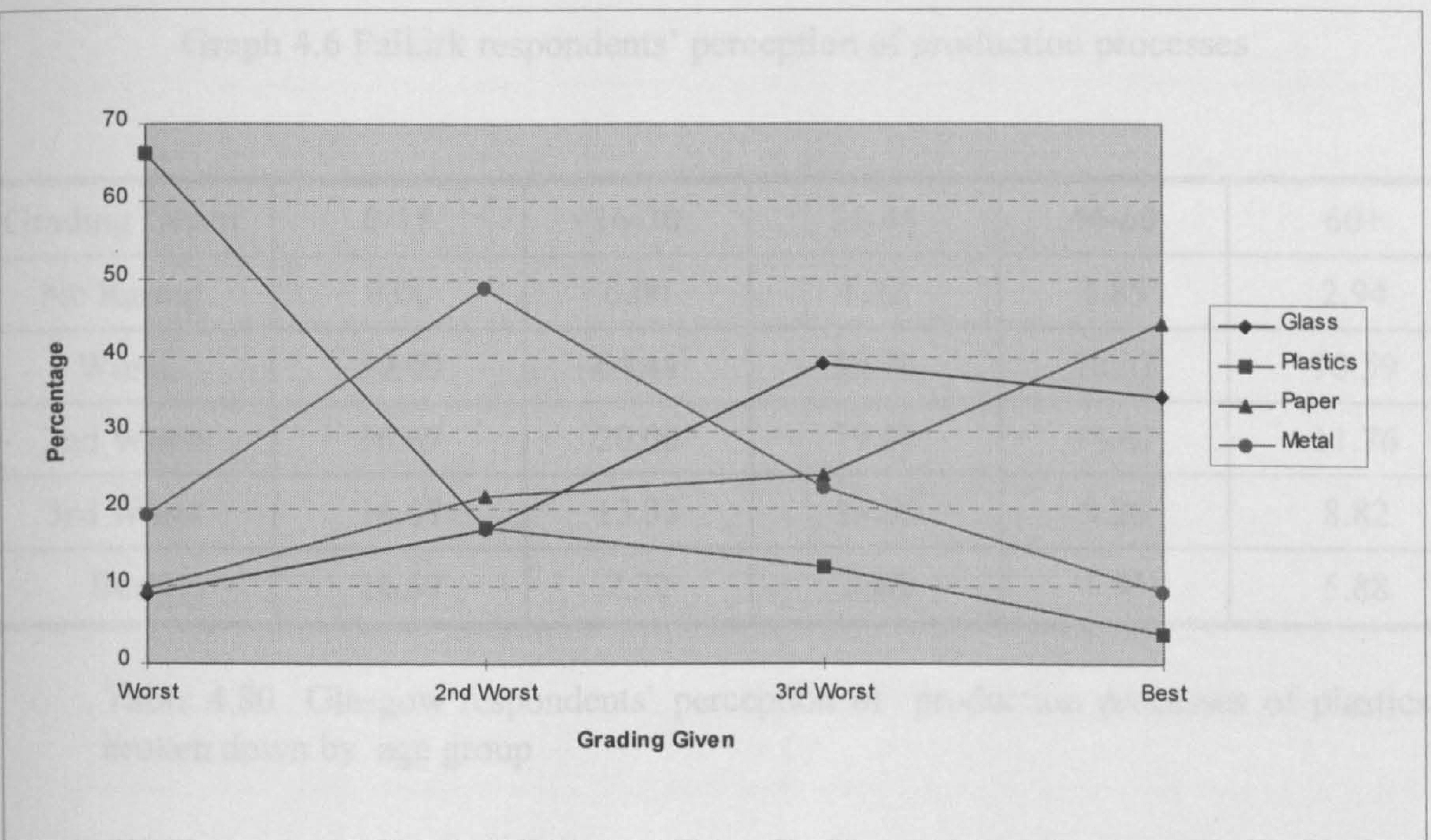
Grading Given	Glass	Plastics	Paper	Metal
Worst	9.03	66.22	9.71	19.22
2nd Worst	17.33	17.57	21.58	48.75
3rd Worst	38.99	12.50	24.46	22.78
Best	34.66	3.72	44.24	9.25

Table 4.78 Percentages of Glasgow respondents' perception of all materials' production processes

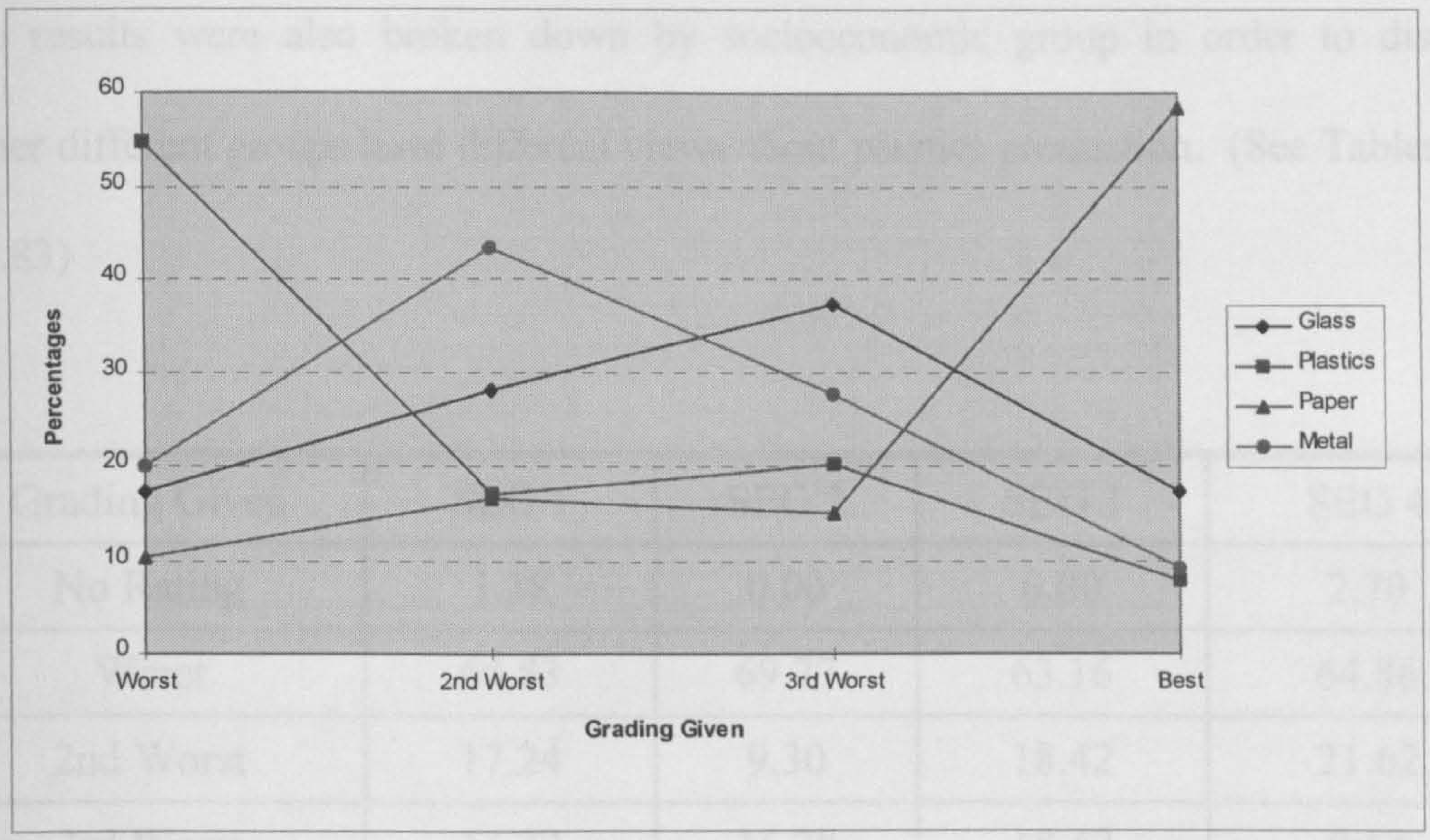
Grading Given	Glass	Plastics	Paper	Metal
Worst	17.35	54.92	10.42	19.90
2nd Worst	28.06	17.10	16.65	43.37
3rd Worst	37.24	20.21	15.10	27.55
Best	17.35	7.77	58.33	9.18

Table 4.79 Percentages of Falkirk respondents' perception of all materials' production processes

As can be seen from Graphs 4.5 and 4.6, in Glasgow, plastics was judged to have the worst production process, followed by metals, glass then paper. The same pattern occurred in Falkirk, but with only 55% choosing plastics as having the worst production process, compared with Glasgow's 66%. These differences were statistically significant at a 5% level. When the results for this question were broken down by age group, (see tables 4.80 and 4.81) it can be seen that in Glasgow, the older age groups have a less favourable opinion of plastics production. In Falkirk however, it is both the youngest and oldest groups who believe that plastics have the worst production process. Again, a Chi-Squared test shows these differences to be significant at a 5% level.



Graph 4.5 Glasgow respondents' perception of production processes



Graph 4.6 Falkirk respondents' perception of production processes

Grading Given	0-15	16-30	31-45	46-60	60+
No Rating	0.00	0.00	1.22	1.85	2.94
Worst	50.00	64.44	59.76	70.37	70.59
2nd Worst	16.67	20.00	19.51	16.67	11.76
3rd Worst	16.67	13.33	15.85	9.26	8.82
Best	16.67	2.22	3.66	1.85	5.88

Table 4.80 Glasgow respondents' perception of production processes of plastics broken down by age group

Grading Given	0-15	16-30	31-45	46-60	60+
No Rating	0.00	2.13	3.33	2.22	6.98
Worst	80.00	45.55	58.33	46.67	60.47
2nd Worst	20.00	25.53	18.33	11.11	9.30
3rd Worst	0.00	21.28	16.67	31.11	11.63
Best	0.00	8.51	3.33	8.89	11.63

Table 4.81 Falkirk respondents' perception of production processes of plastics broken down by age group

These results were also broken down by socioeconomic group in order to discover whether different groups have different views about plastics production. (See Tables 4.82 and 4.83)

Grading Given	SEG 1	SEG 2	SEG 3	SEG 4
No Rating	1.38	0.00	0.00	2.70
Worst	64.83	69.77	63.16	64.86
2nd Worst	17.24	9.30	18.42	21.62
3rd Worst	11.72	16.28	18.42	8.11
Best	4.83	4.65	0.00	2.70

Table 4.82 Glasgow respondents' perception of production processes of plastics broken down by socioeconomic group

Grading Given	SEG 1	SEG 2	SEG 3	SEG 4
No Rating	3.19	4.76	3.92	2.94
Worst	54.26	57.14	50.98	50.00
2nd Worst	17.02	9.52	13.73	23.53
3rd Worst	18.09	23.81	25.49	11.76
Best	7.45	4.76	5.88	11.76

Table 4.83 Falkirk respondents' perception of production processes of plastics broken down by socioeconomic group

In both Glasgow and Falkirk there is no significant difference in the opinions of the various socioeconomic groups. They all believe that plastics have the worst production processes.

Participants were also asked about the disposal processes involved with each of the materials. Again, participants were asked to rank the environmental damage caused by disposal of each of the four material types, from the worst damage to the least. The results are summarised in Tables 4.84 and 4.85 and in Graphs 4.7 and 4.8.

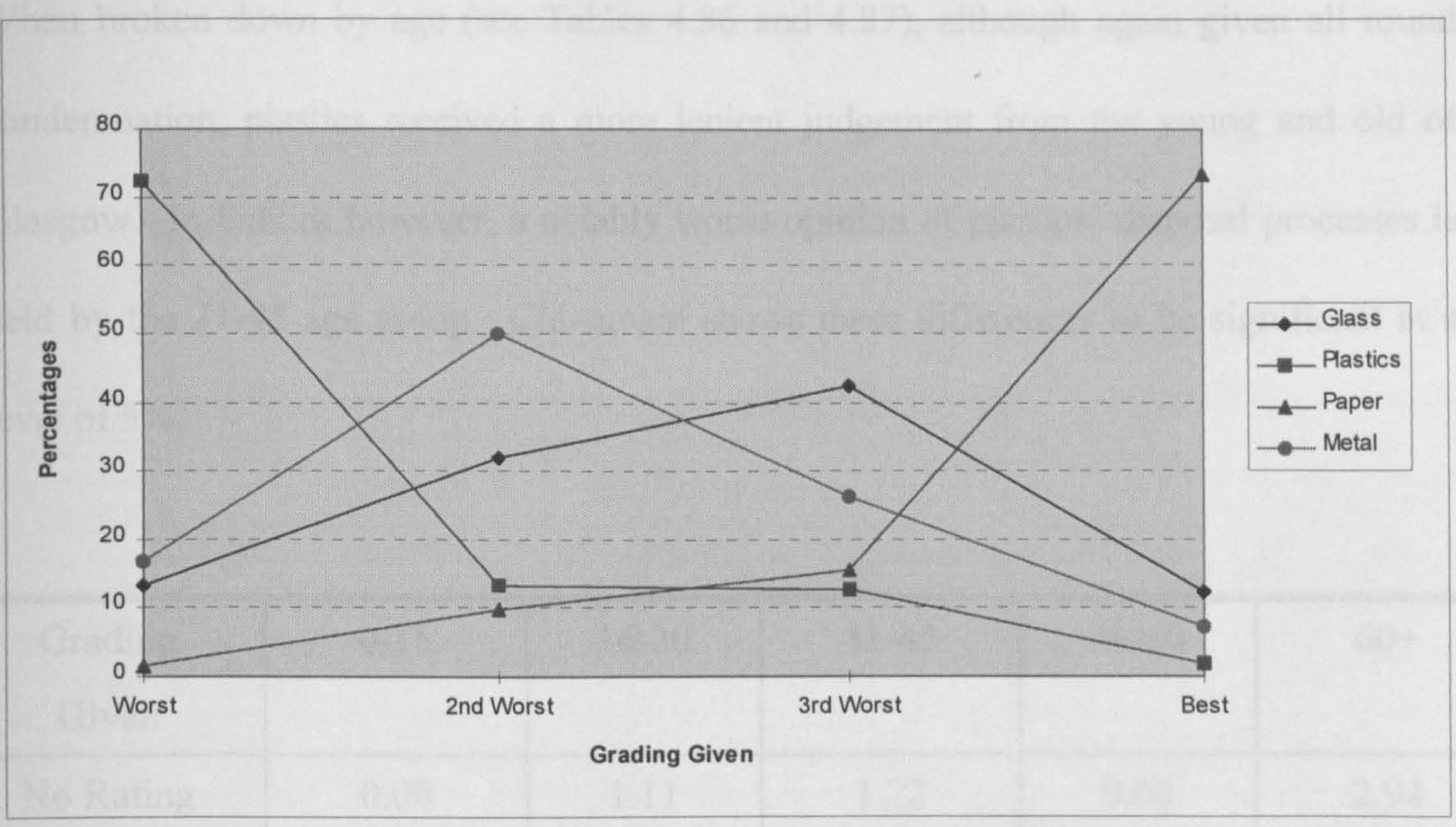
Grading Given	Glass	Plastics	Paper	Metal
Worst	13.41	72.30	1.49	16.67
2nd Worst	31.88	13.18	9.67	50.00
3rd Worst	42.39	12.50	15.61	26.09
Best	12.32	2.03	73.23	7.25

Table 4.84 Glasgow respondents' perception of disposal processes of all materials

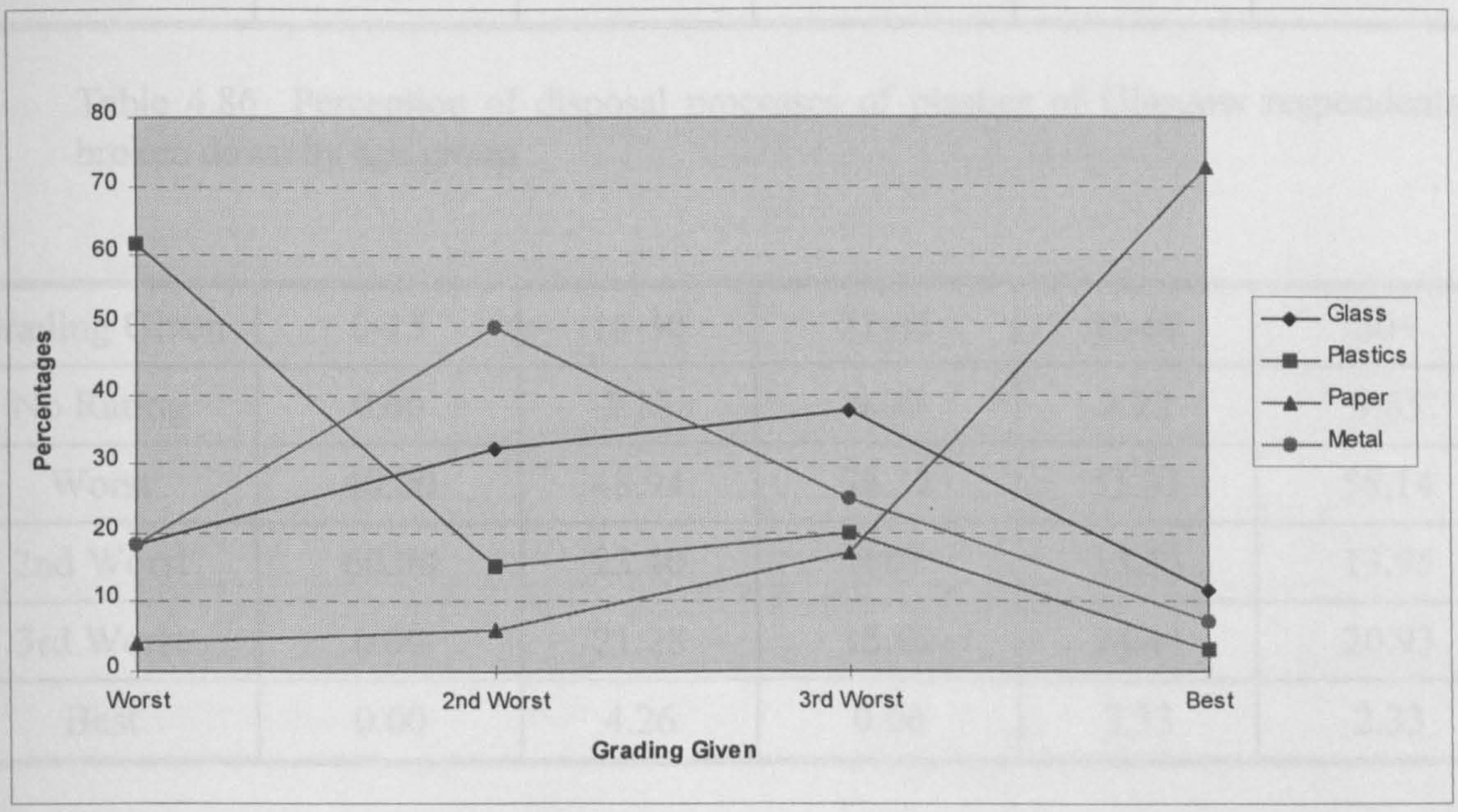
Grading Given	Glass	Plastics	Paper	Metal
Worst	18.37	61.73	4.10	18.37
2nd Worst	32.14	15.31	6.15	49.49
3rd Worst	37.76	19.90	16.92	25.00
Best	11.73	3.06	72.82	7.14

Table 4.85 Falkirk respondents' perception of disposal processes of all materials

In Glasgow plastics were rated worst in terms of environmental damage caused by their disposal processes. In Falkirk, plastics were also thought to have the most environmentally damaging disposal processes, but by a smaller margin. These differences were found to be significant at a level of 5%, using a Chi-Squared test.



Graph 4.7 Glasgow respondents' perception of disposal processes



Graph 4.8 Falkirk respondents' perception of disposal processes

When broken down by age (see Tables 4.86 and 4.87), although again given all round condemnation, plastics received a more lenient judgement from the young and old of Glasgow. In Falkirk however, a notably worse opinion of plastics' disposal processes is held by the 31-45 age group. Chi-square shows these differences to be significant at a level of 5%.

Grading Given	0-15	16-30	31-45	46-60	60+
No Rating	0.00	1.11	1.22	0.00	2.94
Worst	50.00	74.44	71.95	81.48	70.59
2nd Worst	16.67	16.67	9.76	7.41	11.76
3rd Worst	33.33	6.67	15.85	9.26	8.82
Best	0.00	1.11	1.22	1.85	5.88

Table 4.86 Perception of disposal processes of plastics of Glasgow respondents broken down by age group

Grading Given	0-15	16-30	31-45	46-60	60+
No Rating	0.00	2.13	0.00	2.22	4.65
Worst	40.00	48.94	78.33	53.33	58.14
2nd Worst	60.00	23.40	6.67	13.33	13.95
3rd Worst	0.00	21.28	15.00	24.44	20.93
Best	0.00	4.26	0.00	2.33	2.33

Table 4.87 Perception of disposal processes of plastics of Falkirk respondents broken down by age group

A less even split in opinions over the disposal of plastics seems to exist in the various socioeconomic groups than for production (see Tables 4.88 and 4.89). In Glasgow, Socioeconomic Group 2 are more lenient towards plastics than the other groups. In Falkirk it is Socioeconomic Group 1 which is more lenient. Again, these differences are shown to be significant at a 5% level.

Grading Given	SEG 1	SEG 2	SEG 3	SEG 4
No Rating	2.07	0.00	0.00	1.35
Worst	68.28	53.49	84.21	81.08
2nd Worst	11.03	32.56	2.63	10.81
3rd Worst	15.17	11.63	13.16	6.76
Best	3.45	2.33	0.00	0.00

Table 4.88 Perception of disposal processes of plastics of Glasgow public broken down by socioeconomic group

Grading Given	SEG 1	SEG 2	SEG 3	SEG 4
No Rating	2.13	4.76	1.96	0.00
Worst	51.06	71.43	68.63	67.65
2nd Worst	15.96	9.52	15.69	14.71
3rd Worst	27.66	14.29	11.76	11.76
Best	3.19	0.00	1.96	5.88

Table 4.89 Perception of disposal processes of plastics of Falkirk public broken down by socioeconomic group

It seems that both the Falkirk and Glasgow interviewees perceive plastics to be the most environmentally damaging of the four materials in both its production and its disposal. This reputation does not necessarily reflect the true nature of these processes, but it could have one of two effects on the recycling rate for plastics. Since the respondents believe that plastics is an environmentally damaging material, they could exercise their power as consumers and switch to purchasing products which are protected by other packaging materials. Another possible consumer reaction might be to increase their recycling of plastics in order to reduce production and disposal processes to a minimum.

If the plastics industry wishes to change the public perception of its products, it will certainly require a concerted, long term education campaign. Many companies have already begun this process with publications such as *Unwrapping the Truth - the facts about polyethylene* (BP Chemicals, 1991), *Plastics in Perspective* (APME & PWMI, 1991), *Plastics Packaging is Environmentally Friendly* (Linpac, 1989), *Plastics Packaging: Safeguarding our Health and Environment* (Linpac, 1993), *PET and the Environment* (Carters Drinks Group, 1992), *Plastics and the Environment* (Thomas, 1989), *Polystyrene is recyclable again and again...* (Polystyrene Recycling Association, 1992).

Respondents were also asked which of the four materials groups they believed to be the easiest to recycle. The results are summarised in tables 4.90 and 4.91.

Material	Total	Percentage
Glass	55	18.33
Plastic	8	2.67
Paper	199	66.33
Metal	36	12.00
None	2	0.67

Table 4.90 Numbers of Glasgow respondents who believe each of the materials to be the easiest to recycle

Material	Total	Percentage
Glass	25	12.50
Metal	9	77.00
Paper	154	77.00
Plastic	7	3.50
None	5	2.50

Table 4.91 Numbers of Falkirk respondents who believe each of the materials to be the easiest to recycle

In both areas, most people thought that paper was the easiest material to recycle, with glass next, then metal and plastics last. People obviously have reservations about the recyclability of plastics. This could have implications for the credibility of plastics recycling schemes and so affect the willingness of people to participate. Some of the publications mentioned in the last section address this misconception, but they are generally aimed at industrial customers making decisions about packaging materials rather than at members of the public.

Respondents were also asked to estimate what proportion of their waste was plastics. The categories that were chosen for this question were deliberately not worded in terms of exact proportions in order to make the question easier to answer and indicate that only an estimate was sought. This has however led to the choice of non-exclusive categories, in that 'very little' is 'less than half'. Another problem is that plastics account for 20% of the volume of domestic waste and 7% of its weight (Newport, 1990). When the question was asked, it was assumed that the interviewees would respond in terms of volume rather than weight, but it was not specified in the question. The results that were obtained are therefore only a guide to the respondents' perceptions of plastics as part of the domestic waste stream. These are summarised in tables 4.92 and 4.93.

Perceived Proportion	Number of Interviewees	As a Percentage of Interviewees
Very Little	82	27.42
Less Than Half	140	46.82
About Half	17	5.69
More Than Half	54	18.06
Almost All	6	2.01

Table 4.92 Glasgow respondents perception of plastics waste as a proportion of their total rubbish

Perceived Proportion	Number of Interviewees	As a Percentage of Interviewees
Very Little	69	34.17
Less Than Half	82	41.21
About Half	23	11.56
More Than Half	1	0.50
Almost All	24	12.06

Table 4.93 Falkirk respondents perception of plastics waste as a proportion of their total rubbish

In Glasgow, 74% gave a fairly accurate answer. In Falkirk this figure was 76%.

4.7.12 Qualitative Data

This section outlines some of the other relevant factors that became apparent from observations and experiences whilst carrying out the survey rather than by getting people to answer questions.

4.7.12.1 Glasgow

At the time of the survey, the majority of the banks which made up the Glasgow collection system were the smaller 2.5 cubic metre size as a temporary measure. As these are less obvious than their 5 cubic metre counterparts they attract less attention. As was shown above, the bins themselves provide most of their own publicity (see Table 4.54) and so this could have affected the public's response. In general the banks were not properly labelled (also due to the fact that they were not intended to be employed as a permanent measure) and some had no markings at all. This meant that very few people realised what the bank was for, with many mistaking it for another glass bottle bank due to the similarity in shape. Again this may well have made quite a large contribution to the effectiveness of the scheme.

The bin sites on the whole were badly maintained and a number of the banks had been vandalised. A few of the banks had already been replaced by the larger 5 cubic metre type. These have printed markings which clearly state the purpose of the bin. The replacement of the smaller bins will continue and consequently the situation will be considerably improved.

There was also much confusion as to what could and should actually be deposited in the bins. Many people prided themselves in collecting every conceivable item that was made of plastic to recycle (the most common mistake is to deposit plastic bags but the variants can be as obscure as cotton reels) and very few realised that the bank was intended solely for plastic bottles. This problem has been somewhat rectified by the appearance of a new label recently attached to the larger bins (see Appendix 11) which explains which plastics are required.

In many cases the plastic bottle bank was sited with at least one other type of recycling bin (i.e. paper, glass or cans). Many of the participants felt that all the types of banks should be sited together in order to ease contribution. This would certainly maximise the visual impact of the bins.

4.7.12.2 Falkirk

On the whole, participants in the kerbside collection scheme were content with the service provided. However, in some areas the scheme appears inconsistent, with a collection taking place one fortnight and not the next. If this happens bags are left uncollected and therefore either have to be taken back into the home or remain in the street causing a litter problem. There were also cases where the service had started up when the scheme was launched but had since been discontinued without notifying the residents. Other minor complaints included too few bags being left by the collectors and end houses or cul-de-sacs being frequently missed out. In addition, a number of streets said to be included in the collection area are in fact not covered by the scheme.

Many participants are confused as to whether or not plastic bottle tops should be included in their collection bags. This has arisen from the phrasing of the initial publicity leaflet which simply stated that tops should be removed before the bottles were put in the bag. Many people have taken this to mean that the top should be removed, but put in the bag separately. There are also a number of people who cut and/or crushed their bottles to make room for more bottles in the collection bag. This makes identification of bottle type, and hence sorting, difficult.

There is also a prevalent belief that if a collection bag is lost, or if one is not left by the collectors, then the plastics cannot be deposited within the scheme. This is not the case as any bag or box containing plastics will be accepted by the collectors thus allowing the household to 'rejoin' the scheme.

A number of people desired the ability to recycle a wider range of plastics, whilst others wanted a similar collection facility for glass and cans to be added to the existing scheme.

4.8 Bias

There was a number of factors working to bias the results of this survey. One of the most obvious of these factors is the larger proportion of interviewees in what has been termed Socioeconomic Group 1 (this includes those who are retired, housewives/husbands, unemployed, still at school or students). See Figures in Appendix 10. Despite attempts to vary the times of interview, especially covering evenings and weekends, in order to minimise this effect it seems that these groups simply are more willing to stop and answer questions than groups 2-4. This was also found by Belton et al (1994). This may be due to time factors. There is also a slight bias towards female respondents for much the same reasons.

Another set of biases result from the type of questions that are being asked. There is quite a lot of social pressure on people both from the media and more specific action groups to be 'green'. This need to be 'seen to be green' may have caused some exaggeration from the respondents (Glenn, 1987). This adds to the normal exaggeration that people tend to use when answering questions in general and the effects of reflexivity (Yin,1994). Also, due to the high media profile of environmental issues at the moment, many buzzwords have been created (the main ones here seem to be 'environment', 'recycling' and 'non-biodegradable'). These tend to be quickly lighted on as a question is read to an interviewee, often before the rest of the options are known. They are also among the most frequent responses to the open-ended questions in the survey. It is hard to tell what sort of meanings have been attached to these phrases. It is also perhaps possible that all of these factors are increased in Glasgow by the fact that much of the interviewing was done standing next to the recycling bins.

Although the results in Falkirk seem on the whole much more positive, both concerning behaviour and attitude, this cannot be attributed completely to the success of the Scottish Conservation Projects scheme being much greater than the Glasgow system. There exists historically low and high orientations towards recycling in Glasgow and Falkirk respectively, for both paper and glass. See Appendix 12.

One further bias might be that a second group of interviewers were carrying out a survey about recycling in Glasgow at roughly the same time. It was their survey which resulted in the paper by Belton et al (1994). Although their survey dealt with different issues, it was done in the same fashion and therefore some of the respondents participating in this study had already answered questions about recycling. This may mean that some of the answers to questions in the general section which rely on the respondent's cold response or gut feelings will have suffered a slight bias.

4.9 Review of Research Methods

The aim of this section is to review the research decisions that were made at the outset of the study and consider how they have enabled the stated objectives to be met.

The use of a questionnaire has made it possible to raise a wide range of issues with 500 members of the public in a relatively short space of time. In terms of addressing the number of questions and issues outlined in section 4.4 above, this research approach has been successful. An semi-structured interview based study, or an observational approach, or indeed a postal version of the same questionnaire would not have elicited this number of responses from a scattered population such as plastics recyclers. This is particularly true of the Glasgow recyclers. The mixture of closed and open questions has combined an efficient means of capturing factual information with an ability to gain a richer and less biased insight into the behaviours, perceptions and opinions of users and non-users of the two schemes.

This is not to say that the approach, or the instrument itself is free from drawbacks. As has already been discussed above, the research objective of exploring the motivation of users and non-users has not been well served by the use of either open questions (which simply led to blank faces) or closed questions (where the use of certain phrases in the prompts was felt to bias the answers, as predicted by Patton, 1990). This theme is better suited to other research methods and further and different consideration of it can be found reported in Chapters 5 and 6. The work undertaken here has helped develop valuable understanding about motivation and the ways in which it can be studied, but were the survey to be repeated, these questions would not be included.

The questions relating to the reuse of plastics would also be omitted from further survey work. These were included at the request of the sponsoring firm but are felt to deal with a separate (although related) issue which does not lie within the specific domain of this thesis.

In the light of the results of the above analysis, a further pair of questions would be included in a future questionnaire which investigated the idea of 'one recycler per household'. This could be done by asking the respondent whether they themselves undertook the recycling activities in their household, and if not, asking them to describe the person(s) who usually carried it out. This could help test the hypothesis, raised by the analysis of this study, that one person might be responsible for recycling in each household. It would also help begin the task of identifying this individual and examining their characteristics.

These changes to the content of the questionnaire would have the side effect of shortening its length and sharpening its focus.

Including one bring and one collect scheme in the survey has not led to as powerful a vehicle for comparison of their relative merits as was hoped. Many of the differences observed in the two samples could be explained by other influences, as discussed above. On the one hand, the choice of Glasgow and Falkirk may have been poor as they represent very different contexts for the recycling schemes and have therefore weakened the possibility of comparison. However in terms of the access to and support of the scheme managers, there could have been no better selection for this study, or the visits and further empirical work described elsewhere. On reflection it would have been wiser to either select two cases which were more similar, or restrict the research to one collection type. Finding more similar schemes would be facilitated by the current move towards the provision of integrated bring and collect schemes, described in Chapter 2. In the future it may be possible to carry out this kind of research in an area which has both a bring and a collect scheme in operation.

The piloting strategy used in this study was successful in detecting a repetitive element in the original questionnaire design. It failed to pick up the problems associated with the motivation questions, but this may be due to the inexperience of the researcher rather than an indication that the piloting strategy was not sufficiently robust.

The sample size utilised in the study was adequate for the intentions of the research aims. However it failed to anticipate the extensive cross tabulation that would be possible and intriguing to the researcher during the analysis phase of the research. This has the result that some of the results, although they are very interesting, could not be considered entirely statistically robust. In a future study, a larger population would be surveyed in order to provide a larger number of distinctions to be made in the data during analysis without straining the statistical integrity of the testing procedures.

In order to redress some of the bias of this survey towards some population characteristics, and armed with the knowledge gained from this work, the design of future survey work could include the use of quotas. These could be used to balance the representation of scheme users and non-users, genders, age groups and Socioeconomic Groups in the survey responses. This would be considerably more time consuming, but the quality of inferences that could then be drawn from the data would be significantly greater.

The techniques used to analyse the data have proved to be extremely useful and flexible tools. Spreadsheet based data management has likewise been a powerful research ally. This is important for the manipulation and presentation of the large quantity of data generated by this study. It has also allowed the investigation of research questions not explicitly included in the research design, which is particularly useful in a study of this nature which has a new field of enquiry as its starting point.

Overall, the research decisions made in the study design have resulted in a useful and interesting study which both answers and raises many research questions.

4.10 Conclusions

This chapter presents and reviews the results of a quantitative survey of users and non-users of two plastics collection schemes which have selected different operational strategies. The questions included in the research instrument were aimed at discovering the recycling behaviour of the patrons of the two schemes, their opinions about why the schemes had been set up, and about the collection methods. It also sought to elicit their perceptions about plastics as a packaging material and in comparison with other packaging materials. The survey results are summarised below.

The public believes that plastics are a greater environmental hazard in both their production and disposal than other materials. The degree of condemnation does vary by age and by socioeconomic group, although no strong patterns have emerged.

Fewer people know that plastics can be recycled than realise that other materials are recyclable. This could be due to the fact that the development of recycling schemes involving post-consumer plastics waste are relatively recent in this country, compared with those for glass, paper and metals. Consequently perhaps, people also regard plastics as the most difficult of the materials to recycle.

The Falkirk collect system has achieved higher rates of participation and awareness in terms of plastics recycling than Glasgow. This indicates that both the scheme and the publicity associated with it are effective. It is however impossible to distinguish between the effects of such a comprehensive publicity system and the convenience factors characteristic of collect systems. There is certainly some evidence to suggest that the convenience of kerbside may not be the only factor contributing to this success. For example, on average, the recyclers in Falkirk recycle three materials, choosing to utilise the banks provided for glass and metal as well as recycling the materials included in the kerbside collection. Also, the overall participation in recycling of all four materials is very slightly higher in Glasgow than in Falkirk. Perhaps Falkirk's real achievement then, is the high awareness and motivation levels established by its publicity campaign.

In Glasgow, it is the over sixties who are particularly likely to contribute to the scheme. This does not seem to reflect a time factor, as the unemployed, for example are less likely to participate than other groups. The significant factor here may well be 'time organisation' or a 'waste not, want not' attitude which owes its origins to the ration card of the war years. It is also possible that this age group feels a higher degree of social obligation than other age groups. It seems that volume is not a factor: Those who have more plastics waste are not any more likely to recycle plastics than other groups.

The higher yield of plastics obtained in Falkirk is due to a higher percentage of household participation, rather than a higher proportion deposited per household. Glasgow users contribute a higher proportion of plastics per month, but also deposit a larger percentage of contraries. There is a lower level of contraries in Falkirk which could probably be attributed to the higher level of information given in their information leaflet.

The Glasgow users' preferred bin site is near local shops or supermarkets/shopping centres. This seems sensible in terms of the household packaging cycle: when packages are empty and can be recycled, they also need to be replaced. The shopping trip is a situation where bags and/or cars make their outward journey empty, providing both the space and weekly opportunity to take recyclables to the recycling banks.

Special trips are not be common enough to be a problem. Neither does there appear to be any real 'Jam-Jar' effect in either area. Contamination with garden chemicals does not seem to be such a widespread threat as was feared but nevertheless may warrant special information being included in instructions in the future.

One important finding from this research is that those who recycle one material are more likely to recycle others. This has implications for the targeting of recycling promotional material and could provide the plastics recycling industry, as a newcomer to the domestic waste recycling scene, with a high potential, low entry market at which to aim their publicity.

Another interesting finding that needs to be pursued is the idea of one recycler per household. If further research confirmed this theory and went further to identify the 'recycler', the plastics recycling industry could design its promotional material to address this group more directly.

Many of the people interviewed in both areas who were recycling plastics were extremely, and in some cases overly, enthusiastic. People seem to be largely receptive to the ideas (and even ideals) of recycling, but are quite easily put off by the reality (and sometimes inconsistency) of the schemes. On the premise that it is harder to make a new customer than to keep an existing one (Orsmond, 1995; Kotler, 1991; Bradley,1992; Lele & Sheth, 1987), it is vital that the plastics recycling industry makes every effort to maintain a reliable service.

4.11 Recommendations

4.11.1 General

Education must take place at all levels to convince the public that plastic is not the most environmentally unsound choice of material for packaging. This education should be in the form of continuous (or at least sustained) publicity regarding the current facilities available and an increase in the information on how and why these facilities should be used. This information may need to be in different formats to have impacts on different social or age groups. It is particularly important to design promotional material for use with children, who are the recyclers of tomorrow.

In order to help maintain the support of current recyclers, feedback information could also be posted on banks and included in information leaflets.

4.11.2 Glasgow

All banks should be clearly marked as to their purpose. The importance of this cannot be overstated as the bins raise a great deal of awareness for the scheme.

A smaller bin could be provided near the banks to collect discarded bottle tops and other rubbish, thus maintaining a clear site. Servicing the sites on a regular basis might also be considered.

Grouping of glass, plastic, paper and metal can banks together on one site would be more convenient for users of the scheme and may encourage recycling of more materials in those who currently only recycle one or two. This arrangement may also reduce the number of trips made.

The Cleansing Department should continue their policy of siting banks near local and supermarket shopping centres where possible.

Further research should be undertaken to determine the spheres of influence of different sites and site types in order to refine the system of allocating banks across the city.

4.11.3 Falkirk

Bags with handles which could be more easily tied could be provided to stop bottles falling out into the street and causing a litter problem. Bins would also solve this problem and also stop the bags blowing about and becoming a nuisance.

If the collection is to be terminated in an area, some form of notification should be given to the householders concerned.

Householders should be made aware of a method of joining the scheme if they have not taken part so far or have missed collections.

The collection could also be backed up by a supporting plastic bottle bank located in the centre of the area. This would mean that those who had missed or had been missed out by collections would have somewhere to deposit their bottles.

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Chapter 5: Motivational Aspects of Plastics Recycling: A Literature Review

5.1 Introduction

One of the aims of Chapter 4 was to explore what motivates people to recycle, and conversely, what discourages them. Participation is crucial to the success of recycling schemes which are dependant on contributions from the public for their raw materials. Understanding the possible ways in which a higher proportion of the public could be encouraged to recycle would be of great benefit to those who run recycling operations. This information has however proved to be as elusive as it is important. It was discovered that the research instrument employed in Chapter 4 was not appropriate for the generation of this kind of data. This realisation led to an extended literature search. Much of the work that looks specifically at understanding, explaining and attempting to create motivations linked with recycling is in the field of Psychology. The aim of this chapter is to provide a review of the work undertaken in this field.

Much of the literature is concerned with measuring motivation indirectly, as an antecedent of participation rate. The participation rate for a recycling scheme is the proportion of the population served by the scheme who contribute to it. It is often expressed as a percentage. This measure is more easily assessed and accessible to scheme organisers, as an indicator of scheme success than motivation levels.

A high proportion of the literature and studies discussed below pertain to the US public, but there is nevertheless much that the UK can learn from this work. Some caution should however be used before the results of studies carried out at one side of the Atlantic are applied to the general public on the other. A study by Arbuthnot and Lingg (1975) found little overlap between the experiences and beliefs of the French and American recyclers they examined. These differences were partly attributed to the amount of time that environmental problems had been manifest in the two cultures, and the levels of importance placed on them by the governments and media. Twenty years later, the gap between the saliency of environmental issues is much less significant, possibly rendering the experiences of one continent more applicable to the other. It would be interesting to reiterate this work in order to establish whether any of the differences had been sustained. Whether the reactions of the UK public could be likened more to the French or American public is also a matter for further study.

5.2 Characteristics of the Recycler

Many studies have been aimed at discerning the characteristics of recyclers and non-recyclers. One of the common strategies has been to try to identify the demographic profiles of these two groups. Much work has been done in this area and it is often found, for example that recyclers are older (Vining & Ebreo, 1990; Belton et al, 1994), better educated (Cohen, 1978; Sundeen, 1988) and wealthier (Arbuthnot, 1974; Pirot, 1980; Vining & Ebreo, 1990; Ball & Tavitian, 1992) than non-recyclers. Jacobs et al found, for instance that **initial** levels of participation were often related to housing values (Jacobs, Bailey & Crews, 1984). They also found that schemes which were based in cities which had higher mean income levels had greater participation rates. Pirot studied sample populations from metropolitan and small urban areas, but found no differences in either attitude or behaviour (Pirot, 1980). However, these results have not been obtained by all studies and their general validity is now being questioned (Van Liere & Dunlap, 1980;

Mohai & Twight, 1987). For example, Arbuthnot (Arbuthnot, 1974) found that recyclers were younger and had the same amount of education as non-recyclers. Other studies still have found no demographic variables significant at all (Ferris, 1988) or remain unsure (Brudney, 1990).

Arbuthnot put forward the theory in his study (1977) that it is not demographic variables, but personality traits which can be used to predict an individual's recycling behaviour. He showed that recycling behaviour was predictable from the amount of education a person had, and also how much comprehension they had of environmental matters. He was also able to predict the amount of environmental knowledge a person would have from a set of questions which revealed that person's personality, attitudes and access to information through books. Another study (Kok & Siero, 1985) found that the amount of time an individual has 'free' in their lifestyle, the more likely they are to recycle. This may explain the high incidence of retired recyclers found in many projects, and echoes the findings of Chapter 4.

Webster (Webster, 1975), in his paper entitled *Determining the Characteristics of the Socially Conscious Consumer* compared the characteristics that had been defined as predictors of ecologically sound behaviour in two earlier studies (Berkowitz & Lutterman, 1968; Anderson & Cunningham, 1972). Whilst some of the variables in these studies are similar, some are conflicting. Webster found the following factors to be predictors for recycling behaviour (Webster, 1975):

Personality Factors

Tolerance

"Characteristic of an individual who is permissive, accepting and non-judgmental about other people's social beliefs and attitudes"

Responsibility

"Describes an individual who is conscientious, responsible, dependable, articulate about rules and orders and who believes that life should be governed by reason"

Attitudinal Factors

Perceived consumer effectiveness

A measure of how much impact individuals believe their purchases will have on the environmental policies of manufacturers

Social Responsibility Scale

Those who score high on this scale tend to be conservative, middle class, educated, Republican, involved in the community, contribute time and money to social causes, interested in politics and do not feel alienated and powerless in society.

Socioeconomic Factors

Education

Simmons and Widmar (1990) agree to a large extent with this, describing the most likely predictors of recycling behaviour as:

A sense of responsible action

(e.g. believes that "harming nature harms man" and that the current generation is responsible for the future consequences of current environmental behaviour);

Conservation Ethic

(e.g. believes in the wise use of natural resources).

McGuinness, Jones and Cole (1977) also found relationships between participation in a recycling scheme and ecological and community-focused beliefs. Kuylen and Van Raaj (1979) describe 5 different types of recyclers:

- Economic Recyclers;
- Social Recyclers;
- Ecological Recyclers;
- Legitimate Non-Recyclers;
- Non-Recyclers.

It follows that each of the non-recyclers could be a potential member of one of the other four groups and should therefore be given different kinds of persuasion. This could be taken into consideration when designing promotional material for recycling schemes. If demographic or personality traits could be discovered which would allow predictors for each group to be developed, it may be possible to target each of them more specifically.

Sheth (Sheth, 1978) has another system of categorising people as regards their potential recycling habits and has suggested methods of dealing with each of these groups. See Table 5.1.

	Psychological Orientation	
Actual Behaviour	Recycler	Non-Recycler
Recycler	(A) Reinforcement Strategy	(B) Rationalisation Strategy
Non-Recycler	(C) Inducement Strategy	(D) Confrontation Strategy

Table 5.1 Strategies for increasing consumer participation, from Sheth (1978)

Where

A. Reinforcement would involve providing education and feedback

B. Rationalisation might mean explaining the positive effects of conservation behaviours

C. Inducement to overcome perceived or actual inhibitors might involve emphasising or increasing the ease and convenience of schemes

D. Confrontation techniques would include measures such as economic disincentives and mandatory recycling

It seems that personality and attitudinal measures are better predictors of recycling behaviour than socioeconomic and demographic variables. This is unfortunate as these measures are harder to determine, isolate and therefore target with educational or persuasive information.

5.3 Awareness and Action

One of the phenomena discussed in Chapter 4 was the difference between the awareness and actions of members of the public. This concept has been the subject of a number of studies. These confirm that although most members of the public seem to be concerned about the environment, and will verbally endorse most schemes or individuals that seek to conserve or improve it, this is not necessarily an indicator of either their environmental knowledge or actions.

Unfortunately, even when individuals do have quite a significant amount of environmental knowledge, understanding and even concern it has been shown that they will not necessarily translate this into environmental action. Recycling it seems, like many altruistic behaviours is "characterised by wide-spread approval but limited participation" (Hopper & Nielsen, 1991). This general support for recycling must however, be regarded as a positive factor. Belsie (Belsie, 1990) believes that the fact that recycling is endorsed by a large majority of the public means that it has a high success potential. De Young (1990) also found a "strong pro-recycling attitude" among those interviewed in his Michigan study. The problem faced by the recycling industry is therefore not simply to convince members of the public that recycling is a good idea, but to persuade them to act according to beliefs they possibly already hold. Although there is no simple missing link that will turn attitudes into behaviour, there are several factors that have been found to be high in individuals whose opinions and actions coincide:

1. Knowledge

   How much accurate information an individual has relating to current environmental problems

2. Awareness of Consequences

   This relates to how well an individual perceives the personal consequences of ecologically unsound behaviour

3. Ascription of Responsibility

   How each person sees their own and others' contribution to a problem

4. Perceived Effectiveness of Contribution

   To what extent people believe that their contribution will make a difference to the problem.

Humphrey et al believe that the understanding and behaviour of the public are "highly coincident in the short run, diverging thereafter" (Humphrey, Bord, Hammond and Mann, 1977). Rogers offers an explanation for this pattern, pointing out that there is a difference between forming and maintaining behaviour, as only behaviour which has the expected positive consequences will be maintained (Rogers, 1983).

This has implications for both the expectations which are raised by a recycling scheme and the users' perception of what they have achieved by participating. It is perhaps important to make some distinctions at this point between the success and perceived success of a scheme, and the user achievement and the scheme achievement. There is an urban legend in Glasgow that a door to door collection of waste paper which was started by the District Council some years ago eventually resulted in all the collected paper being landfilled.

What actually happened is that the cleansing department set up a scheme to collect paper when virgin wood pulp prices were high and there was a high demand for post-consumer paper. A large number of public and private schemes sprung up all over the country, and quickly became viable. However, this caused a glut in low grade and mixed paper waste, causing the bottom to drop out of the market and a large proportion of the new schemes (including Glasgow) collapsed. Collections in the city ceased and the paper which had been collected from the Glasgow public was stored in the hope that a market would recover. Clearly, this scheme was successful for a while in terms of making money for the council, but in the eyes of the participants, the scheme was a failure and they had not achieved their objective; to recycle paper. The expected positive consequences of putting paper out for separate collection were not realised. Eventually, most of the paper was sold with little or no profit margin and perhaps some was indeed landfilled. This has damaged the expectations of the Glasgow public both in terms of the intentions and permanence of recycling services. This also underlines the need for reliability of services which was discussed in relation to the case study schemes above.

Other studies have investigated the psychological process of becoming a recycler. McGuire (1973) outlines three stages of cognition which precede the joining of a recycling program:

1. Attend to information relating to program
2. Comprehend what program entails
3. Have a favourable attitude towards program

Kok and Siero go further to explain that behaviour is determined by intention which in turn is a function of the attitude a person has towards a particular behaviour and social norms. Attitude itself is a function of belief strength and evaluation of consequences.

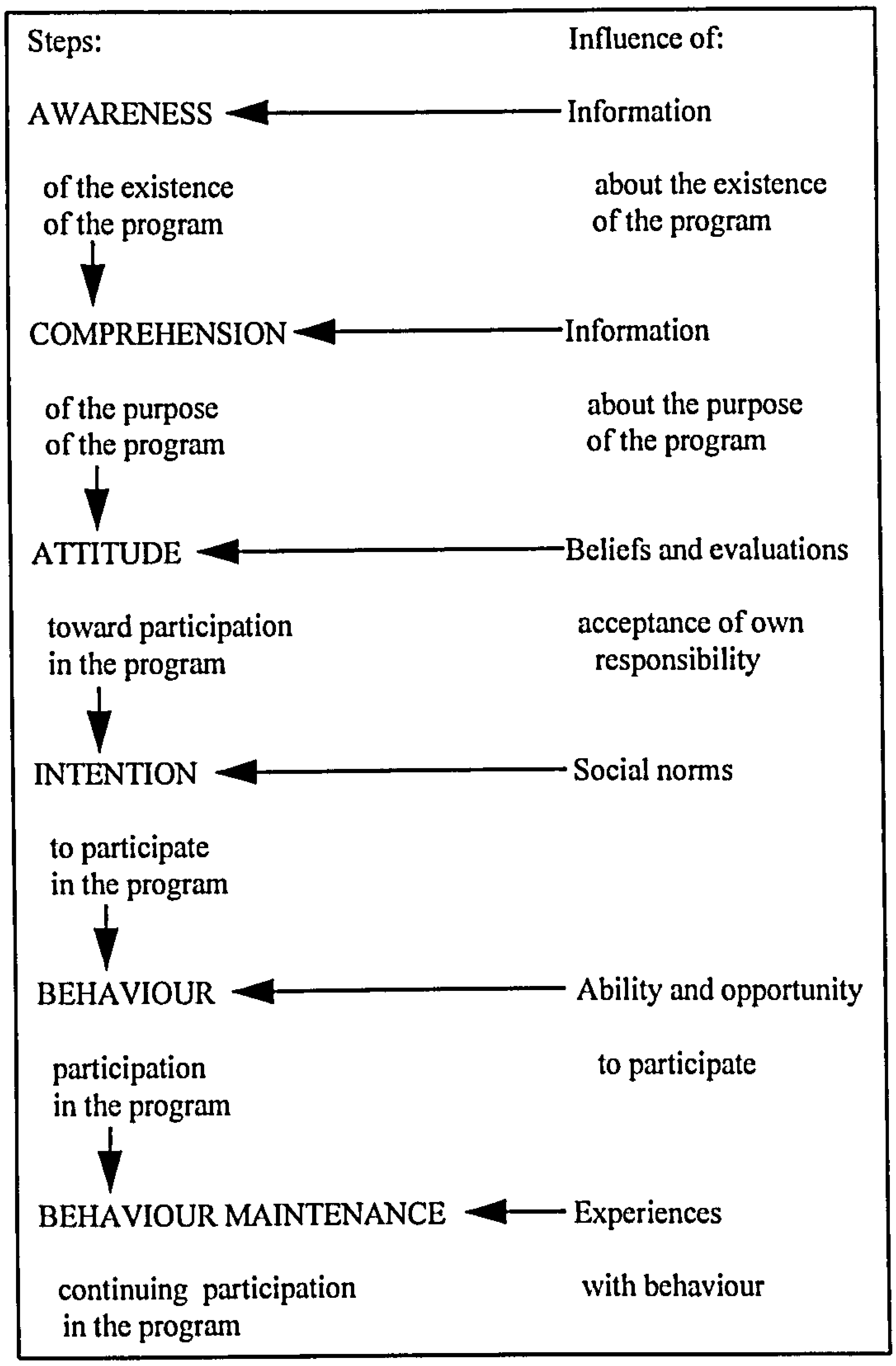

Figure 5.1 Model of attitude change and behavioural change through communication, reproduced from Kok & Siero, 1985

They go on to determine formulae for these functions and conclude that an individual will comply with a request to perform a behaviour if their attitude is favourable, they have a positive intention towards it, and they are provided with the opportunity to perform the behaviour. They summarise the whole process in six steps: See Figure 5.1 (Kok & Siero, 1985).

5.4 Strategies for Increasing Motivation

What follows are brief explanations of some of the more common behaviour modification techniques used by psychologists to influence the environmental behaviour of the public.

The impact of any of these techniques must be tested by some measure which renders them comparable. The most common measures for these studies are participation and diversion. Participation can be defined as the percentage (or percentage increase) of those people who could take part in any scheme who actually participate. This is the most common measure used and allows comparison of contingencies used to encourage other environmental behaviours (for example, energy conservation schemes) to be compared with recycling initiatives. Diversion is the amount of solid waste that is diverted from the usual waste stream as a result of a scheme. Although diversion rates are only applicable to recycling, it is an extremely good measure of a scheme's success. Many of the experiments described below have used both forms of measurement. This gives a particularly accurate picture of the effect the scheme is having on a community.

Oskamp (Oskamp, 1983) suggests that the behavioural research that has been done in this area can be broadly split into two categories: Antecedent Strategies; and Consequent Strategies. These groupings are relatively self explanatory. Those which attempt to affect the recycler (or potential recycler) prior to the recycling act are described as Antecedent Strategies, whilst Consequent Strategies are those which come to pass once someone has taken part in an act of recycling. Some believe (Geller, 1981; Olsen & Goodnight, 1978) that in general, consequent strategies are much more effective than antecedent ones. However Ester and Winett (Ester & Winett, 1981-82) found that "specific, salient and repeated antecedent strategies" can have significant effects. The following section outlines some of the different types of intervention strategies that have been used to increase recycling rates, or other ecological behaviours.

5.4.1 Prompts

There are many types of prompt used in order to try to encourage recycling. They can be verbal or written, personal or general and distributed privately (i.e. through individual letter boxes) or publicly (i.e. in the local newspaper). Much work has been done on the effects of including different types of information in these prompts.

Prompts and other forms of information are relatively cheap ways of attempting to change recycling habits. This is obviously an advantage for an industry which operates under tight financial constraints. However, it does not necessarily mean that these methods are cost effective, which is more important, especially if community wide projects rather than experimental pilot studies are to be launched. Another problem might be the permanence of the effect that a prompt has on an individual. In their study, Spaccarelli et al found that reminder hand bills had a small but temporary effect on participation (Spaccarelli, Zolik & Jason, 1989). Simmons and Widmar recommend that any education campaign must be continual in order to be effective (Simmons & Widmar, 1990).

Obviously, important consideration should be given to the content and design of persuasive communications. For instance, Burn and Oskamp (1986) believe that:

> The impact of persuasive communications will be reduced if the behaviour changes that it recommends are too far removed from a person's current beliefs and practices.
>
> The effectiveness of persuasive communications may be enhanced by the inclusion of information which comes from reference groups which are relevant to the individual concerned. Neighbours, for example are a good reference group to consider for something as domestic and visible as kerbside recycling schemes. This includes two strategies; it provides confirmation that others are already carrying out the desired behaviour, and the source of the information contained in the persuasive communication is felt to be credible by its recipient.
>
> If persuasive communications can promote the involvement that a person feels with the issue concerned, this will help increase their impact. This could be increased, for example by using personal contacts to deliver and discuss the communication.
>
> Fear appeals are another tactic which have been shown to have an effect in modifying behaviour. This approach involves spelling out the seriousness of the possible outcomes of undesired behaviours, along with estimates of the likelihood of them happening, the effects these will have on an individual's life and also

promoting the perceived usefulness of the advocated behaviour in averting these outcomes (Oskamp, 1983).

Another important factor in the design of such information is that **specific** tasks should be recommended, not just a plea to 'contribute' or to 'do better' or 'save the environment'.

Some other studies have recommended some or all of these strategies for designing prompts (Cook & Berrenberg, 1981; Craig & McCann, 1978). Geller (Geller, 1981) adds that prompts should be polite rather than demanding, specify a task in such a way as to make it seem easy and be placed near the required point of response. He refers to a study by Zolik et al which experimented with placing prompts asking people to turn off lights and save energy next to light switches (Zolik, Jason, Nair & Peterson, 1982-83). This finding underlines the importance of providing instructions for recyclers at the recycling site in a bring system.

Olsen (Olsen, 1981) also has a group of stipulations for information design and distribution. She advocates that scheme information should:

- Emphasise individual benefits rather than sacrifices
- Not make financial savings the sole justification
- Not expect information alone to motivate people

- Stress benefits to society in order to provide an altruistic rationale

- Spread information through interpersonal interaction and hands on demonstrations.

Like all of the techniques discussed here, prompts and provision of information have their proponents and contestants. Personal contact with a verbal prompt was successful in raising participation in a study by Jacobs et al (Jacobs, Bailey & Crews, 1984), but proved of no benefit in others (Pardini & Katzev, 1983-4; Spaccarelli, Zolik & Jason, 1989). Another study reports that intensive prompting was successful in raising the number of participants in a scheme, but was not cost-effective (Jacobs, Bailey & Crews, 1984). Combining prompts with other types of information also has many advocates (Ester & Winett, 1981-2; Geller, 1987; Geller, 1989; Stern & Oskamp, 1987). A couple of studies have reported that, although prompts alone had little effect on recycling rates, supplying containers as well as prompting had a significant effect (Jacobs, Bailey & Crews, 1984; Reid, Luyben, Rawers & Bailey, 1976; Seaver & Patterson, 1976). In these cases, the containers themselves may be acting as effective prompts. Another study found that utilising incentives along with a regime of prompting increased recycling levels, but only in the short term (Luyben & Cummings, 1982).

Comprehension was found to be higher amongst those who had their initial awareness raised by adverts rather than by seeing instructions near drop-off sites due to the higher information content of the adverts. A similar effect was found by Jacobs et al who found that putting persuasive communications in brochure form rather than taking out an advertisement in a daily newspaper had a greater effect on participation. This could be because the higher information content of the brochure had a greater impact on householders, or perhaps that the brochure was kept longer than a daily newspaper. (Jacobs, Bailey and Crews, 1984)

Prompts have also been combined with other types of behaviour modifier. Luyben and Bailey found that prizes and information was a better combination than providing special containers along with information (Luyben & Bailey, 1979). Spaccarelli et al also advocate combining written prompts with another strategy in order to obtain the maximum benefit (Spaccarelli, Zolik & Jason, 1989). In fact, Arbuthnot (Arbuthnot, 1977) found that integrating several different kinds of prompt (in this case a telephone survey, a verbal appeal to recycle and a letter asking for participation) gave a much higher increase in reported participation than when any of them were used alone. Another study (Reid, Luyben, Rawers & Bailey,1976) has shown that combinations of different prompt types, for example information and personal contact could be effective. Hopper and Nielsen (Hopper & Nielsen, 1991) however, are of the opinion that it will take more than reminders and information to make the necessary changes to attitudes in those who are not already sympathetic towards recycling.

Vining and Ebreo, also believe that prompting or supplying information to households has little effect on recycling behaviour when used alone (Vining & Ebreo, 1990). Ester and Winett's study found that an information campaign alone has no effect (Ester & Winett, 1981-82). These results are particularly interesting as this is the method currently favoured by the Government and many other bodies.

It is also worth noting that, in the light of the recycler characteristics discussed in the previous section, the same persuasive communication or information campaign will not necessarily have the same effect on everyone. Pirot, (1980) for example, found that prompting had a transient effect on upper-middle and middle income households but no effect on lower-middle or lower income households.

5.4.2 Feedback

Feedback is another type of information based strategy where recyclers are kept informed about how much they have contributed to a scheme. Feedback can be either continuous or intermittent. It might take the form of information about how near or far the contribution so far is from a pre-defined target, or just simply how much environmental benefit is being gained from the scheme. This is sometimes used as part of a contest contingency, either along with, or instead of prizes. Feedback can also be used in a non competitive way to allow individuals or groups to assess their own progress.

Quite a large proportion of the work carried out on feedback to date has involved its use in schemes which are aimed specifically at the reduction of household energy consumption. In a typical scheme, the energy consumption of a household is measured by a meter reader several times per week. This is obviously quite a time consuming and expensive process, but it is interesting to note that Hayes and Cone (1981) have had some success in reducing energy consumption with monthly feedback. It has been estimated that using feedback as a behaviour modifying strategy can produce 10-20% energy savings (Winett & Neale, 1979), although other studies show only minimal changes in consumption (Hirst & Lazare, 1981; McDougall, Claxton & Ritchie, 1981). When it is combined with other strategies, for example modelling or incentives, it is believed that even higher savings could be achieved (Winkler & Winett, 1982). One of the most encouraging features of this method is that its effects often remain once the treatment period has ended (Pallack, Cook & Sullivan, 1980; Winett, Neale & Grier, 1979). Feedback is thought by many to work so well because it combines elements of both informational and motivational methods (Seligman, Becker & Darley, 1981).

Hamad et al introduced a feedback condition in order to increase participation in a recycling scheme. They set up a system for posting up progress reports for a school recycling scheme. This did encourage the children to recycle more, but did not make enough difference to produce significant results (Hamad, Cooper & Semb, 1977).

Feedback could be incorporated into plastics recycling schemes in a number of ways. Scheme feedback could be provided by posting diversion rates for bring systems in local shops, papers or at the recycling sites. Participation and diversion rates for kerbside systems could be displayed in local shops, papers or delivered to individual households covered by the scheme. It is possible that the latter could be incorporated in local newspaper delivery. Individual feedback could be provided at manned bring sites or as part of a collect system my marking a card for each deposit and providing a sticker or similar token for a certain number of deposits, which is a system resembling the one utilised by the blood transfusion service. These measures would however add to the cost and time of recycling service provision.

If the 'meter reader' could be removed from the equation then this procedure would become much more cost effective. Some attempts have been made to introduce self monitoring systems in the energy reduction campaigns, where the householder is taught to read their own meter on a regular basis. The school paper recycling scheme described above is a variant of the self monitoring system, designed to encourage children to recycle paper. The participation and/or diversion rates that were determined from the large poster in the classroom where each child recorded his/her contribution to the scheme, seemed to be very high, but the amount of paper actually collected suggested that these results may have been subject to some exaggeration by the children. Another approach might be to mechanise the meter reading process. Becker and Seligman, for example tried using a flashing light to indicate when an air conditioning system was running whilst the temperature outside was below 68 degrees Fahrenheit (Becker & Seligman, 1978). It is hard to imagine how a mechanised process might be introduced to either bring or collect systems without the use of sophisticated and expensive machinery.

5.4.3 Modelling

Another form of antecedent strategy which is a variant on the prompt is modelling. This method utilises television and other media to demonstrate the desired behaviour. Bandura (Bandura, 1977) experimented with using television to demonstrate the behaviours that he wished the public to carry out. This technique was found to be quite successful in several studies (Winett, Hatcher, Fort, Leckliter, Love, Riley & Fishback, 1982; Aronson & O'Leary, 1982-83). The launch of the Teesside plastics recycling scheme included television coverage by the children's programme 'Blue Peter'. In this example of modelling, an action sequence of children squashing and depositing plastic bottles, entitled *Doing the Crunch* was set to a lively, modern piece of music (RECOUP, 1993).

5.4.4 Convenience factors

Another group of measures which has been studied in order to examine the effect on participation can be termed convenience factors. Convenience is a very significant contributory factor for most recycling behaviours. The time, effort and resources required of individuals to sort, prepare, store and transport materials for recycling (which would after all have previously been thrown away without a thought) are all factors which may act as a barrier to recycling behaviour. They all affect how 'convenient' recycling will be for householders.

One study has shown that difficulties perceived by recyclers and prospective recyclers include all the time and effort that individuals must spend on their rubbish compared with their previous waste regime, the cleaning of recyclables, and the storage space required (Williams, 1991).

In a study of convenience factors relating to kerbside schemes, Jacobs et al (Jacobs, Bailey & Crews, 1984) discovered that weekly pick-ups of recyclables that coincided with the regular rubbish collections had higher participation rates than those which did not. This suggests that the convenience of not having to remember about or take out rubbish for different collections is a positive advantage in the eyes of the consumer.

In relation to bring schemes, it was found that the two factors which members of the public viewed as posing the largest problems were the distance that they must travel to the container, and the process of bringing recyclables to the container. Witmer and Geller (Witmer & Geller, 1976) also found proximity of containers to be an important factor in the decision to recycle in their study of paper recycling among students living in university dormitory accommodation.

5.4.5 Scheme Characteristics

Work by Folz and Hazlett suggests that the success of a recycling program has little to do with the type of people involved in it or even the way that it has been publicised (Folz & Hazlett, 1991). They studied many different US schemes to see if they could find any factors which made a scheme successful. Their findings can be summarised as follows. Cities with higher rates of participation place more importance on citizen involvement in policy initiation and program design decisions. Schemes which have mandatory participation, kerbside collections and which offer composting facilities all have higher recycling rates. Other factors include providing free bins, setting goals, public education campaigns, and using marketing strategies. Cities using general waste collection fees to finance recycling programs and who therefore charge more for waste collection also enjoy higher participation rates. Higher diversion rates are experienced by cities which utilise compartmentalised trucks for collection of recyclables. Cities which had both higher landfill fees and more experienced recycling co-ordinators also had higher diversion rates. Although some demographic variables were identified by this study, they were unimportant compared with other factors such as having a specific recycling policy, the process by which the policy decisions were made (i.e. decentralised, consultative processes with emphasis on citizen involvement worked best), methods of program operation, the amount of 'outreach' and education provided. Interestingly, several of the factors that they uncovered as being present in all of the more successful schemes related to people who ran the scheme, such as the experience of the recycling co-ordinator.

5.4.6 The influence of others on recycling behaviour

Social influence has been identified as one of the important elements in an individual's decision whether or not to recycle (Vining & Ebreo, 1990). This may be in the form of an individual's wish to conform to their neighbours' or families' perception of correct behaviour, or it could involve a wider frame of reference, like the degree of support for recycling behaviours in their community. A social influence may however not only be positive, encouraging people to recycle. In a household or community there may be a negative social influence towards recycling, scorning those who participate. This sort of social incentive or disincentive has been shown to have significant effects on the recycling behaviour of the individual (Cook & Berrenberg, 1981). The aim of social education must therefore be to nurture positive influences whilst reducing the power of negative ones. Humphrey et al make the point that both actual and **imagined** social pressure influence the potential recycler (Humphrey, Bord, Hammond & Mann, 1977). Kok and Siero (Kok & Siero, 1985) suggest that public behaviour is affected by social norms, whilst private behaviour is not. This could be an important difference between bring and collect recycling schemes, which could be described as private and public behaviours, respectively.

One group of experiments which involve the use of social influence to encourage recycling makes use of block leaders. This refers to a peculiarly American system. In the States, most homes are arranged in 'blocks' (the area in between intersecting roads). These often have an identity with which the residents associate. In some places, these blocks have organisations or 'block clubs' of which many or all households are members. The 'block leader' approach used in these studies involves recruiting a member of the block to visit each of the homes on his or her block personally and provide information about the scheme and encourage the residents to take part.

Using block leaders to make personal contact with householders and to encourage them to recycle is a way of attempting to utilise both prompting and social influence to obtain recycling behaviour. Hopper and Nielsen (1991) report that this approach can give lasting behaviour change. This result was also found by Spaccarelli et al who found that block leaders were effective if the commitment of the block leaders themselves is high and if there is frequent personal contact between the leaders and the members of the neighbourhood (Spaccarelli, Zolik & Jason, 1989). They also found this technique to be particularly successful where the neighbourhood already had an established 'block club', or similar organisation as well as some previous neighbourhood involvement. However neighbourhoods which did not recycle at all before the intervention period and also had block clubs were less likely to recycle than those with no club. This indicates that such organisations may have either negative or positive influence on the acceptance of recycling. Arbuthnot et al confirm that these techniques can give good results but express doubts as to the ability of scaling up such a system which requires a personal contact with every household (Arbuthnot, Tedeschi, Wayner, Turner, Kressel & Rush, 1977).

In order to assess the effects that encouragement had on the quality of separation of materials for recycling, Humphrey et al (Humphrey, Bord, Hammond & Mann, 1977) used a different reference point than the social one which the block leader represents. They organised an office recycling scheme in which some of the staff were encouraged by their departmental heads or supervisors. They found that those who were encouraged separated their waste paper more accurately than those who were not. Participants who were supplied with two bins or a divided bin in which to place their different grades of waste paper also separated more accurately than those who were merely given instructions. The scheme was set up in such a way as to ensure that some of those asked to participate would need to expend much more effort than their colleagues. Although some slight differences were detected between these groups in terms of the quality of separation, these differences were not found to be statistically significant. There was, however, a deterioration in the accuracy over time and although encouragement did appear to have a small effect on reducing the effects of satiation, again this was not statistically significant. Unlike the sorting quality, people's enthusiasm for recycling paper did not diminish over time. In another study, Jacobs et al found that distributing containers to participants and non-participants in a paper recycling scheme gave quite a substantial increase in the number of people taking part in the scheme. This increase slowly declined over time. The initial increase that was enjoyed by the scheme meant that the introduction of containers was cost-effective for the first few weeks of the trial.

If personal contact cannot be achieved, it has been shown that simply posting flyers through individual doors has a more beneficial effect on the recycling rate than a newspaper advert would (Jacobs, Bailey & Crews, 1984). This may indicate that members of the public feel more inclined to contribute to a scheme that has taken the trouble to contact them on an individual basis. There may be an element of the same effect that is gained from personal contact at work here.

5.4.7 Incentives

There are a variety of different types of incentive which have been employed in order to encourage recycling. These take three main forms: non-monetary incentives; monetary incentives; and monetary disincentives.

5.4.7.1 Non-monetary Incentives

The most common type of non-monetary incentives are raffles and contests. In the raffle contingency, a raffle ticket is given for each donation of recyclables or each donation over a certain weight. At the end of a specified period, the raffle is then drawn and prizes are allocated.

Hamad et al found that although organising contests had an initial effect on the paper recycling levels amongst elementary school children, the effect died away as soon as the competition was over (Hamad, Cooper & Semb, 1977).

Jacobs and Bailey (1982) found that running a lottery gave better participation rates than contingencies involving information provision, giving participants penny for each pound of paper deposited, and weekly kerbside pick up. None of these strategies proved cost effective. The raffle contingency was also found by Witmer and Geller (Witmer & Geller, 1976) to achieve higher participation rates than giving prompts or holding a competition. They also reported that, like most of these type of modifiers, the behaviour change does not last beyond the end of the intervention condition.

Luyben and Bailey found that if they offered children small toys as a reward for recycling paper, there was an increase in participation (Luyben & Bailey, 1979). Hamad et al found that a combined intervention of providing prizes and feedback increased the participation rate of school children (Hamad, Cooper & Semb, 1977). Several other studies have found that incentives such as raffles and contests combined with prompts work better than prompting alone (Geller, Chaffee & Ingram, 1975; Witmer & Geller, 1976). Both raffle and contest contingencies raised the participation rates for paper recycling in a study of an American University campus (Geller, Chaffee & Ingram, 1975). In the same study, the highest diversion rates were recorded when the most valuable prize was on offer.

One lesson which should be learned from the study by Witmer and Geller is that the offered reward must be appropriate to an individual for it to be considered an incentive. In their study of several university dormitories, one of the conditions that they introduced was a contest between the dorms, with a prize of $15 to be awarded to the kitty of the dorm which recycled the most paper each week. On the whole, this prize was sought after, as dorm funds were used to finance parties at the weekends. One of the dorms, however was reserved for members of the Army Officer Cadet Training Corps. This dorm was included in the study as it was thought that the cadets may exhibit more team work and group spirit than their civilian counterparts. In fact, this dorm was not allowed to have parties at all, and so the promise of boosting their dorm funds provided little or no motivation. This was reflected in the returns for this dorm.

Various types of contests can also be used, either with or without prizes. Prizes can, for example be awarded for the largest contribution, or can be given on receipt of a certain amount or value of material recycled.

5.4.7.2 Monetary Incentives

One form of monetary incentive is to pay the recycler the market value of their contribution. A recently developed example of this is the reverse vending machine which pays a small cash sum for returned aluminium drinks cans. Tokens which are redeemable at local stores (sometimes representing discounts) can also be used in place of currency. Like the raffle tickets, these may be distributed for each recycling act, or for a certain amount of material, either on a cumulative or one-off basis.

Winett, Kaiser and Haberkorn (1977) reported that they used monetary incentive with some success, but there was a doubt as to how cost effective and/or sustainable these methods might be in the long run. In a study in 1982, Jacobs and Bailey found that prompting people, providing monetary rewards, issuing lottery tickets and increasing the frequency of collections all raised participation levels, but none of these techniques proved cost effective (Jacobs & Bailey, 1982).

Another version of the monetary incentive is what can be termed 'removing obstacles'. Here, the incentive is often still money, but the consumer does not perceive it as a financial reward, rather as the removal of a financial obstacle. This has been tried with many sorts of environmental behaviours such as buying vehicles to help start off van or car pools, or reserving preferred parking spaces for its users. Another example is providing discounted tickets to encourage bus use (Katzev & Bachman, 1982; McClelland & Canter, 1981; Owens, 1981).

Other schemes have provided a low-interest loan service or set up grants to aid home insulation. This technique has also been successful in recycling programmes where participation has been increased by providing receptacles to store recyclables prior to collection (Ho, 1982). Like many of these provisions, the bags, boxes and bins may also serve as a prompt to the public.

5.4.7.3 Monetary Disincentives

Monetary disincentives are one of the most commonly applied modifiers. Many Government campaigns fall into this category. They are also employed by many of the major service providers in this country, such as British Telecom, British Rail, British Gas and Scottish Power. This sort of negative reinforcement appears to be less successful in promoting environmental behaviour. Foxx and Hake, for example found that "for the average American consumer, doubling the cost of gasoline or electricity will only reduce consumption by around 10%" (Foxx & Hake, 1977; Winett & Neale, 1979). Although some economists have found greater price elasticity in the demand for residential energy.

The main advantage of monetary disincentives is that they are cheaper and more easily implemented than some of the other modifiers. These are probably the reasons that such measures have been adopted so readily by many local and national governments.

One common form of monetary disincentive is a peak pricing policy. Several studies (Black, 1978; Caves & Christensen, 1980; Kasulis, Huettner & Dikeman, 1981) have found that it is possible to reduce the energy consumption significantly during times of high demand by charging a higher rate for the energy used within this period. This method is not as effective if the peak period includes many non-workday hours.

There are no measures which could be applied to recycling which are entirely equivalent to the peak pricing policy. There are however a number of ways in which differentiated pricing policies could be used to boost recycling. On a local scale, one such measure would be to introduce different charges for the removal of household waste. This could either be a simple two charge scheme where households are charged one rate if they recycle and another if they do not, or include a series of charge bands relating to the weight of refuse discarded.

Another example of monetary disincentive which has been implemented by a number of US states is the system of fines associated with not recycling in areas where recycling has been made mandatory.

5.4.8 Motivating the Altruistic Recycler

De Young believes that extrinsic incentives such as those described in the previous section will never provide the necessary, long term behaviour changes. Although he agrees that for a recycling program to be effective (and cost effective), some sort of incentive will be required to encourage participation (Geller, 1982) In his study (De Young, 1986) states that intrinsic motives such as feeling good about helping the community or saving the environment can be significant incentives to recycle. More specifically, he lists some of the behaviours that people gain such satisfactions from and groups them:

Frugality

- Avoiding waste
- Repairing
- Storing things for undetermined future use

Self-Sufficiency (Nicholls, 1981)

- Finding new ways to be self-sufficient
- Rediscovering old methods

Participation

Making a 'difference'

Community involvement

Bringing a sense of order to the world

His later study on recycling attitudes provides further evidence for the importance of the intrinsic motivator (De Young, 1990).

Katzev and Pardini (Katzev & Pardini, 1987) report that recent studies in psychology have found that "moderate external techniques can work better than powerful ones". The reasons for this are summarised as follows:

- interest in a desirable activity may be undermined by using extrinsic incentives;
- both urges for and against an activity can simply make a person do the opposite;
- effectiveness of behaviour change techniques diminish as incentives become more attractive or threats more severe;
- compliance is more readily obtained with weak rather than strong external pressures. This is because individuals may credit their own attitudes or beliefs (intrinsic values) when external pressures or justifications are less obvious.

This kind of incentive is a minimal justification technique.

Other studies which support this altruistic definition of recycling include De Young and Kaplan (De Young & Kaplan, 1985-86) and Davidson-Cummings (Davidson-Cummings, 1977).

The two main types of behaviour modifying strategy which seek to employ intrinsic satisfactions as motivations are goal setting and commitment.

Goal setting, which is often combined with feedback, involves setting targets for either individuals or groups of recyclers to meet. The goals may or may not be time related. Commitment can be a public or private statement of commitment by either a group of people or an individual.

The aims of these methods are the same as those which use extrinsic motivations: to change attitudes in such a way that "substantial and lasting behaviour change" is achieved (Hopper & Nielsen, 1991). The routes to this goal are however fundamentally different. No individual or immediate rewards are received by the recyclers, their only motivation is the belief that they are doing something 'good'.

McCaul & Kopp tried using goal setting to reduce the public's energy consumption. The introduction of goals did not increase the numbers of people participating in the scheme, but it did increase the amount of energy that each participant saved. They also found that subjects reduced energy consumption when the task with which they were presented was quite difficult and feedback was provided (McCaul & Kopp, 1982). Hamad et al also found goal setting to work well in a paper recycling scheme set up for school children.

This technique was particularly effective in encouraging children to recycle greater quantities of paper (Hamad, Bettinger, Cooper & Semb, 1980). Katzev and Pardini recommend that the targets that are set must be "small, reachable and sustainable" to begin with (Katzev & Pardini, 1987).

One of the major benefits in using techniques like commitment to modify behaviour, is that the effects produced appear to last long after the period that people had pledged to contribute for is over (Wang & Katzev, 1990). Wang and Katzev found that individual, public commitments had substantial effects on recycling behaviour. Both participation and diversion were increased by asking people to sign a pledge in which they promised to recycle for a certain length of time. Names of participants were then published. This group out-recycled both those who signed group commitments and those who were offered an incentive. Group commitment also proved better than using incentives for the amount of weight the scheme managed to divert from the waste stream. On average, those who were offered incentives recycled more often than (but not as much as) those who signed group commitments. However, the effect of the group commitment lasted longer than that of the incentive. Burn and Oskamp also carried out a study which compared the effects of public commitment with material incentives and also with the use of persuasive communications. Although all groups recycled more than the control group, none of the techniques proved better than the others, even when all three methods were combined (Burn & Oskamp, 1986). A similar project which compared the use of commitment with the distribution of tokens and a third combined condition (Katzev & Pardini, 1987) found that both groups which involved commitment recycled more than those without. The effects of intervention also lasted longest in the two commitment groups. Interestingly, the token only group actually recycled less during the intervention period and the commitment plus token group only redeemed 28% of the tokens which they received. This may indicate that providing even a small material incentive can undermine the participants' rhetoric that they are 'doing good', to the extent that they will discontinue their recycling behaviour. Steininger & Voegtlin (1976) note this possibility, but feel that it unlikely to have a significant effect on the recycling rate "since those recycling might (be equally likely to) believe that they had served as models for the entire community in bringing about 'payment for recycled materials', and therefore, go on recycling". Other studies have also found commitment techniques to be quite successful (Pallack, Cook & Sullivan, 1980; Pallack & Cummings, 1976).

Katzev and Pardini found that the effects of a written pledge are greater and longer lasting than those of a verbal pledge. They also found public commitment more effective than private commitment (Katzev & Pardini, 1987). They believe that the effectiveness of commitment is due to several factors. It could be that once an individual has made a pledge, they fear disapproval if they fail to comply with its terms. This may be even more strongly felt in public or group commitments. Another feature of this type of contingency is that it deals very directly with the issue of recycling, perhaps making it less easy to ignore. There is possibly also another effect of such strategies. Once someone has made such a declaration, they may subsequently believe that since they were moved to do so, they must therefore be genuinely concerned about the environment and alter their behaviour accordingly. This is an example of what is called 'motive by account'.

Dunlap also states that intrinsic motivations such as concern for the environment would be sufficient incentive to recycle once an individual had satisfied their basic economic and other survival needs (Dunlap, Grieneeks & Rokeach, 1983). This refers to an idea championed by Maslow (Maslow, 1954) who created the well known hierarchy of needs (See Figure 5.2). This would predict that people will only recycle once they have fulfilled the needs that they perceive to be more important than such environmental concerns. As wealthier people could be said to have progressed higher up the pyramid of needs, this may explain their reputation for recycling more than their less affluent counterparts.

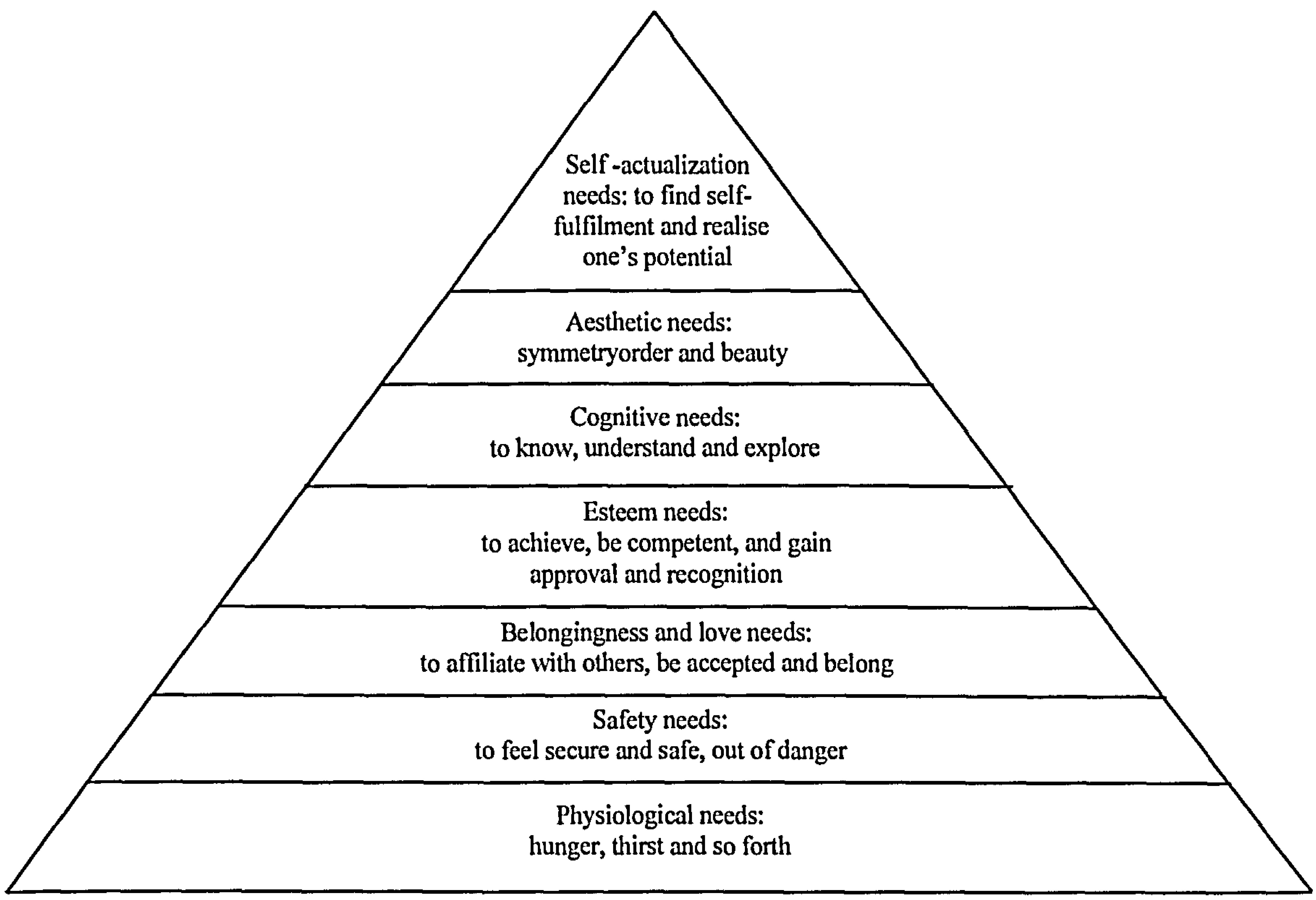

Figure 5.2 Maslow's Hierarchy of needs

It would not, however, explain the flourishing recycling industries of Egypt and India, described in Chapter 3, which are run by the poorest sections of the population, in a similar way to rag and bone men found in Britain earlier this century. What is certainly likely is that recyclers award lower order values to environmental issues than non-recyclers (Dunlap, Grieneeks & Rokeach, 1983). This ties in with the idea that those who perceive the personal consequences of environmentally damaging behaviour are more likely to recycle. Obviously, if an individual thinks that their health or standard of living will be impaired if current waste disposal practices are not changed, then recycling will be perceived as a low order value and therefore they are likely to change their behaviour accordingly. This train of argument is particularly hopeful as it would mean that making people more aware of, for example the health problems associated with landfill leachate or the increased future costs of landfill (converted eventually, it must be assumed to higher monetary contribution from the public) would move the recycling act further down the hierarchy of needs of many people and so increase participation and diversion.

Oskamp points out (Oskamp, 1983) that as well as perceived negative personal consequences of not recycling providing motivation to recycle, perceived negative personal consequences of taking part in recycling, for example effort, loss of comfort (especially in energy conservation), inconvenience or negative health factor may well prove to be a major disincentive to recycle.

Measures such as goal setting and commitment would be quite time and resource consuming to implement, in that they require each household to be visited individually. However, since no rewards or further administration are associated with these systems, they may prove less expensive and/or more cost effective over time that other modifiers.

5.5 Conclusions

There seems to be no overall agreement between these experts as to which method of behaviour modification produces the greatest increase in recycling behaviour. It does, however seem that the schemes which are successful are well designed, backed by a recycling policy whose development process has included community consultation, run by experienced individuals and which provide information and personal encouragement. All of these factors could be considered to be characteristics of schemes which are taken seriously and expected to succeed by their operators. The contrast between these schemes and the UK operations is striking in terms of both the attitudes and the resources invested in their success.

As with the promotion of any novel product or service, market segmentation research should be carried out in order to try to ascertain which groups or individuals should receive which sorts of promotional information (Vining & Ebreo, 1990). Research by O'Riordan and Turner has shown that attitudes amongst members of the public in this country are more positive in relation to paper than towards metals and glass (O'Riordan & Turner, 1979). Findings in Chapter 4 indicate that members of the public may have even greater reservations about the production, disposal and recyclability of plastics. These perceptions may well have implications for the design of promotional information. More research will be required to ascertain whether promotional techniques which have been adopted to encourage paper, metal and glass recycling will be effective for plastics. There is a need for extensive consumer research into the recycling of each of the four material groups before it can be assumed that the results generated by studies of one material can be applied to the others.

Over a decade ago, Geller (1981) advised that in order to introduce conservation behaviours on a large scale, the government should draw up a detailed plan which considered design, piloting and implementation of recycling services, in the way that the introduction of any other government policy would be prepared. The call for local authority recycling plans in *This Common Inheritance* (1990) could be interpreted as the inception of this sort of program. The information contained in the submitted plans could certainly serve as a basis for the sort of process advocated by Geller. The intention was not however one of generating information to assess the level of recycling activity so that recycling policy could be developed and implemented, but rather to focus the attention of the local authorities on the recycling target set in This Common Inheritance.

A similar view, couched in commercial rather that governmental terms is expressed by Fairweather and Tornatzky (1977) who are proponents of what they term "systematically planned dissemination" of environmental behaviours. This approach is also advocated by Darley and Beniger, who recommend that conservation techniques should be regarded as Innovations (1981). It is generally accepted that innovations in technology will require wide dissemination before they are accepted and reach their full potential. In many cases, an innovation will replace a traditional technology or behaviour and so consumers will need to be convinced of its usefulness and necessity in their lives. It is well embedded in human nature to be sceptical of change and reticent to leave old habits. Darley and Beniger (1981) suggest that the following dimensions are considered for the introduction of conservation behaviours (or any other innovation):

- Capital Costs of innovation
- Perceived Savings
- Certainty of Savings
- Value, Attitude and Style Compatibility of the innovation to the adopter
- The Innovation's requirements for changes in the adopter's life pattern
- Trialability (the innovation's ability to be tried out before an adoption decision is made)
- Dissatisfaction with the existing system
- Effort and Skill required in installing the innovation

Oskamp (Oskamp, 1983) criticises some of the work done in this area to date as being too ready to accept self reports of behaviour. Obviously, self reporting of an action like recycling which, as has already been shown, is endorsed by most of society, may be susceptible to both intentional and unintentional exaggeration and may not be representative.

Another criticism of the general methodology of these studies is that the conservation actions that are taken by the public in response to these schemes may not be effective in reducing overall environmental impact. Reducing the environmental impact of consumer behaviour is a primary goal for recycling schemes. However, in most cases, this is not measured directly. Diversion rates are measured instead, on the basis of the assumption that if diversion rates are increased, environmental impact will decrease. Whilst this is not always the case, the assumption can be justified on the grounds that assessing environmental impact is a complex and difficult exercise, expensive in terms of both time and money. The methodology involved in the calculation of environmental impact is also still subject to much debate within the academic community and the results generated by different studies may vary depending on the approach taken. Diversion rates, on the other hand, can be easily determined and are transparent and allow meaningful comparison between schemes. The environmental impact of a small or pilot recycling scheme is unlikely to be less than for previous waste disposal behaviours. There is however a need to persevere with these schemes despite this until environmental and economic economies of scale are achieved and the public progress further up the recycling learning curve.

One problem that appears to have been encountered by many of the techniques described above, particularly those involving extrinsic motivations, is that the effects that are produced by employing the behaviour modifier are only apparent for as long as the intervention state lasts. This is obviously a very big stumbling block for techniques which aim to make permanent changes in the waste disposal habits of a country. Humphrey et al report that, in general, behaviour is subject to satiation effects. This means that novel behaviour will always be regarded by the public as 'better' than mundane behaviour (Humphrey, Bord, Hammond & Mann, 1977). Perhaps any behaviour technique that is utilised would produce diminishing returns over its period of use. This highlights the importance of establishing recycling behaviours as part of a household's domestic routine.

5.6 References

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Chapter 6: An Ethnographic Study of Plastics Recyclers

6.1 Introduction

This chapter is concerned with the further study of some of the questions covered in, and raised by, the work discussed in chapters four and five. During the course of the research into the attitudes, perceptions and behaviours of both the users and non-users of the Glasgow and Falkirk plastics recycling systems, much was learned about the reactions of the public to both plastics and the schemes designed to recycle them as well as the research instrument itself. A huge amount of data was generated and analysed, but the responses to the questions which were intended to assess the motivation for participation in recycling schemes were disappointing, in that they did not seem to have been considered by, or conveyed the essence of the issue to the interviewees. The structured nature of the questionnaire did not allow these points to be embellished in a satisfactory manner, and in some cases, seemed to produce a bias.

Two things have been made clear by the study of the public reported in Chapter 4 and the review of the literature in Chapter 5: participation is a central issue in the success of recycling projects; it is not best studied using the statistical analysis of the output of a structured questionnaire.

A decision was therefore made to carry out a second study with an entirely different approach to both data generation and analysis, with the aim of pursuing some of these questions further and generating more data which would complement the original results and provide triangulation of both data and method (Denzin, 1970).

6.1.1 Objectives

The general aim of this chapter is to carry out exploratory research into the issues affecting the motivation of members of the public who recycle plastics. More specifically it will:

a) explore the public's perception of their scheme in order to assess whether or not certain aspects of the schemes are particularly important and, therefore, perhaps related to motivation levels;
b) discover in detail how individuals recycle their plastics.

6.2 Method

The research methods utilised were qualitative and were employed in order to attempt to develop an understanding of how plastics recycling was perceived and undertaken by the interviewees. The research was undertaken in the Falkirk area only, as this simplified both the identification of subjects and the practical aspects of the interview procedure.

6.2.1 Sampling

When using qualitative techniques, sampling is not carried out as a discrete stage in the research process as it would be in a quantitative study, but rather is woven into and directed by the research thread. It is also based on events rather than people, so that one person may provide samples of four or five different phenomena, whilst the next may give several examples of the same one.

There were two main influences on the choice of subjects: those people who represented phenomena thought to be relevant from the results of the previous study; and those who represented phenomena suggested to be important by the literature.

The sampling technique employed was based on Gummesson's interpretation (Gummesson, 1992) of "Theoretical Sampling" (Strauss & Corbin, 1990). In this method, people are chosen whom the researcher believes will provide insight into the situation under study. For example, since it was felt that individuals who already showed their environmental concern by their actions would represent such a key case, someone who was involved in practical conservation work was chosen. In this case, the informant also represented the dissatisfied customer, someone who had tried the scheme, but had become unhappy with certain aspects of it and had subsequently stopped saving plastics for recycling. Once the categories that are generated become saturated, the theory is complete and sampling stops.

Most of the interviews were done with children. This approach was chosen for a number of reasons. One of the main promotional strategies for the Falkirk scheme involved a series of school visits which provided classes with an explanation of and instructions for the newly launched scheme. The involvement and encouragement of children in plastics recycling is particularly important as they represent the generation for whom the EC directives will become a reality. It was also felt that interviewing children would provide a practise medium for the interviewer and that some of the 'card games' included in the research design would particularly appeal to children of primary school age. Furthermore, as children may not have the same level of social awareness as adults, they may therefore not feel under the same pressures to provide environmentally sensitive answers as were felt to be operating in some of the answers given to the survey in chapter 4. This frees them to relate their true experiences and impressions of the scheme.

Children are also less sophisticated in their use of language to explain concepts. They share some of the misconceptions held by adults, but present them in such a way that it makes it easier for the researcher to comprehend and isolate them.

The most important reason for choosing children as interview subjects is that they help the researcher in her pursuit of the 'stranger's' viewpoint. One of the concepts central to qualitative research is that in order to learn about the world from the perspective of others, the researcher must take the rôle of the 'stranger' (Schutz, 1964). This enables the researcher to question the system under study in such a way as to allow the interviewees to provide a detailed and thorough explanation of their perspective: The stranger, the researcher in this case, "becomes essentially the man who has to place in question nearly everything that seems to be unquestionable to the members of the approached group" (Schutz, 1964).

In society, children represent the spontaneous stranger. They are still learning the rules of their social environment and therefore can provide more explicit insight into its operation than adults who may have stopped learning and questioning these rules and so take them for granted and find them more difficult to articulate.

The groups of children were selected from two different years of Bantaskin Primary School. The school catchment area includes a number of areas served by the Scottish Conservation Projects collection beats. The age groups chosen for this exercise were primary 4 (8 year olds), and primary 7 (11 year olds). These two age groups were selected, in consultation with an educationalist, as it was hoped that they would strike a good balance between including children who could provide a strong example of the 'stranger' viewpoint, as well as those who would be most likely to be involved in helping with the processing of the plastic bottles in their households. Permission to interview the children was sought from the head teacher, who also provided a room in the school where the interviews could be held. The class teachers selected individual students who had experience of recycling plastics.

In order to identify a scheme user who was actively involved in conservation, contact was made with another part of Scottish Conservation Projects which is involved in practical conservation projects locally. The interviewee was identified by them as a regular volunteer who lived within the catchment area of the recycling scheme.

6.2.2 Interviews

The method for gathering data in this study was the unstructured interview. Much of the technique was developed from the interview methodology described in *The Ethnographic Interview* (Spradley, 1979). This provided an underlying format for the questioning which proved extremely helpful to a researcher unfamiliar with these techniques.

Spradley is a Structuralist. Structuralists believe that "the true nature of things may be said to be not in things themselves, but in the relationships which we construct, and then perceive between them" (Hawkes, 1977). They therefore seek the meanings of phenomena by analysing the ways in which we organise them. This can be seen in the design of Spradley's scheme of interview questions.

Spradley outlines three groups of question (Spradley, 1979):

> *Descriptive Questions* which ask the interviewee to describe an object, time, space, person, activity or event. These are used initially to set the scene from the point of view of the interviewee and familiarise the interviewer with their language and experience;
>
> *Structural Questions* attempt to discover how information is organised by the informant. They help to identify which of the items or concepts described by the informant can be grouped and how these groups and the elements within them are related to each other;
>
> *Contrast Questions* are used in the later stages of the interview process to assess the meaning of the various terms or groups to the person who has described them, by focusing their attention on the similarities and differences between them.

The interviewees were asked at the outset of the interview to relate their experience of the plastics recycling scheme. This is termed a "Grand Tour" question (Spradley, 1979) which is a type of descriptive question. It was explained to the informant that the object of the interview was to understand the recycling scheme from their point of view. It was added that if they touched on things that seemed not to be fully developed or understood by the interviewer, then they may be asked to expand or explain these things later in the interview. This technique allowed the interviewees to describe their experiences as they occurred to them. It also minimised interviewer input and thus the potential for bias. The narrative that is generated therefore represents the most obvious or salient properties of the scheme according to each person interviewed. Giving the interviewees the initiative in this way leads to valuable insight into their own point of view and value systems, which was not preserved in the previous study.

Once the framework had been established, the informant was pressed for more detail or depth. This was done using three main methods:

1. using mini tour questions to enlarge on something that the informants had touched upon in the narrative given in response to the initial grand tour question. For example, if they mention that they rinse bottles as part of the recycling process, they would be asked how they went about doing this;

2. employing structural questions of various kinds to confirm and uncover relationships between some of the activities and objects mentioned in the grand tour. Some of this work was done by writing the names of items or stages mentioned in the answers to the descriptive questions on to index cards and asking the interviewee to group and order them in different ways. A full set of the cards

used, and examples of their use can be found in Appendix 13. For example, the informants might be asked to sort a pile of cards which represented all the things that they had classed as recyclable into piles according to some criteria of their own choice. Another way in which cards were employed was by asking the informants to sort cards which represented all the various stages that the informants had outlined as being necessary in the recycling process, into the order that they usually carried out these tasks;

3. again using cards, the 'dimensions' (Strauss & Corbin, 1990) of some of the recyclables were established by using contrast questions. This was done by mixing up all of the cards which had the names of all of the recyclables that the interviewee had mentioned written on them, laying out three and asking the interviewee to identify a property which two of the recyclables shared, but that the third did not. This is repeated for as many different combinations of recyclables as possible. This approach has its origins in personal construct theory (Kelly, 1955). It was developed by Bannister and Fransella (1993) as part of their Repertory Grid technique.

The interviews were all taped, with the permission of the interviewee and subsequently transcribed verbatim. Each of the respondents was interviewed more than once in order to provide time for the interviewer to listen to the first interview in great detail and pick up the themes and terms which seemed to be under-developed the first time round.

The children were initially interviewed in groups of three in order to minimise any apprehension they might have about the interviewer or interview format. This made transcription difficult, but eased the flow of useful information by emphasising the fact that value was given to all answers and that the interviewer was not pursuing a 'right' answer, as each informant was encouraged to relate his/her own individual experience. The use of two interviews also helped to prevent their attention wandering from the subject before all the useful data was collected.

Since the scope of this study was quite narrow, it was possible to generate enough information to provide an ethnographic analysis from a relatively small number of interviews. The final sample size for this study was 7, with 4 of the participants being interviewed twice.

6.2.3 Coding

Once all of the data has been transferred from tape to word processor, they can be analysed in great detail. In order to facilitate this traditionally long and complex manual task, a piece of software called *The Ethnograph* was used.

6.2.3.1 The Ethnograph

This system allows the transcribed interviews to be translated from the word processor format into a numbered document which can then be coded. Codes are entered by attaching an eight letter 'name' to one or several lines of text which identifies the subject of those lines. Codes may be altered, nested or amalgamated in any number of ways, giving a great deal of flexibility to the researcher whilst the original transcription remains intact. These features have proved to be powerful assets in the analysis of the interview transcriptions.

6.2.4 Analysis

Two different systems of analysis were utilised in the search for an appropriate method of examining the data. The first method adopted was a Grounded Theory approach.

6.2.4.1 Grounded Theory

This is a method of analysing data qualitatively. It was created by Barney Glaser and Anselm Strauss in their work with patients with terminal diseases (Glaser & Strauss, 1967). This method provides a rigorous system of analysis which produces theory wholly grounded in the data collected.

There are three main activities involved in this process:

> "*Open Coding:* The process of breaking down, examining, comparing, conceptualising, and categorising data...
>
> *Axial Coding*: A set of procedures whereby data are put back together in new ways after open coding, by making connections between categories. This is done by utilising a coding paradigm involving conditions, context, action/interactional strategies and consequences...

Selective Coding: The process of selecting the core category, systematically relating it to other categories, validating those relationships, and filling in those categories that need further refinement and development."

(Strauss & Corbin, 1990)

There is no fixed path through these stages, rather the researcher moves backwards and forwards between them as the research thread dictates, eventually ending up with a grounded theory.

This method was initially selected as it provides an explicit framework of analysis which is both established and rigorous. This lends much support to the beginner and provides many ways of becoming aware of and overcoming personal bias which may otherwise colour or direct the research. This process has been termed developing "Theoretical Sensitivity" (Strauss & Corbin, 1990). Another feature of this technique is that it encourages the researcher to take account of "Process" (Strauss & Corbin, 1990). This means that, for example, particular attention is paid to incidents which change the normal course of an event. The causes and consequences of such incidents are also studied, adding a dynamic dimension to the study

6.2.4.2 Ethnography

The Ethnographic approach follows a similar analysis pattern to that of Grounded Theory, but focuses more specifically on the semantic relationships employed by the informant. To complement the three question types described above, there are three levels of analysis:

6.2.4.2.1 Domain Analysis

This is the primary analysis level. Spradley advocates that the route to developing an understanding of the social phenomena that the ethnographer seeks to study, lies in becoming familiar with and analysing the language of the informant. This is done by utilising the Universal Semantic Relationship, which is a grammatical pattern or rule, found in all human language, as a tool to aid the process of analysis. Spradley outlines nine Universal Semantic Relationships. These are:

Strict Inclusion	(X *is a kind of* Y)
Spatial	(X *is a place in/part of* Y)
Cause-Effect	(X *is a cause/result of* Y)
Rationale	(X *is a reason for doing* Y)
Location for Action	(X *is a place for doing* Y)
Function	(X *is used for* Y)
Means-End	(X *is a way to do* Y)
Sequence	(X *is a step/stage in* Y)
Attribution	(X *is a characteristic of* Y)

A term which has the same semantic relationship to several other terms is called a "cover term". This is symbolised in the list of generic semantic relationships above as Y. The group of words that it relates to are called "included terms". The included terms are represented in the above list of semantic relationships as X. During the domain analysis, the interviews are read over and all possible cover terms and included terms are entered on to a domain analysis worksheet. An example of a blank domain analysis worksheet, as used in this study, can be seen in Figures 6.1, whilst a completed one is shown in Figure 6.2.

DOMAIN ANALYSIS WORKSHEET

Semantic Relationship

Form

Example

Included Terms	Semantic Relationship	Cover Term

Structural Questions

Figure 6.1 A blank domain analysis worksheet

DOMAIN ANALYSIS WORKSHEET

Semantic Relationship	*Strict Inclusion*
Form	*X is a kind of Y*
Example	*a Siamese is a kind of cat*

Included Terms	Semantic Relationship	Cover Term
Irn Bru		
Pepsi		
Orangina		
Lemonade		
Tango		
Cola		
Lucozade		
7up		
Vimto	*is a kind of*	*big juice*
Orange Crush		*bottle*
Cream Soda		

Structural Questions: *Are all of these big juice bottles?*

Can you think of any more big juice bottles?

Figure 6.2 A completed domain analysis worksheet for the domain kinds of bottles

The worksheet format shown in Figures 6.1 and 6.2 provides a systematic and comprehensive method for recording each domain in a format which will aid the completion of the domain analysis as well as the subsequent stages of analysis. The space left at the bottom allows the ethnographer to take note of any structural questions which can be used in the next interview both to confirm the domain information already noted, and to discover structure within the domain. This leads on to the next stage of analysis.

Examples of domains found for each of the Universal Semantic Relationships are given, as examples, in Appendix 14.

6.2.4.2.2 Taxonomic Analysis

The next stage of analysis uses the results of the domain analysis and the structural questions to build taxonomies. These show the hierarchical structure of the included terms in a domain. They begin the exploration of how the various concepts that are represented by the included terms relate to each other and to the cover term. Figure 6.3 shows part of the taxonomy which evolved from the Plastic Bottles domain.

6.2.4.2.3 Componential Analysis

The idea of this stage of the process of analysis is to bring together the information collected. This is done by utilising a third type of diagram, the paradigm. Until now, the analysis has focused on the similarities between the concepts that have been described by the interviewees. In order to enhance the understanding of the meaning of these concepts, the ethnographer

Plastic Bottles	Juice Bottles	Wee Juice Bottles	Vimto
			Irn Bru
			Orange Crush
		Medium Juice Bottles	Kia-ora
			Blackcurrant
		Big Juice Bottles	Irn Bru
			Pepsi
			Orangina
			Lemonade
			Tango
			Cola
			Lucozade
			7up
			Vimto
			Orange Crush
			Cream Soda
	Shampoo Bottles	Own Brand	Asda type
			Safeway type
			Tescos type
		Brand Name	Timotei
			Head & Shoulders
			Scottish Fine Soaps
	Household Cleaning Materials	Abrasive	Jif
			Flash
			Ajax
		Laundry Liquids	Ariel
			Bold
			Persil
		Spray Bottles	Milton Disinfectant
			Dettox
			Johnson's

Figure 6.3 Part of the Taxonomy Kinds of Bottles

now focuses on the differences between them. This is done using the taxonomies that were constructed in the last stage of analysis and the answers that the informants give to the contrast questions. An example of a paradigm is shown in Figure 6.4.

Contrast Set	Dimensions of Contrast			
	Top	Colour	Size	Handle
Milk	Screw on	White	Big	Yes
Mineral Water	Screw on	Blue	Big	No
Foam Bath	Squooshy	Green	Medium	No
Irn Bru	Screw on	Clear	Big	No
Deodorant	Roller	Clear	Wee	No
Vimto	Screw on	Clear	Big	No
Big Kia-ora	Screw on	Clear	Big	Yes
Timotei	Flip	White	Wee	No
Pepsi	Screw on	Clear	Big	No
Softener	Screw on	Blue	Big	Yes
Tango	Screw on	Clear	Big	No
Orangina	Screw on	Clear	Big	No
Cola	Screw on	Clear	Big	No
Dettox	Spray	Clear	Medium	No
Head & Shoulders	Flip	White	Wee	No
7up	Screw on	Green	Big	No
Lucozade	Screw on	Orange	Big	No
Blackcurrant	Screw on	Clear	Medium	No
Lemonade	Screw on	Clear	Big	No
Asda Shampoo	Screw on	Clear	Medium	No
Cream Soda	Screw on	Clear	Big	No
Orange Crush	Screw on	Clear	Big	No
Aspirin	Screw on	Brown	Wee	No

Figure 6.4 A partial paradigm of Plastic Bottles

Having carried out these stages of analysis, the data gathered in interview has been systematically processed into a representation of the language used and understood by the interviewee. This data set can then be used to write an ethnography.

Spradley's Developmental Research Sequence methods have many of the advantages that were also found in the Grounded Theory methods. The analysis process has been made more straight-forward and more methodical by the breaking down of the process into discrete, but interrelated tasks. The techniques both promote the understanding of the situation from the point of view of the informant rather than the person carrying out the study. They are also similar in the rigour and guidelines they provide for the first time qualitative researcher.

Another similarity between the methods lies in the advised starting point of the researcher. Spradley advocates that, "The most productive relationship occurs between a thoroughly enculturated informant and a thoroughly unenculturated ethnographer". This ideal state was not possible in this case for two reasons. The first is that when the interviews took place, the recycling scheme in Falkirk had only been operational for around eighteen months, which does not allow enough time for thorough enculturation. Secondly, the arrival at the discovery of the problem under study in this chapter was made through a course of literature review, quantitative survey and field work, which rules out thorough unenculturation. These are however, not prohibitive circumstances for a good ethnography in this area.

While both Grounded Theory and Ethnography are concerned with creating 'emergent' or 'grounded' theory from the data, and both advocate that preunderstanding (Gummesson, 1992) must be both declared and considered, Spradley's question design provides a formal method of dealing with the perspective that the ethnographer inevitably brings to the data. The analytic structure provided facilitates the researcher in the suspension or bracketing of preconceptions, expectations and usual ways of thinking about the subject under study. This epoche of the researcher's personal reality aids the exploration of the informants' perspective. The focus of the Ethnographic methodology also seemed to be more readily adjusted to the narrow range of behaviours relevant to this study.

There was a number of reasons for the selection of the Ethnographic methods for this study. The initial reason for employing the Spradley methodology was that, unlike most of the texts written for the guidance of the beginning ethnographer (including Grounded Theory), a methodology for obtaining, as well as analysing, the data was presented. Perhaps the most important reason for continuing with Spradley's methodology beyond the data collection stage was that, despite the investment of time in the Grounded Theory analysis, the interpretation of the data obtained by following the initial steps of Spradley's Developmental Research Sequence proved extremely problematic using a second methodology. Having completed the open coding stage using the Grounded Theory analysis format, it was found very difficult to proceed to the axial coding stage. Unfortunately, it seems that the two techniques were not as compatible as was originally hoped. Spradley's ethnographic methods were therefore selected as they provided a more powerful, transparent, accessible and explicit form of analysis.

6.3. Results

In Conformity and Conflict, Spradley states that "The methods of ethnoscience are designed to map culturally shared systems of knowledge" (Spradley & McCurdy, 1977). They have been utilised in this study, not to understand or represent a whole lifestyle, but to analyse the actions, perceptions and feelings which relate to a very small part of a lifestyle. Since the domestic reality of preparing plastics for recycling is just a small piece of what are very complex lives, and it is neither long established nor publicly discussed, there is no 'recycling culture' common to all participants which can be unearthed by an ethnographic study. Different people have related different minutiae from their recycling experiences. However, what this piece of work focuses on are the common threads which run throughout these experiences and what can be learned from these for the future of recycling.

During the course of the interviews with the various informants, two main foci for discussion of the plastics recycling scheme emerged. The first was the range of bottles that could be recycled, their characteristics and their relationships both to each other and to the recycling process. It soon became clear that the various bottles were categorised by the recyclers mainly by their contents (See Figure 6.5).

Perhaps this seems obvious, as the bottles are packaging products and are therefore inextricably linked with the product they protect. Few people would buy a plastic bottle full of Coca-Cola with the primary intention of owning a plastic bottle. However, when talking to those who collect, sort and reprocess the bottles, the primary classification property of a bottle is the polymer from which it was made. An example of this approach

Plastic Bottles	Juice Bottles	Wee Juice Bottles	Vimto
			Irn Bru
			Orange Crush
		Medium Juice Bottles	Kia-ora
			Blackcurrant
			Wine
			Scotch Juice
			Cartons of Juice
		Big Juice Bottles	Irn Bru
			Pepsi
			Orangina
			Lemonade
			Tango
			Cola
			Lucozade
			7up
			Vimto
			Orange Crush
			Cream Soda
	Milk		
	Mineral Water		
	Jam		
	Donut Tray		
	Mousse Tub		
	Butter Tub		
	Yoghurt Tub		
	Shampoo	Own Brand	Asda type
			Safeway type
			Tescos type
			Scottish Fine Soaps
		Brand Name	Timotei
			Head & Shoulders
	Hand Cream		

	Moisturising Body Lotion		
	Shower Gel		
	Foam/Bubble Bath		
	Deodorant		
	Aftershave		
	Anything From The Chemist	Medicine	
		Pills	Paracetamol
			Aspirin
	Household Cleaning Materials	Washing Up Liquid	Fairy
			Excel
		Abrasive	Jif
			Flash
			Ajax
		Laundry Liquids	Ariel
			Bold
			Persil
		Softener	Lenor
		Spray Bottles	Milton Disinfectant
			Dettox
			Johnson's

Figure 6.5 Kinds of Bottles

to categorisation can be seen in the Falkirk information leaflet in Appendix 5 of Chapter 4. This categorisation system is meaningless to the consumer, despite the attempts of manufacturers to label bottles with the polymer types and SPI codes. Even when mention was made of the different types of plastic, the recyclers found it very difficult to describe the differences that they perceived. Figure 6.6 shows the domain worksheet for types of plastic. Informants also had trouble grouping the plastic types into general categories, feeling that there was a huge amount of variety; "they are all different types".

DOMAIN ANALYSIS WORKSHEET

Semantic Relationship	*Strict Inclusion*
Form	*X is a kind of Y*
Example	*a Siamese is a kind of cat*

Included Terms	Semantic Relationship	Cover Term
Firm		
Thicker		
Simulated Glass		
Softer		
Harder		
Sort of		
crumples when		
the cap's off		
	is a kind of	*type of*
		plastic

Structural Questions

Figure 6.6 A completed domain analysis worksheet for the domain kinds of types of plastic

This discovery, that the informants categorise the bottles that they recycle by contents, can be put to use in the design of literature provided by a recycling scheme. In order to ensure that the widest possible range of bottles is included in the recycling bag, further research could be done to see if there is a particular way of categorising the bottles which is universally meaningful.

It is interesting to note from the full taxonomy shown in Figure 6.5 that a number of contraries have been included as part of the list of 'plastic bottles' described by the informants. These are items which have been included by the children, who seem to see no difficulty with describing butter tubs, for example, as plastic bottles. They remember that it is only plastic bottles may be recycled, but simply expand their definition to include items they think ought to be similar enough to be recyclable. Perhaps there is a case for not only stating what it is that the scheme **can** recycle, but also what it **cannot**. The mention of bottles which are made from glass (e.g. Wine) also demonstrates that the children are not necessarily in the habit of distinguishing between the materials used for packaging.

Another grouping method that was used by the informants in this study was to group the bottles by the places they would be kept during their lifetime as a package. The two primary classifications here were 'kitchen' and 'bathroom', with some informants dividing 'kitchen' into 'cupboard' and 'fridge' (See Figure 6.7). Although some of this will vary with the topography of each home, as can be seen from the inclusion of 'Softener' in both 'Kitchen' and 'Bathroom', representing the different storage habits of different informants, there may well be universal elements to be found. Perhaps relating the bottles to where they are kept, or even to the groupings imposed by the supermarkets would be a useful and universal categorisation to use in literature.

<table>
<tr><td rowspan="14">House</td><td rowspan="6">Bathroom</td><td colspan="2">Handcream</td></tr>
<tr><td colspan="2">Shower Gel</td></tr>
<tr><td colspan="2">Foam Bath</td></tr>
<tr><td colspan="2">Deodorant</td></tr>
<tr><td colspan="2">Aftershave</td></tr>
<tr><td colspan="2">Softener</td></tr>
<tr><td rowspan="8">Kitchen</td><td rowspan="5">Cupboard</td><td>Jam</td></tr>
<tr><td>Big Juice</td></tr>
<tr><td>Medium Juice</td></tr>
<tr><td>Wee Juice</td></tr>
<tr><td>Softener</td></tr>
<tr><td rowspan="3">Fridge</td><td>Mineral Water</td></tr>
<tr><td>Milk</td></tr>
<tr><td>Donuts</td></tr>
</table>

Figure 6.7 Where Things are Kept Domain

Another way to bridge this gap between the perception of the individual recycler and that of the collectors and reprocessors is to educate the public to distinguish between the three main polymer types. This can be done either by identifying the different properties of the different polymers, or by emphasising the existence of the SPI codes. The advantage that this would have over the search for a universal classification system is that it is much less time consuming and potentially more accurate and universal. On the other hand, it may alienate many who are not comfortable with the difficult names used for the different polymer types. It would need to be presented in a very innocuous manner.

Another categorisation made by one informant was that some of the bottles were put out 'every fortnight', some 'periodic', and some 'few and far between' (See Figure 6.8). This meant that there were more of the first category around the house, which made them 'obvious'. The reason that there were fewer of some bottle types was that it takes a longer time for the contents of some bottles to be used up than others. Being 'not so obvious' has two effects on a bottle: it is more difficult to recognise as a recyclable plastic bottle in the first place, and it is more difficult to remember to recycle it when it is empty. Literature associated with the scheme should try to take this into account and prompt both recognition and memory of the less 'obvious' bottle types. After all, many of the bottles included in the category of infrequent recyclables are the household cleaning materials bottles which are made from HDPE.

Bottles	Every Fortnight	Milk
		Big Juice
		Foam Bath
	Periodic	Shampoo
		Hand Cream
		Household Cleaning Materials
		Moisturising Body Lotion
	Didn't Immediately Present Itself as A Plastic Bottle	Anything From The Chemist
	Sometimes Put Them In	Deodorant
		Timotei

Figure 6.8 How Often Things are Recycled Domain

A further system of categorisation adopted by several of the informants was related to how easily the bottles were cleaned. With this system, bottles were deemed easy to clean, quite easy to clean, quite difficult to clean, or difficult to clean, depending on the absence and/or presence of a number of properties. The properties which make a bottle difficult to clean are not being able to see through it, having sticky contents, having a wee nozzle, and having something stuck in the nozzle. A bottle could have a combination of properties which included some negative ones, but still be easy to clean. These features are therefore not individually responsible for making an item easy or difficult to clean. What seems to be important is the mixture of features present. For example, it is more difficult to clean a bottle if it has a wee nozzle, but a wee juice bottle, which is recorded as having a wee nozzle is categorised as easy to clean. This is because none of the other features which would make it difficult to clean are present.

This sort of information should be used to aid manufacturers in the design of bottles. Design for recyclability is a concept which has made a big impact in the production of products like motor cars, washing machines and other consumer durables over the last few years (Nussbaum & Templeman, 1990). Surely there is a case for such considerations to be brought into the design process of packaging products which, after all, have a much shorter life span. Features like labels that peel off, detachable nozzle inserts, screw-off tops and pouring spouts rather than fixed ones, and wide necks for easy rinsing would make the process of recycling much simpler for the householder and pose less contamination problems for the processor.

The second focus of discussion with informants centred around the different stages of the recycling process. When asked about the scheme, the informants invariably launched into a description of the various strategies they had for carrying out the tasks associated with the operation (See Figure 6.9). These strategies did vary between households, but not significantly. Some people use a brush or cloth to clean their bottles, especially if they had sticky contents, whilst others relied on fast running water to remove traces of contents. All agreed that there was a difference between the way they rinsed their bottles and the way they would wash dishes, "I didn't wash them properly, just rinsed them to make sure that, whatever the contents had been, they were no longer in the bottle". Some of the informants did not receive green bags, but participated by contributing to the collection taken from the house of a relative.

In the decisions that affected each of the different strategies for the various processing stages, lay a trade off between the contribution made by each bottle and the time and effort involved in processing it. This was expressed by one informant who felt that she'd "got to be mad" to stand and clean the tiny shampoo and handcream bottles. She also categorised the big juice bottles as being 'worthwhile', showing that she felt that the amount of plastic salvaged by processing each one was worthy of the amount of her time that it had taken to make it ready for collection.

It was mentioned earlier that one of the informants was chosen because of her practical conservation background. It is interesting to consider whether or not the motivation for recycling is similar to the motivation for conservation. This informant used the idea of an operation being 'worthwhile' in terms of the a person's time and effort to compare these two types of environmental action. She described her conservation work as a 'constructive' process, but recycling as a 'destructive' one. Her sense of contribution was her reward from her practical conservation work. As far as recycling was concerned, however, "If it had been something constructive rather than destructive, this is the way I was looking at it. I wasn't looking on it as a constructive exercise. From a housewife's point of view, getting rid of these things is a destructive exercise because you are disposing of these things, you no longer want them, and whereas if I had looked at it...from a constructive point of view I would have been saying, Oh yes, these are going to more important things, then I maybe would have taken more time over it".

Another problem that was touched on by one of the informants was the difficulty of ascribing a value to the plastic bottles which justified the amount of time they had to spend processing them. She said that "It was a great deal of hard work as far as I was concerned because it was something I was throwing out".

One of the things that the literature supporting plastics recycling schemes could include is a system overview which allows a perspective to be gained on the importance of plastics recycling. It could emphasise the importance of each contribution and the value that the plastics had for both the reprocessors and in terms of the environment.

There are two groups of rules that are followed by the informants: explicit instructions which have been outlined by those organising the collection of the recyclables; and implicit rules which are either interpretations of the explicit instructions, or additions of the householder. Figures 6.9 and 6.10 show the stages in recycling as described by the informants and the list of instructions given by the collectors respectively.

<table>
<tr><td rowspan="26">do bottles</td><td colspan="4">get green bag</td></tr>
<tr><td colspan="4">take in green bag</td></tr>
<tr><td colspan="4">empty bottles</td></tr>
<tr><td colspan="4">collect bottles</td></tr>
<tr><td rowspan="16">clean</td><td colspan="3">take off bottoms</td></tr>
<tr><td colspan="3">take off whole tops</td></tr>
<tr><td rowspan="3">take out ball</td><td colspan="2">put it on the ground</td></tr>
<tr><td colspan="2">put foot in the very corner</td></tr>
<tr><td colspan="2">jump on it</td></tr>
<tr><td colspan="3">take off lids</td></tr>
<tr><td rowspan="2">take seal off</td><td colspan="2">pull it up and down</td></tr>
<tr><td colspan="2">cut with scissors or a knife</td></tr>
<tr><td rowspan="5">take label off</td><td>take off price</td><td>pick it off</td></tr>
<tr><td rowspan="4">take off the product label</td><td>pick whole lot off</td></tr>
<tr><td>get a corner</td></tr>
<tr><td>tear whole thing off</td></tr>
<tr><td>soak</td></tr>
<tr><td rowspan="3">rinse</td><td colspan="2">turn it under the tap</td></tr>
<tr><td colspan="2">gradually the mess comes out</td></tr>
<tr><td colspan="2">use a wee brush or a cloth</td></tr>
<tr><td colspan="4">squash bottles</td></tr>
<tr><td colspan="4">put them in the green bag</td></tr>
<tr><td colspan="4">tie up the green bag</td></tr>
<tr><td colspan="4">put the green bag outside</td></tr>
<tr><td colspan="4">give the green bag down to Gran's</td></tr>
<tr><td colspan="4">man comes to collect them</td></tr>
</table>

Figure 6.9 Taxonomy of instructions as related by informants (stages in doing bottles)

plastic bottle collection instructions	pick up bag
	collect plastic bottles
	remove tops
	wash out
	tie off bag
	put bag out

Figure 6.10 Taxonomy of instructions given by SCP

As can be seen, the processing of the bottles is seen as a much more complex set of interrelated tasks by the recyclers than by the collectors. A few of these operations are also interpreted in several different ways by the householders, showing that the set of instructions given to them was far from exhaustive. For example, one informant felt that plastic deodorant bottles were not recyclable as she could not remove the roll-on tops and comply with the instructions. However, another person said "I put it on the ground when it's all finished and I put my foot right in the very corner and just jump on it and the ball just gradually comes out". He had therefore deemed the deodorant bottle recyclable. In a similar way, one informant decided that if tops were not to be included, then all attachments to the bottles must be removed, "because the plastic in these...was probably a lot similar to the tops". This included the cups that the PET bottles sit in and the seals that form part of the bottle top before it is opened for the first time. This was because she felt that "anything foreign to the actual product that they were looking for would hamper the recycling process". There were also certain instructions that the householders would supersede with information from another source. For instance, one of the people interviewed had decided that she would not include bleach bottles in her green bag, "because you had to take the lid off, and even though it was being rinsed out and all the rest of it, I balked at that one...it had at one time contained a dangerous substance and therefore, it was safest with the lid still on it and in the bin...rightly or wrongly, that's how I felt it was safest". All of the informants in this study had interpreted the instruction "wash out bottles" to include the removal of their labels.

This information can be used to generate a more full and helpful set of instructions. This would help remove the onus for making decisions about what can and cannot be recycled out of the hands of the householder, avoiding much worry and confusion. The evidence here of the many different strategies adopted by different householders also suggests that information could be provided as to the best way to go about the processing tasks. Schemes setting up in a new area may even like to hold a community workshop to demonstrate the processes to those concerned or unsure about the procedure. The important thing is to provide some form of support for the householder who has queries or doubts regarding the instructions.

Another gulf between the way in which the instructions for processing are regarded by the processors and the householders lies in the importance attached to them. The rules that surround the scheme and the strategies that the individuals adopt for achieving them are of paramount importance to those who contribute the plastics. To the processor, the same instructions represent a number of desired outcomes which they neither particularly stress in the literature, nor police, nor even really expect from the householders. In fact, they seldom refer to the instructions, except to comment when a batch of plastics being sorted is particularly unpleasant.

For the householder, the domestic reality of providing bottles for the recycling process is of more significance and importance than the object of the scheme. Notions of reducing landfill, for example, are provided if the reasons why they think the scheme was started are pursued, but if interviewees are simply asked to describe the scheme, the first topic of discussion covered is that of the instructions.

It was mentioned above that the householders were not supplied with any information which gave reasons why the various instructions should be carried out. This has led in almost all cases to those involved in the processing of the bottles ready for collection inventing what they believe are the reasons for being asked to undertake the various tasks. For the rinsing operation, these ranged from assumptions that the bottles must be washed out because otherwise, "you might get germs", or "if it's milk, it'll start to go off... if there are dribs and drabs of shampoo and all what have you, I don't know whether the chemicals in these would start mixing with the chemicals in the plastic". The children were particularly inventive, one informant said that, "BP has got a recycling box...they put them through the machines and reuse them all again" and another added that "they get washed again but you can't get inside the bottles 'cause they're squashed", and that this was why you had to clean the insides of the bottles. One informant thought that having to tie up the bag was "fair enough" because otherwise there would be "plastic bottles right down the street and blown to Linlithgow"

Obviously the householders have considered the reasons behind the instructions, and adopted some of their own to explain the necessity of carrying out the different operations. It may well prove of interest and value to those asked to follow the instructions to have the reasons which lie behind the instructions explained to them, however briefly. This gives justification to their actions and also to the fact that they have been asked to do particular things. As one informant said, "I felt that if they said don't leave tops on or labels or whatever, there must have been a reason for it".

Plastics recycling is a relatively new addition to the list of domestic chores. For those who carry out this operation, it represents a change in the way they process domestic rubbish. Many of the ways which householders carry out domestic tasks, such as washing dishes or cleaning shoes, have been learned from older members of their household when they were young. These tasks can be carried out using what Schutz (1964) describes as "Thinking-as-usual". There are, however, no existing rules from parental sources for plastics recyclers to follow. Instead, they must borrow rules from other domestic operations, or make new ones.

This means that the recycling practice will vary between households as each individual makes decisions about the interpretation and application of the instructions that they have been given. Since the processing of the bottles for recycling is done in the privacy of the home, there can be no public scrutiny or evaluation of the different decisions made or methods used. There did not appear to be any evidence of discussion of the 'fuzzy' areas between households.

The act of contributing to a recycling scheme which is organised via a kerbside collection is one which is highly visible. The presence or absence of your green bag shows those who live nearby clearly whether or not you participate in the scheme. The green bags of others also act as a reminder to householders to put their own bags out. This means that the status of 'recycler' may be earned by those who put out their bags. The social approval which is gained by this act does not however extend to the state of the contents of each bag. So, although both participation and 'proper' processing of recyclables might be social expectations, only the act of participation can be verified by others and therefore provide status. Whether or not the bottles have been cleaned and squashed is then a matter for the conscience of the individual.

Social expectation was alluded to by the informants on numerous occasions by the use of terms such as "ought", "must" and "had to" when referring to the instructions or stages of processing the plastic bottles.

The concepts of social expectation and the earning of social status via certain behaviours is a universal feature of society. Perhaps the recycling organisations could take advantage of these phenomena by attempting to increase the perceived social status or reward for those who recycle.

The literature reviewed in the previous chapter gave many instances of convenience being an important factor in the design of recycling schemes. Some of the procedures described by the householders for processing some of the items they put out for recycling are far too complex and variable to be attributed the label of 'convenient'. One of the informants commented that "I felt it was more than the whole process was worth as far as my time was concerned". If these processes are to become more convenient, part of the change must lie with the design of the bottle. Simplifying the range of bottle shapes and raw materials has been taken to a new level in Denmark, where they have introduced one basic bottle shape which is coloured blue for non-food use and green for food use. This sort of step will never come of its own accord, but will require governmental support in the form of prescriptive legislation. However, smaller steps may be made by the manufacturers themselves in the absence of such legislation. One of the bottles that one of the informants reported as being unrecyclable during the interviews of early 1993 was the Timotei bottle. The reason for this was that the lid, which looked as though it was a screw top, was actually fixed to the neck of the bottle. The shampoo came out through a flip top which was part of this lid. "I didn't put these in because I couldn't get the tops off". Since this time, Timotei have altered the design of their bottles to enable this flip top to be screwed off, hence rendering the bottle recyclable. This sort of change has not altered the appearance or function of the bottle during its lifetime as a useful product in any way, whilst improving its recyclability immeasurably. This sort of consideration should be brought to the attention of the manufacturer in order to improve the convenience, and hopefully participation in recycling schemes. Incidentally, this change in design of Timotei bottles was not adopted in order to aid recycling, but to allow customers to choose between using the lid as a flip top or screw cap, stop leakage which was occurring in the previous design by making the cap stronger, and in response to consumer preference for the flatter lid which enabled the bottle to be stood upside down, allowing a greater amount of the product to be emptied from the bottle (Elida Gibbs Consumer Bureau, 1994).

Basically, what all of the informants are describing is a routine. Even those who claim not to adhere to any particular system of processing the recyclables are describing a routine. Every domestic task has an element of routine attached to it, and perhaps this is a key to adoption of a new task. In Conformity and Conflict, Spradley points out that individuals attempt to "organise their behaviour in pursuit of goals", (Spradley & McCurdy, 1977). For recycling to become part of our society, we must organise our lives in a way that permits its occurrence. Each of us must develop a recycling routine.

It is also important that those collecting the plastics from householders contribute to the establishment of this routine by providing consistent service. The reason that one of the informants gave up processing her recyclables was that she perceived the collection scheme as inconsistent and unreliable. She said that "it began to fall apart at the seams" and she "stopped putting them out". She believed that she "would probably have continued doing it, if it had always been the same".

The adoption of recycling practices will involve **change**: change in our domestic routine, change in the way waste is processed by the householder and by the local authority, change in the way packaging is manufactured and change in the legislation in this country. Facilitating this change in household practice must be the responsibility of every member of the packaging chain. Plastics recycling is not a difficult task, nor one that is fundamentally different from other domestic tasks that we carry out without question each day. However, it does involve us reconsidering our routine to include it as part of our domestic management. As one informant put it, "You have to think about it".

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Chapter 7: Evaluating Plastics Recycling Programs: Economics and Participation

7.1 Introduction

In an environment where market forces prevail, the financial viability of any industrial or commercial operation is obviously a key issue. Although many of the recycling schemes in the UK operate within the public and voluntary sectors, the question of whether or not a project has a positive or negative financial contribution to make to an organisation is still crucial. In fact, several of the recycling mechanisms which are already in place in the UK have been implemented in order to pursue a monetary objective. For example, industrial scrap is often reworked or reprocessed as it is recognised as having an inherent value because it contains raw material or energy. It is cheaper for many industries to recover these resources than to buy new ones. The fact that this practice is now more widespread than ever is a testimony to the economic benefits it can bring.

Compared with the patterns of recovery and rework found in industry, the recycling of domestic waste is a relatively new phenomenon. Again, the recycling processes which do exist have been developed in order to promote practices which will save money. Post-consumer glass has been recycled in this country since 1977 (Matthews, 1986). The schemes co-ordinated and promoted by United Glass provide their factories with a low cost supply of cullet (broken glass). The cullet is added to the furnaces used for melting the raw materials for new glass. This means that lower temperatures are required for glass production which reduces the cost of operation by decreasing the amount of fuel necessary to produce each tonne of glass.

7.1.1 Objective

Since plastics collection schemes are in the unique position of not being able to directly purchase their raw materials, the link between raw material input and the financial outcome of a system is perhaps less formal in accounting terms than in other processing operations. There is however an important relationship between these factors which is to a large extent unexamined and requires a more explicit treatment.

The aim of this chapter is to explore the effects that different levels of public participation have on the financial viability of plastics recycling schemes.

The first stage of this analysis is to find out what it costs to collect post-consumer plastics waste for recycling. This section begins with a review of related work done in this area to date. For the purpose of this study, the Glasgow and Falkirk systems have again been employed as case studies to represent bring and collect schemes. In order to explore the financial characteristics of these collection schemes, the development of simple spreadsheet-based financial models of the Glasgow bring and the Falkirk collect schemes is undertaken. The models and their outcomes are then discussed, including a consideration of the local factors which have made the most significant impression on these outcomes. More generalised figures for bring and collect schemes are then entered into the model framework and the effects of the changes made are examined. The next part of this chapter loqks at the effect that participation rates have on the financial viability of plastics recycling schemes. The final section suggests some of the other measures that could be taken into account when assessing plastics recycling schemes.

7.2 Assessing the financial cost of plastics recycling

A survey of literature relating to costing recycling operations was undertaken in order to establish what previous work had been done in this area.

7.2.1 A survey of the literature

There has been quite a number of studies aimed at assessing the economic aspects of recycling various sorts of waste. These studies have been grouped and summarised below.

Cost Groups

The costs involved in any project can be divided into three groups: capital costs, fixed costs and variable costs. The capital costs for a post-consumer plastics waste collection scheme will include purchases of plant and other equipment such as collection vehicles and MRF components such as conveyor belts, balers, raised sorting platforms and cages or nets for the sorted plastics. A bring system will also have the cost of providing banks, whilst a kerbside system which intends to utilise permanent receptacles, such as the blue box or divided wheelie bin will have the cost of these to add to its initial outlay of capital.

The cost of premises could also be included as a capital cost, but it is more likely that an organisation would lease or rent the space they require to house their recycling operations, at least to begin with and these costs would therefore contribute to the fixed costs. Other fixed costs would be the cost of heat, light and salaried staff.

Variable costs will include power for the baling and sorting operations, fuel and maintenance for the vehicles, baler wires and any charges or costs associated with the disposal of contraries. If the scheme is a kerbside one which is designed around the use of green bags or other disposable receptacles, the costs of these will also be included as a variable cost.

The possible financial benefits to the recycler also fall into three categories (Glenn, 1988): revenues from the sale of reclaimed materials; savings in the current collection and disposal methods; and grants. Not all of these benefits can however be realised by all recyclers. The practice of passing on local authority savings to the collector is discussed below.

Recycling Credits

A recycling credit is an amount of money paid to an organisation, by the local authority, for each tonne of waste which is diverted from the municipal solid waste stream. The recommendation for the payment of recycling credits was first introduced by the UK Government in the white paper *This Common Inheritance* (DOE, 1990) and should represent the savings made by the recycler on behalf of the local authority in terms of collection and disposal costs.

The aim of the recycling credit is to "allow the achievement of an economically efficient level of recycling activity through the effect of market forces" (DOE, 1991). Biddle (1991) suggests that in many cases, "avoided cost savings can be far greater than the revenues from the sale of recycled material". This shows the relative importance of the income for the recyclers.

In order to investigate the levels of credit that were being paid and should be paid in the UK, Touche Ross were commissioned to do research in this area. The result was the Touche Ross Report on Waste Recycling Credits (DOE, 1991), which outlines the following groupings for savings to the WDA generated by recycling programs:

Short Run Savings

A lighter load on the vehicle should give :

- less wear and tear on the vehicle
- lower fuel consumption
- less vehicle maintenance
- less spares

Long Term Savings

Reduction of rounds should give :

- less vehicles
- less labour
- less fuel

It may well be that disposal costs will be avoidable in the short term, whilst collection costs are only possible to alleviate in the long term. Touche Ross estimate that 80% of the costs for a rural waste collection system are fixed in the short term. The corresponding percentage for urban collection is even more inflexible at between 88% and 92%. They estimate that, in general a 10% reduction in the amount of waste collected will only produce a saving of 2% in collection costs (DOE, 1991).

They also report that recycling credits or rebates in the UK are currently paid at a level which the WDA considers will encourage recycling rather than making an attempt to reflect the cost savings that the recycler secures for the WDA. No waste collection credits are currently paid in the UK, or in fact in any of the countries considered by the report. They also report that no disposal credits are currently paid in England for plastics, although they are paid for other materials.

In many cases, especially where the local authority is also the recycler, no recycling credit is actually paid as it is seen as a meaningless transfer of money between one hand of the organisation (or even department) and the other. This does however affect the accountability of the schemes.

Another common scenario is for the recycling credit not to be paid at all, even to third parties. There is no legislation supporting this scheme, so there is no come back for recyclers who operate in a region where it is not local authority policy to issue recycling credits.

Deyle and Schade (1991) found in their analysis of American kerbside programs that collection costs were of a higher order than disposal costs. In a study of the UK waste management costs, Rushbrook (1984) found collection costs to be around three times larger than disposal costs. This raises the issue (especially in England and Wales where there are separate Waste Collection Authorities and Waste Disposal Authorities) of the promotion of a collection credit. They also found municipally operated systems to be more cost effective than the contract ones.

The choice of weight rather than volume as the unit of measurement for solid waste in the determination of recycling credits contributes to the provision of unrealistic levels of credit being paid to many materials recyclers. The choice of weight rather than volume to measure quantities of solid waste is uniform throughout the industry. This may be purely historical, or have come to pass simply because it is easy to determine how heavy a vehicle full of waste is (vehicles are usually weighed on a weigh bridge on the way into and out of landfill sites. The second reading can then be subtracted from the first to calculate what weight of waste has been deposited) and thus charge appropriately. It is also possible to alter the volume of a load of waste by using compaction equipment, but the weight cannot be changed. Russell (1982) suggests that weight is a more precise system of waste measurement than volume as the density of solid waste is so variable.

Despite these problems, a unit of volume for measurement of the quantity of solid waste would make sense in terms of landfill. Since landfills are holes in the ground, the constraining factor is not weight, but volume. Their lifetime will be determined by how much volume of waste is buried in them over a period of time, and will usually be independent of the weight of rubbish they hold: A landfill is closed because it is full, not because it is too heavy. Due to its high volume to weight ratio, a tonne of waste plastics will obviously take up much more room in a landfill than a tonne of waste paper.

Therefore, it could be argued that a recycler who diverts a tonne of waste plastics from landfill should be paid a higher level of recycling credit as, even considering that a degree of compaction will take place prior to landfill, they have saved the Waste Disposal Authority more money.

Factors affecting viability

Another prevalent theme in the literature is the exploration of some of the many external factors which affect how much it will cost to collect and process a tonne of post-consumer plastics waste for recycling. The four factors mentioned by Turner are mass, contamination, homogeneity and location of the secondary materials (Turner, 1981).

Location

Domestic wastes are by nature extremely diverse in their location. Small amounts of a wide variety of materials which have potential for recovery can be found in every household. This makes the collection of materials time and resource consuming. Sorting of the fractions is an even more complex and expensive task in terms of time and money.

Contamination

Compared with industrial wastes, post-consumer refuse is also highly contaminated. This makes the possibility of primary, and sometimes even secondary recycling quite difficult. Washing the sorted material can counteract many of the contamination problems posed by domestic wastes, but this process adds yet more time, money and material resources to the recycling operation.

Homogeneity

Domestic waste in general, but plastic wastes specifically, have a low level of homogeneity. Perhaps worse is the fact that plastics are perceived to be more heterogeneous than is actually the case. This means that members of the public are seldom asked to sort their plastics into the various polymer types, for fear of overwhelming them and thus losing their good will. This puts the task of sorting in the hands of the collector, again adding to the time and expense of processing materials.

Mass

The last viability factor mentioned by Turner is mass. This is a particular problem for post-consumer plastic waste. The fact that plastics have such a high volume to weight ratio, means that the viability of collection can be affected by the proportion of the bottles that the public squashes before they are collected. Compaction equipment in the collection vehicle is one solution, but it is very expensive to employ such a specialised vehicle and the compaction ratio is still too small to reduce the number of trips the vehicle must make by an amount that would compensate for this extra cost (Simmons, 1993).

A study by Garrison (Garrison, 1988) identifies a number of factors which effect the efficiency with which the collection process can be undertaken. These include housing density, kerb miles, traffic problems, topography, degree of driver responsibility to sort materials, level of participation, level of multifamily housing and the quantity of materials at each stop. To these, Kemper and Quigley (1976) add crew size, container type and weather. Other considerations might include the number of dead ends or narrow streets, the recycling history of an area, and the number of cars per head of population.

Most of these factors are of an external nature, out with the direct control of the collector, and each of them can add time and therefore, money to the collection of each tonne of waste. This will be reflected in the variable costs of the operation. The large number and variety of the factors outlined in these studies shows the degree of complexity faced by the designers of collection systems.

Another factor which can affect the calculation of the economic feasibility in this way is the price of virgin materials. Bollard (1982) believes that "A continuing industrial problem will always be the indirect domination exerted by the petrochemical firms who through their virgin pricing policies have power of life or death over recyclers".

Geoff Wright of SWAP calls for stable, fair prices for reclaimed material which are based on the market prices of the raw materials they replace (Wright, 1990). Although the cost of disposing of domestic waste is covered by rates or taxes paid by the householder, it is common for these costs to be subsidised. This means that the consumer rarely pays the 'marginal cost of disposal' (Curlee, 1986).

The introduction of legislation in Germany which mandates the collection of post-consumer packaging waste for recycling, before an industry infrastructure had established sufficient outlets to reprocess it, has led to large amounts of German plastics being offered to reprocessors in the UK at negative cost. This is currently having an artificial effect on the market prices of recovered plastics (RECOUP, 1993(a); Atkinson & New, 1993(a)).

Problems of comparison

When assessing the viability of any operation, it is obviously important to consider what financial viability is, and how it will be defined and measured. A number of different approaches has been taken. Many believe that recycling should only be carried out if the income that it generates can match the costs that it incurs. This is certainly the condition under which the recycling officer in Glasgow must operate. However, other forms of waste disposal are not expected to break even in this way. In general, Waste Disposal Authorities and Waste Collection Authorities expect to pay a certain amount to dispose of each tonne of waste that the public within their jurisdiction generates. Taxes are raised from the public to cover these costs. In the recycling equation, recycling credits can therefore be included in order to represent these costs that would otherwise be paid by local authorities to dispose of waste. This extends the concept of breakeven to include the public cost avoided by the recycler.

In support of this line of definition, Lamb et al state that "A municipality should recycle whenever net recycling costs are less than total disposal costs, which include collection and landfilling or incineration" (Lamb, Marron & Pilling, 1990). This widened definition of breakeven is helpful to the recycler, but still not ideal.

The range of costs and benefits that are quantified by different studies can also vary enormously. These range from straightforward financial analysis (Simmons, 1992), through an economic approach which considers factors such as opportunity costs or public and private costs and benefits of recycling (Turner, 1981; Maltezou, 1991)), to Cost Benefit Analysis, which attempts to quantify all factors pertaining to recycling initiatives, including social and environmental benefits (Pearce & Turner, 1977; Hanley & Spash, 1993).

There has been a number of studies undertaken to explore the costs and benefits of recycling a variety of materials, both in the UK and the US. Many of these studies concentrate on identifying the various cost and benefit components of recycling schemes, and building them into a general model or index. The results of these studies are sometimes contradictory, for example in a study of post-consumer recycling in America, Deyle and Schade concluded that recycling would only cost less than not recycling under what they described as "optimistic circumstances" (Deyle & Schade, 1991). On the other hand, Lamb et al believe that the cost of recycling in general will be less than the current cost of disposal in the US, where landfill costs are high, and that for the UK, the net cost of recycling should be zero (Lamb, Marron & Pilling, 1990).

In a summary of the costs involved in plastics recycling, Williamson (1992) reported cost estimates for schemes around the world, as shown in Table 7.1.

Scheme	£/ton
USA (SWS) average	55
Reprise	99-164
RECOUP	99-170
Leeds	10
TH Berlin	208
DSD Germany	84

Table 7.1 Costs associated with recycling schemes (adapted from Williamson, 1992)

RECOUP has estimated that the current UK costs for the collection and sorting of plastics from the public costs between £50 and £100 per tonne for Drop off systems and between £65 and £130 per tonne for Kerbside systems (RECOUP, 1993(b)).

A study of kerbside collection systems in the UK found that schemes were reporting the following net costs per tonne (Atkinson & New, 1993(b)). See Table 7.2.

Area of Scheme	Net Cost (£/te)
Separate wheeled bins	
Leeds	68
Blue box	
Stocksbridge, Sheffield	130
East Sheffield	110
Milton Keynes	65
Adur	130
No container	
Chudleigh, Devon	59
Havering	36
Inverness	77
Etterick & Lauderdale	50
South Molton	40
Green bag	
Cardiff	63-82
Falkirk	36

Table 7.2 Costs associated with UK kerbside recycling schemes (adapted from Atkinson & New, 1993(b))

The costs shown above are 'as reported by the scheme operator'. Although this is obviously one of the most straightforward ways of obtaining information about scheme costs, it has been found that costs reported by the scheme itself and those calculated by outside sources can vary. A study carried out for the Council for Solid Waste Solutions identified a number of discrepancies between reported and calculated costs as shown in Table 7.3.

There is a number of reasons why these research results vary from study to study. In fact, it is hardly surprising considering the number of factors which can affect financial viability. It underlines the need for local data which is a virtual necessity in analysis of this sort. Although much can be learned from the examination of models of specific schemes, and also from the building of more general models, it is widely held that in order to assess the success of a scheme, or the likely success of a proposed scheme, a local data set is essential (Turner, 1981; Turner, 1978; Russell, 1982). This is not always something which can be acquired quickly or easily, but it must nevertheless be a starting point for analysis.

Program	Reported Costs (£/te)	Calculated Costs (£/te)	Percentage Discrepancy
Arlington	23	31	+ 35%
Champaign	10	64	+ 540%
Edmonton N	105	61	- 42%
Palo Alto	15	26	+ 73%
San Francisco	65	48	- 26%
Seattle N	33	28	- 15%
Seattle S	31	28	- 10%
Somerset	39	77	+ 97%
Toronto	98	79	- 19%

Table 7.3 Reported and Calculated Costs for Kerbside Collection of Recyclables (adapted from Perkins, 1992)

Whether or not recycling will be viable in financial terms will also depend largely on local conditions. To some degree, the economic viability of a recycling scheme will depend on how high the current costs of disposal are (Deyle & Shade, 1991). If landfill space is beginning to run out and further construction will be expensive (or space is not available), then recycling may be seen as an option which prolongs the life of the current facilities and therefore postpones the need for high levels of capital investment. The same recycling program would however not be regarded as financially viable in another area where land is readily available or where current facilities are expected to last into the foreseeable future. The financial viability of a recycling operation as compared to other local options is not therefore an objective measure of its performance. Perhaps this indicates a need to standardise or legislate a range of recycling credit levels.

As was discussed above, there is no one definition of what constitutes 'viable', or agreement about how calculations are carried out. Despite these differences in accounting philosophy and practice, it is unusual for studies to make their preferences in these matters explicit. It is often difficult to tell whether the accounting methods of various studies are similar enough to allow direct comparison.

Many schemes also attract some form of sponsorship, donations or similar help from industry or other bodies. These contributions will vary from scheme to scheme, and can make a huge difference to the overall scheme viability. Although obviously such contributions are extremely helpful to plastics recycling operations, they can make direct comparison between schemes difficult if they are not explicitly stated in the operational accounts.

Another potential issue for comparison of the costs of these two schemes is the way in which the population being served by them is calculated. It is much simpler to identify the area served by a collect system than it is to estimate the proportion of a city's population served by a bring system (Atkinson & New, 1993(a)). With waste disposal costs calculated per head of population, or per household, it is difficult to make convincing cost comparisons without this sort of information. Further work on plastic bank spheres of influence may aid such calculations or estimations.

Another possible obstacle for comparing research outcomes lies in the fact that many of the studies which address the financial efficiency of recycling relate to US schemes. Although many general lessons can be learned from this work, without further study based on UK schemes, it is difficult to predict which elements, if any, would be transferable to the UK waste management system. In an area which has proved that local data makes an essential contribution to accuracy and relevance, it is probable that apart from issues such as research design and implementation, the outcomes of US research will not be sufficient guidance for UK policy makers.

There has also been a number of studies in the UK which pertain to other materials (Wray & Nation, 1977; Deadman, Turner & Grace, 1978; Deadman & Grace, 1979). Again, it is hard to tell how much of this work is applicable to plastics recycling. Many of the studies have been undertaken some years ago, when the economic and legislative climate was quite different. This may also prevent any insights gained being useful to current systems.

The notable exception to this situation is the work carried out on post-consumer plastics waste recycling by RECOUP. RECOUP has undertaken much analysis of the cost and efficiency of plastics recycling in this country, and how streamlining might be achieved in the future. RECOUP has experience of working with all types and scales of plastics recycling operations at all of the various stages of development. RECOUP's work in this field is extremely important, as it benefits many schemes at a practical level.

In a helpful balance between the wish to provide a general structure for assessing viability of schemes and the need to include local data, RECOUP has developed a computer model which assesses the financial feasibility of a variety of different plastics recycling options using data specific to the local authority wishing to consider undertaking a new scheme or make improvements to an existing one. This spreadsheet based model requires a number of basic pieces of information regarding the population and facilities involved and utilises estimates based on RECOUP's experience of other schemes where local data is not available. The aim of this development is to facilitate the design of plastics recycling schemes by allowing the investigation of a number of different varieties of system. The model also allows manipulation of some of the key factors of these systems in order to show how they affect their overall viability (Simmons, 1992).

RECOUP has used this model to produce financial feasibility data for a number of local authorities and other organisations seeking advice on scheme design. The model produces graphical output which gives an indication of the annual costs of various schemes under different conditions, providing decision support for the decision makers involved. It also gets over the problem of allowing schemes to share data whilst retaining client confidentiality.

Whilst this model represents an important development in cost appraisal of plastics collection systems and a vital tool for decision making and design, its design and operation work on the black box principle. This means that although it could possibly be used to undertake an analysis of the relationships between participation and cost, many of the assumptions made (about the treatment of capital, and the number of tonnes that calculations of unit costs are made over, for example), and relationships between variables would not be explicit, it would only allow minimal variation in model parameters and then only through indirect model use, with RECOUP maintaining a customer client relationship with the researcher. Obviously, this is not an ideal research situation and points to the development of a dedicated, researcher-owned set of models.

7.2.1.1 Summary

This section reviews the themes in this body of literature, and the concerns about them that have prompted the financial modelling that follows.

The studies outlined above, and others like them, are important contributions to the study of recycling because they address the issue of the cost of recycling. Since recycling is a relatively new activity for those involved with the management of domestic waste, it is necessary to assess the financial implications of this activity in itself, compared to other like practices, and compared to current practices. This will allow it to be monitored, best practice for financial efficiency to be discovered, and the implications of its introduction in monetary terms to be discussed and planned for.

The practical usefulness of the information produced by these studies is however limited by their failure to be explicit about many issues that make basic differences to the way they can be interpreted, generalised and utilised. In order to provide models and information that can inform practice, they must attend to their approaches to the following:

Aims

Different studies of costs will be designed by different stakeholders in order to meet different aims. They may be intended as decision support to help select between different recycling options, or different waste management options. They may be part of an investment appraisal, detailing the likely costs involved over time with a project. They may be of a more academic nature comparing theoretical or typical scheme designs in the hope of discerning best practice. Each of these studies can be said to be concerned with 'viability' but the definition of this may vary from a financial breakeven, through optimal practices which entail lower operational cost, to a level of service which represents a similar level of spending to current waste management options. Research reporting must include explicit treatment of the purpose to which the study is addressed and its definitions of what constitutes 'success'.

Contexts

The example given above of the definition of recycling 'viability' being affected by how many years of landfill an area had left demonstrates how context can alter the cost calculations. Other examples might include the recycling history of an area, whether or not a scheme enjoyed industrial sponsorship, charity status, recycling credits. It almost certainly varies by the material(s) collected which can command very different income rates with different degrees of stability. Any number of 'local' factors will influence the costs associated with a study and every effort should be made to illuminate and account for these differences.

Scope

There are two important kinds of scope which will effect the cost calculations of a recycling scheme. The first is the scope of the cost study. This means whether or not it includes capital costs, start up costs, contributions to the running of shared buildings, contributions to the costs of personnel or services already employed or carried out by a parent organisation, opportunity costs, social costs, representations of savings made by the same or by other organisations in the long and or short term, or training costs to name but a few. The other kind of scope that must be considered is the scope of the operation studied. This will include issues like whether the study is real, planned or theoretical, what scale of throughput costs are being calculated over, what kind and extent of collection methods are used, whether it is a pilot operation, or working under start up or sable state conditions. All of these factors will have a potential influence on the costs produced by a study and therefore must be dealt with explicitly.

In summary, although costs can be represented as numbers, they are not objective measures which are independent of the circumstances of their collection, calculation or presentation. Despite the fact that many clearly contradict each other, each of the costs reported above for the recycling of one tonne of plastics from domestic waste is undoubtedly true. Devoid of commentary about the nature of their estimation they are useless. They cannot be compared, they cannot provide insight into plastics recycling and they cannot influence decision makers.

7.2.2 Financial Models of Falkirk and Glasgow schemes

In order to begin an exploration of the different sorts of costs involved in recycling plastics using bring and collect systems, data was gathered from the Glasgow and Falkirk schemes. This data was then entered into very simple spreadsheet models. These are shown in Figures 7.1 and 7.2 below. References to specific figures in the models are given in bold parenthesis in the text.

The base year for this analysis was 1993 as this was the first year of consistent operation for the Glasgow scheme. The models have been kept as simple as possible in order to demonstrate and compare the costs of the two schemes, without over stretching the usefulness of the data presented.

The costs have been presented as costs per tonne in order to make the two schemes more easily comparable. This was done by adding all the costs shown together and dividing them by the scheme diversion rate.

The prices per tonne shown in the models are those paid by reprocessors for different polymers **(A)**. These prices are all paid per tonne of delivered polymer, so the cost of transportation is borne by the collectors. As Reprise is based near Liverpool and Wellman is in Holland, transportation costs may vary quite considerably, depending on the choice of customer.

7.2.2.1 Model Analysis

As can be seen from the models, neither the Glasgow nor Falkirk systems managed to achieve a breakeven on their plastics recycling operations. Glasgow's bring system has made a loss of £375.33 per tonne collected, whilst the Falkirk collect system reports a loss of £456.40 per tonne. The operating costs for the two schemes are of a similar order of magnitude. Some of the reasons for these outcomes are discussed below.

The capital costs for each scheme have been included in the calculation of the operating costs by dividing the initial sum paid for an item over its predicted useful lifetime. This value is then included as annual contribution **(B)**. Predicted lifetimes for equipment are shown in Table 7.4 below. Where lifetimes exceed 5 years, they have been divided into 5 annual contributions to represent a typical capital repayment plan.

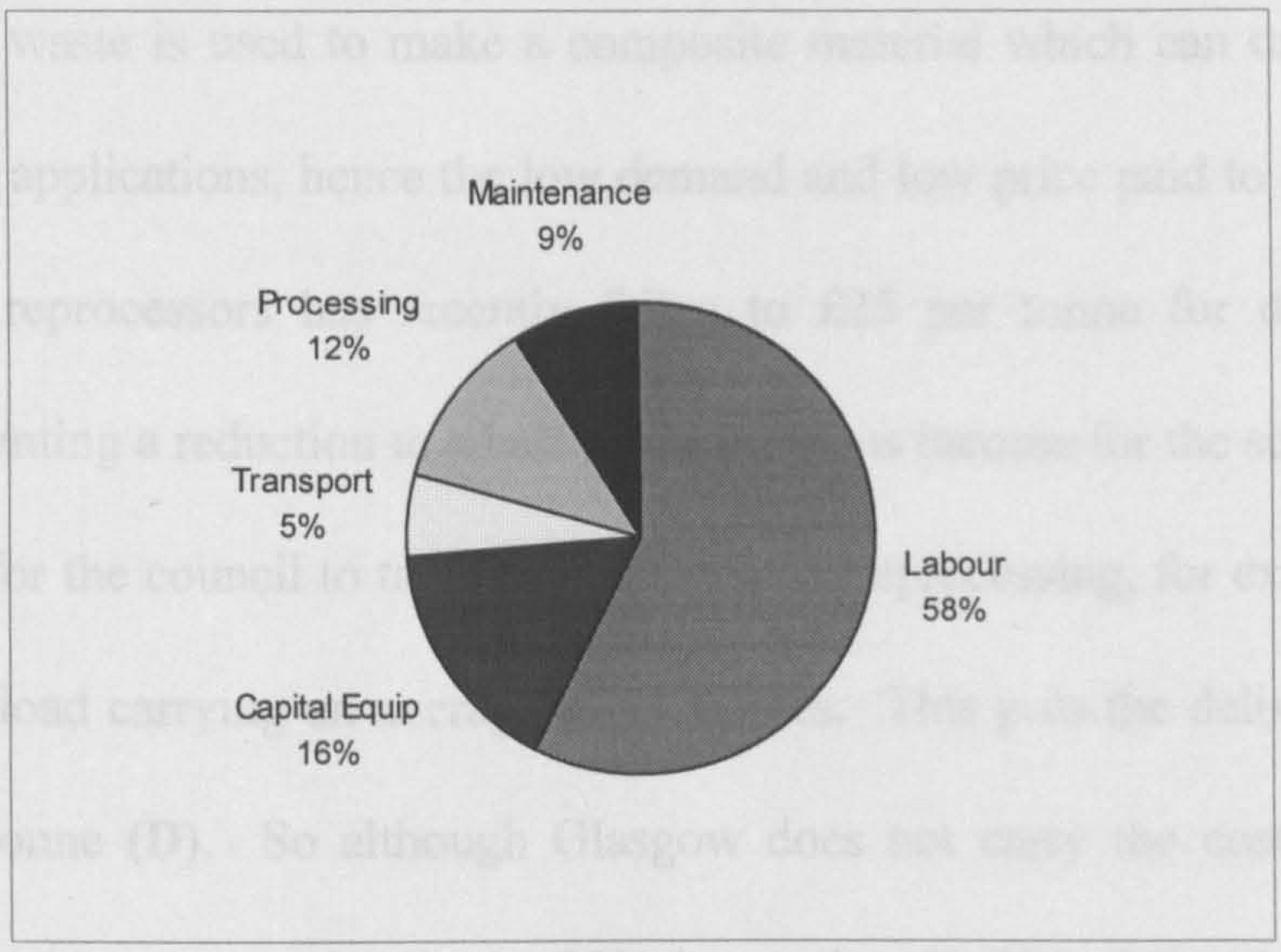
The capital costs for Glasgow are much lower than Falkirk, at £17400, compared with £29357.61 **(B)**. Much of Falkirk's capital outlay has been associated with its sorting operation. The true figure for Falkirk would in fact be much higher as it would include vehicle purchase and MRF components. Unfortunately, these data were not available.

Item	Predicted Lifetime
Collection Banks	2.5 years
Trolleys	5 years
Radios	3 years
Baler	5 years
Can Sorter and Densor	5 years
Forklift Truck	5 years
MRF components	5 years
Nets	2 years

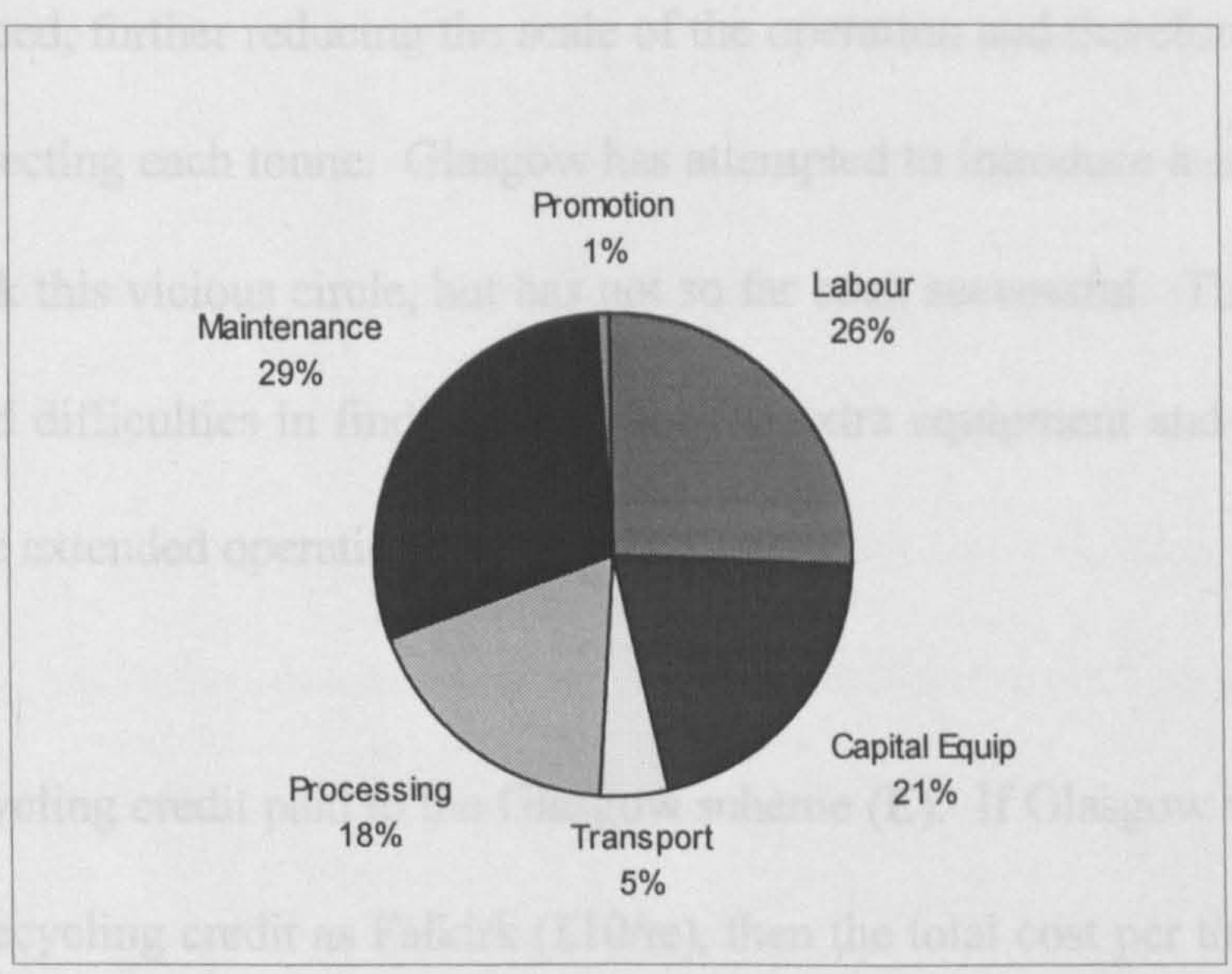
Table 7.4 Predicted Lifetimes of Equipment

Labour costs represent one of the largest cost groups for the Falkirk scheme, at 68% of total costs (C) (See Graph 7.1). Recycling is by nature a labour intensive operation (Glenn, 1988) and this is particularly true of a collect system. Depending on the objectives of the scheme, however, this need not be regarded as a negative characteristic. In a society where unemployment is high, especially amongst the unskilled and manual workers, the introduction of an industry which requires a large, unskilled work force could prove beneficial (Quigley, 1988).

Glasgow's labour costs were a lower proportion of the total operational costs, at 32% (See Graph 7.2). These include the time of the Recycling Officer spent managing the system, but do not include the collection labour, which is simply included as part of the bank emptying contract. For a bring scheme with no sorting operation, this figure seems quite high compared with Falkirk. This could be due in part to the heavy reliance of the Falkirk scheme on Employment Training labour. This allows the Falkirk scheme to employ long term unemployed individuals full time and pay an extra £10 per week for their services, whilst they continue to collect unemployment benefit.



Graph 7.1 Breakdown of costs for Falkirk



Graph 7.2 Breakdown of costs for Glasgow

Glasgow has suffered from the drop in the price offered for mixed plastics. When the scheme started in 1991, £50 was paid for each tonne of mixed plastics waste delivered to reprocessors, but the cost of delivery was met by either RECOUP or the reprocessors. Mixed plastics waste is used to make a composite material which can only be used for very low grade applications, hence the low demand and low price paid to collectors. The price paid by reprocessors has recently fallen to £25 per tonne for delivered mixed plastics, representing a reduction to a half of the previous income for the scheme **(A)**. The delivery costs for the council to take their plastics for reprocessing, for example are £200 per load, each load carrying an average of 11 tonnes. This puts the delivery cost at just over £18 per tonne **(D)**. So although Glasgow does not carry the costs of sorting its plastics, and carries an operational cost 30% lower than Falkirk, it has become virtually impossible to operate a financially viable system. This has led to the withdrawal of financial support by the council. This in turn means that the banks which are vandalised cannot be replaced, further reducing the scale of the operation and therefore increasing the unit cost of collecting each tonne. Glasgow has attempted to introduce a sorting operation in order to break this vicious circle, but has not so far been successful. This has been due to the combined difficulties in finding funds for the extra equipment and moving to new premises for the extended operation.

There is no recycling credit paid to the Glasgow scheme **(E)**. If Glasgow was to enjoy the same level of recycling credit as Falkirk (£10/te), then the total cost per tonne would drop to £365.33. This does not make a significant impact on the costs. This is already higher than the average recycling credit paid by County Councils in England and Wales, which is £2.40 per tonne (DOE, 1991). It is also higher than the highest reported recycling credit payment, which is £8.26 per tonne (DOE, 1991). It is therefore extremely unlikely that this amount will be raised in the near future.

The only other possible source of increased income for the schemes is from their customers, the processors. If greater development in the markets for products containing recycled plastics was to increase the price that plastics processors were willing to pay for their raw materials, the effects on the schemes could be substantial, especially if the prices paid were closer to those paid for virgin polymer. This is especially unlikely at the moment due to the influx of post-consumer plastics from Germany being offered at zero and even negative cost.

It was very difficult to obtain realistic data for some of Glasgow's facilities. For example, the baler that is used by the scheme has been bequeathed to it by a long deceased paper recycling operation. The buildings which house the baler belonged to the council's incinerator when it was in operation and had long been disused. The men who bale the plastics are employees of the Cleansing Department and are seconded for one day per week for these duties. The co-ordination of the whole operation is undertaken by the recycling officer, who is responsible for all materials recycled in Glasgow. All of these things are good in that they reduce the costs directly attributed to the recycling operation, but all of them impede the collection of representative data which can be used to assess the efficiency of the operation and allow it to be compared with others. The costs which represent these resources in the Glasgow model have been included where possible. The baler cost shown represents the estimated cost per tonne baled, multiplied by the number of tonnes diverted by the scheme **(F)**. The baling cost was estimated by the recycling officer, based on the cost of baling municipal waste in the District landfill. Labour costs have been calculated by estimating (with the guidance of the recycling officer) the proportion of time spent by each of the labour grades on the plastics recycling project and entering that proportion of their salaries **(C)**.

The collection banks used by Glasgow District Council Cleansing Department are large, distinctive and expensive (see Figure 2.4). They were designed especially for the scheme by its (then) sponsor BXL. This means that the banks cost nearly twice that of their more standard counterparts, and that the choice of supplier is restricted to one **(G)**. They also have an extremely short lifetime. Due to vandalism, over half of the original banks were rendered unusable within two and a half years of the scheme's launch. This is at worst quarter, or at best half of their expected useful life.

Another problem peculiar to Glasgow is the very large site cleaning costs. Each site is swept five to seven days per week, costing the council £2000 for each site every year **(H)**. This over-zealous site maintenance programme and its associated costs are due to the fact that the service has been included in the street cleansing contract of outside contractors after the negotiation of their tender had taken place. The addition of recycling site maintenance was seen by the contractors as an opportunity to boost the agreed price for the overall contract, which had been pared down by the council during negotiations. The costs of site maintenance which have been allocated to the plastics recycling operation have been calculated by adding a proportion of the site cost equal to the total cost divided by the number of banks it housed and multiplying by the number of plastics banks present.

In order to calculate the promotion costs for plastics recycling in Glasgow, the council's spending on promotion of the recycling services was divided by the total number of banks it provides for plastics, paper, glass and metals **(I)**. This allowed a promotional cost to be allocated to each of their 250 banks. This figure was then simply multiplied by the number of plastics banks (29) provided.

Glasgow banks are emptied by contractors. The collection frequency depends on how high a yield each bank has. There is a fixed cost associated with the servicing of each bank, regardless of how much plastic has been donated. It is therefore in the interests of the council to try to ensure banks will be nearly full when they are emptied. This must be balanced with the fact that banks must not be allowed to become completely full or overflow, as this could create at best an eyesore, at worst a hazard, and, perhaps most crucial of all, members of the public will not be able to deposit their plastics. These issues have been addressed by GDCCD by allocating banks to one of three categories, depending on their fill rates. The A group consists of the banks which fill up the fastest and these are emptied weekly, the B group fortnightly, and the lowest yield banks in C group once every three weeks. In order to calculate the total bank emptying cost for the scheme, the following equation was used **(J)**:

$$\text{TBEC} = \text{CEA} + \text{CEB} + \text{CEC}$$

Where

TBEC = Total Annual Bank Emptying Cost
CEA = Annual Cost of Emptying Group A Banks
CEB = Annual Cost of Emptying Group B Banks
CEC = Annual Cost of Emptying Group C Banks

And

$$\text{CEX} = (\text{BEC} * \text{BX}) * \text{FX}$$

Where

CEX = Annual Cost of Emptying Group X Banks
BEC = Cost of emptying one bank
BX = Number of banks in Group X
FX = Number of times Group X Banks are emptied each year

Since the Scottish Conservation Projects' Action Recycle project operates separately from the rest of the organisation, the determination of costs was a relatively simple process.

One anomaly in this system is that the collection bags which are used by the scheme are donated by BP **(K)**. This represents quite a saving for the operation. The machinery that is employed for their sorting operation was purchased second hand, in cash from a Royal Mail sorting office which was closing down, by a previous operations manager, and so there are no costs entered in the model which represents this equipment.

Some of the costs of the Falkirk recycling operation are shared by all the materials collected. These are things like heat, light and power, advertising, administration and some of the collection labour. Action Recycle has made estimates on the proportions of each of these costs to be allocated to each material in their accounts (McKendrick, 1993). There is no attempt made to explain this allocation, so it has simply been reproduced in the Falkirk model **(L)**.

A number of problems arose in the course of this analysis. One of the major hurdles was the quality and availability of financial data. These are problems which are frequently encountered in studies of this type (Ball & Matthews, 1988; Gueron, 1972). There are implications for the way in which local authorities generate and store information. The adage, Garbage in, Garbage out holds a new irony for the financial study of local authority waste management practices. The 1966 report of the National Academy of Sciences states that, "In order to make rational choices, officials need quantitative estimates of the costs of alternative policies. ... A major shortcoming in solid waste management is the lack of accurate quantity and meaningful cost data, making it virtually impossible to evaluate alternative methods, thus perpetuating archaic practices" (Kemper & Quigley, 1976).

Both the Glasgow and Falkirk schemes had a dearth of information of any kind relevant specifically to their plastics recycling schemes. Where data did exist, it was often aggregated in ways which were unhelpful for this sort of analysis. This was particularly true of the Glasgow scheme whose accounts had been lost to departmental budget codes and other charge centres. For example, when the baler breaks down or banks require maintenance, the recycling officer initiates the work required, but is never charged for it. It can only be assumed that these costs are being charged to another cost centre. This mis-accounting practice is knowingly and deliberately perpetuated by the recycling officer who believes that if the full costs of the plastics recycling operation could be plainly seen by his superiors, then the operation would be terminated altogether.

Another problem peculiar to the council situation is the existence of much external tendering for waste services. This muddies the trail in two ways: Firstly, although tendering has undoubtedly decreased the financial costs of many operations, it does not allow the constituent costs of individual operations to be reported, monitored or controlled

VARIABLES			
number of plastics banks	29		
total no. of banks	250		
population served	25	%	
price per tonne :		(A)	
mixed	£25.00	delivered	
PET	£90.00	Reprise	delivered
	£110.00	Wellman	delivered
natural PE	£100.00	delivered	
PVC	£75.00	delivered	
HDPE	£75.00	delivered	
cost per bank	£600.00		
frequency of pickup	7 days	14 days	21 days
number of sites	25		
bank lifetime	2.5	yrs (O)	
bank capacity	5	m3	
site maintenance	£2,000.00	\site \year	
tonnes collected	84.54		
average tonnage per bank	2.92		
CAPITAL COSTS		(B)	
annual cost of banks	£6,960.00	(G)	
OPERATING COSTS			
bank maintenance	posted	(M)	
baler maintenance	posted		
site maintenance	£10,156.50	(H)	
promotion	£290.00	(I)	
direct labour	£3,772.80		
supervision	£1,162.50	(C)	
coordination	£3,782.40		
bank empty	£5,759.72	(J)	
baling	£422.70	(F)	
baling/storage site	posted	(N)	
bulk transport	£1,537.09	(D)	
Total Fixed Costs	£19,164.20		
Total Variable Costs	£7,719.51		
Total Operating Costs	£26,883.71		
Total Operating Costs\te	£318.00		
Total Capital Costs\te	£82.33		
INCOME			
recycling credit	£0.00	(E)	
revenue\te	£25.00		
Total Costs\te	**£375.33**		

Figure 7.1 Glasgow Bring Model

VARIABLES				
price per tonne :			(A)	
mixed	£25.00	delivered		
PET	£90.00	Reprise		delivered
	£110.00	Wellman		delivered
natural PE	£100.00	delivered		
PVC	£75.00	delivered		
HDPE	£75.00	delivered		
tonnes collected	72.23			
CAPITAL COSTS			(B)	
trolleys	£2,898.30			
radios	£2,133.70			
baler	£10,627.74			
can densor and sorter	£8,227.87			
forklift truck	£4,535.00			
nets	£935.00			
Annual Capital Costs/te	£89.11			
Total Capital Costs	£29,357.61			
COLLECTION COSTS				
vehicle maintenance	£2,304.00		(M)	
insurance - road tax	£960.00			
fuel	£1,906.87			
employment costs	£13,104.00			
trainee costs	£2,808.00		(C)	
collection bags	donated		(K)	
protective clothing	£240.00			
SORTING/BALING COSTS				
bailer maintenance	£1,200.00		(M)	
haulage	£2,166.90		(D)	
trainee costs	£6,720.00		(C)	
protective clothing	£420.00			
premises	£600.00		(N)	
heat, light & power	£600.00		(L)	
Total Fixed Costs	£2,580.00			
Total Fixed Costs\te	£35.72			
Total Variable Costs	£30,449.77			
Total Variable Costs\te	£421.57			
Total Operating Costs\te	£457.29			
INCOME				
recycling credit	£722.30		(E)	
revenue	£5,778.40			
total income\te	£90.00			
Total Cost\te	**£456.40**			

Figure 7.2 Falkirk Collect Model

in any way; and secondly, it makes the owners of all the financial data that is available extremely reluctant to part with it. This anxiety over making cost data known for fear of giving advantage to competitors is a problem which has always been experienced by researchers in the private sector, but which is relatively new to the study of the public sector. This inability to establish shared cost data must surely set back the progress of plastics recycling to some degree. In this particular case of a public sector bring system, the problem is exacerbated by what the 1993 Warren Spring Report on the impact of source separation schemes in the UK described as a general dearth of information pertaining to the costs and benefits of bring systems (Atkinson & New, 1993(a)).

Aggregating data may not necessarily work against the interests of plastics recycling projects as there is surely a case for the presentation of an aggregated set of accounts which would represent the recycling operation as a whole. Instead of advocating that each material breaks even in its own right, it would give recycling operations more flexibility and time (and resources) to perfect new practices if the target were to be to achieve breakeven across all the materials in an operation. This would allow the more profitable and established materials to contribute to the future success of other materials. Unfortunately, in the case of the two operations studied, this has not been the case.

Much of the data used in the construction of the financial models has been based on the memory or estimates of those running the schemes. Obviously this has implications for both comparison between the two schemes studied here and the ability to generalise from the results.

The need for a local data set will also have implications for the generalisability of the models developed above.

Another problem for generalisability might be the scale of the operations studied. The costs examined in the financial models are taken from fairly small scale operations which are to an extent still in their pilot stages. This will affect the outcome of the analysis, not being representative of stable state operation or able to take advantage of economies of scale (DOE, 1993). Quigley (1988) believes that "recycling programs go through learning curves" and that as a scheme becomes established, worker productivity and the efficiency with which the capacity of equipment is used will increase. Kemper and Quigley (1976) believe that disposal should have economies of scale, whilst collection should have economies of density.

It is perhaps interesting to compare the analysis of these specific schemes with the average costs which RECOUP reports for the set up and running of bring and collect schemes. Based on data for 1993, these are between £225 and £253 per tonne for bring and £198 and £248 per tonne for collect schemes (RECOUP, 1993(b)). It is also interesting to compare these costs with the cost of current disposal practices. A study undertaken for the Department of the Environment by Coopers and Lybrand shows that the costs of landfilling domestic waste range from £5 to £30 per tonne. They estimate domestic waste incineration to cost between £15 and £30 per tonne. They have also predicted that future landfill prices will be between £11 and £47 per tonne (DOE, 1993).

7.2.3 Building more general models for Bring and Collect

In order to combat some of the local anomalies in the Glasgow and Falkirk systems, more general models were developed. These used the Glasgow and Falkirk models as a base, but produced results which are more generalisable in that they are intended to represent the average case. The models can be seen in Figures 7.3 and 7.4.

The Bring Model

The main change to the Glasgow scheme was to add a sorting operation. This meant adding the purchase of a baler, a forklift truck, nets, conveyors and a sorting platform to the capital costs **(B)**. The costs used were similar to those in the Falkirk model, except in the case of the MRF components, which were estimated by RECOUP. The introduction of a sorting operation also meant that the income per tonne could be raised to £80 in line with Falkirk **(A)**. This represents the average income from a range of polymers, and it was assumed that Glasgow would obtain a similar mix. The labour costs were recalculated using RECOUP's estimate of £80 of labour required for each tonne of plastics sorted and baled **(C)**.

Maintenance costs for the baler and bank maintenance which are currently carried by another department were also entered into the general bring model. The baler maintenance was based on the level required by the Falkirk system. The bank maintenance was estimated from the experience of other bring schemes **(M)**.

VARIABLES			
number of plastics banks	29		
total no. of banks	250		
population served	25 %		
price per tonne :		(A)	
mixed	£25.00	delivered	
PET	£90.00	Reprise	delivered
	£110.00	Wellman	delivered
natural PE	£100.00	delivered	
PVC	£75.00	delivered	
HDPE	£75.00	delivered	
cost per bank	£600.00		
frequency of pickup	7 days	14 days	21 days
number of sites	25		
bank lifetime	5	yrs (O)	
bank capacity	5	m3	
site maintenance	£1,000.00	\site \year	
tonnes collected	84.54		
average tonnage per bank	2.92		
CAPITAL COSTS		(B)	
cost of banks	£17,400.00	(G)	
baler	£10,000.00		
nets	£1,000.00		
MRF	£21,000.00		
forklift	£4,500.00		
Annual Capital Costs	£11,080.00		
Total Capital Costs	£49,400.00		
OPERATING COSTS			
bank maintenance	£1,000.00	(M)	
baler maintenance	£1,200.00		
site maintenance	£5,078.25	(H)	
promotion	£290.00	(I)	
coordination	£3,782.40	(C)	
bank empty	£5,759.72	(J)	
baling	£1,437.18	(F)	
baling/storage site	£22,000.00	(N)	
bulk transport	£1,537.09	(D)	
SORTING COSTS			
labour	£6,763.20	(C)	
Total Fixed Costs	£31,150.65		
Total Variable Costs	£17,697.19		
Total Operating Costs	£17,884.64		
Total Operating Costs\te	£577.81		
Total Capital Costs\te	£131.06		
INCOME			
recycling credit	£10.00	(E)	
revenue\te	£80.00		
Total Income\te	£90.00		
Total Costs\te	**£618.87**		

Figure 7.3 Generalised Bring Model

Site Maintenance costs account for 32% of the costs of processing each tonne of plastics in the original model. Since the Glasgow site maintenance costs were felt by the Recycling Officer to be slightly inflated (as discussed above), the Glasgow model was used to see what effect a reduced site maintenance charge would have on the annual financial cost per tonne of plastics processed. The results can be seen in Table 7.5.

As can be seen from Table 7.5, a reduction in the site maintenance costs to half of their current rate (£2000 per site each year) would reduce the cost per tonne by £60. This saving represents 16% of the total annual cost of processing each tonne of plastics. This was felt to be a more realistic proportion and was selected for the general bring model **(H)**.

Percentage of Current Site Costs	Annual Cost per Tonne (£/te)
10	267.20
20	279.22
30	291.23
40	303.25
50	315.26
60	327.27
70	339.29
80	351.30
90	363.31
100	375.33

Table 7.5 How reducing Glasgow's site maintenance charges affects costs

Recycling Credits were added to the general bring model at the same level currently enjoyed by Falkirk **(E)**.

It was also felt that although Glasgow has been fortunate in having the use of council buildings for nothing, that this was unusual. A charge of £22000 was made against rent and rates for premises in the general bring model. This figure was based on an average figure recommended by RECOUP (1993(b)) **(N)**.

The short 2.5 year lifetime of the Glasgow bottle banks has also been altered to a level of 5 years, which is a more normal life expectancy for this sort of equipment **(O)**. The bank design used by GDCCD is also unique: the 5m³ bottle shaped banks used as part of the Glasgow model calculations would not be utilised in an 'average' scheme. The financial effects of utilising these banks is explored later.

The Collect Model

In order to make the Falkirk model more general, capital costs have been entered against vehicle purchase, based on the estimate of a hire firm who sells similar vehicles second hand, and for MRF components, as estimated by RECOUP(1993(b)) **(B)**.

Since Falkirk is not charged for the collection bags it uses, it was also necessary to estimate a cost for these. This was based on their annual use of similar bags for their paper collection **(K)**.

VARIABLES			
price per tonne :			(A)
mixed	£25.00	delivered	
PET	£90.00	Reprise	delivered
	£110.00	Wellman	delivered
natural PE	£100.00	delivered	
PVC	£75.00	delivered	
HDPE	£75.00	delivered	
tonnes collected	72.24		
CAPITAL COSTS			(B)
trolleys	£2,898.30		
radios	£2,133.70		
baler	£10,627.74		
can densor and sorter	£8,227.87		
forklift truck	£4,535.00		
nets	£935.00		
vehicles	£6,000.00		
MRF	£21,000.00		
Annual Capital Costs/te	£163.85		
Total Capital Costs	£29,357.61		
COLLECTION COSTS			
vehicle maintenance	£2,304.32		(M)
insurance - road tax	£960.00		
fuel	£1,907.13		
employment costs	£13,105.81		
trainee costs	£2,808.39		(C)
collection bags	£3,000.42		(K)
protective clothing	£240.03		
SORTING/BALING COSTS			
bailer maintenance	£1,200.17		(M)
haulage	£2,167.20		(D)
trainee costs	£6,720.93		(C)
protective clothing	£420.06		
premises	£600.00		(N)
heat, light & power	£600.00		(L)
Total Fixed Costs	£2,580.06		
Total Fixed Costs\te	£35.72		
Total Variable Costs	£33,454.40		
Total Variable Costs\te	£463.10		
Total Operating Costs\te	£457.28		
INCOME			
recycling credit	£722.40		(E)
revenue	£5,778.40		
Total Income\te	£89.99		
Total Cost\te	**£531.16**		

Figure 7.4 Generalised Collect Model

The results of the two general models, compared to their source models can be seen in Table 7.6 below.

	Case Study Based Model (£/te)	Generalised Model (£/te)
Bring	375.33	618.87
Collect	456.40	531.16

Table 7.6 Comparison of costs of case study and general models

Once the full costs of the two schemes have been worked out, the bring scheme model can be seen to have much higher cost per tonne than either the general collect model, or the Glasgow model which it was based on. This outcome confirms the fear of the Recycling Officer that the true costs of recycling plastics in Glasgow is much higher than conventional accounting shows.

There is a large discrepancy in scale between the figures calculated here (Table 7.6), those given as average costs by RECOUP above or reported publicly by scheme operators (Table 7.2) and those reported in accounts by scheme operators. RECOUP believes that a collect scheme utilising bags rather than boxes as its collection receptacle should cost around £80 per tonne for collection of plastics, with a further £118 per tonne to sort, bale and transport them, adding to a total of £198 per tonne. The Coopers and Lybrand report put recycling cost for green bag schemes at between £75 and £95 per tonne (DOE, 1993). Falkirk reported to the Warren Springs researchers that their Net costs per tonne are £36 (Atkinson & New, 1993(b)). The accounts that they produced in the hope of attracting

Scottish Office funding show net costs ranging from £118.61 to £405.39 per tonne in different months, with an average net cost of £207.06. The model based on those same accounts, but including capital contributions calculated the cost per tonne to be £531.16.

This confirms the theory raised by the results of the literature search that there is a lack of consistency in cost reporting and calculation methods.

One of the possible reasons that RECOUP's figures seem so low is that they are calculated over 500te (RECOUP, 1993(b)). Considering that Glasgow and Falkirk have annual diversion rates of 84.54 te and 72.23 te per year respectively, it is easy to see that these schemes are of very different scales to the RECOUP hypothetical cases being examined and that this would therefore not be a reasonable comparison. This underlines the fact that participation is a crucial factor in scheme success, allowing fixed costs to be spread over a larger number of income earning units. It also highlights the need to declare the assumptions that are being made about participation and diversion rates in calculations of unit costs.

7.2.4 Economics of Participation

The aim of this section is to find out the effects of different levels of participation on the costs of the two schemes.

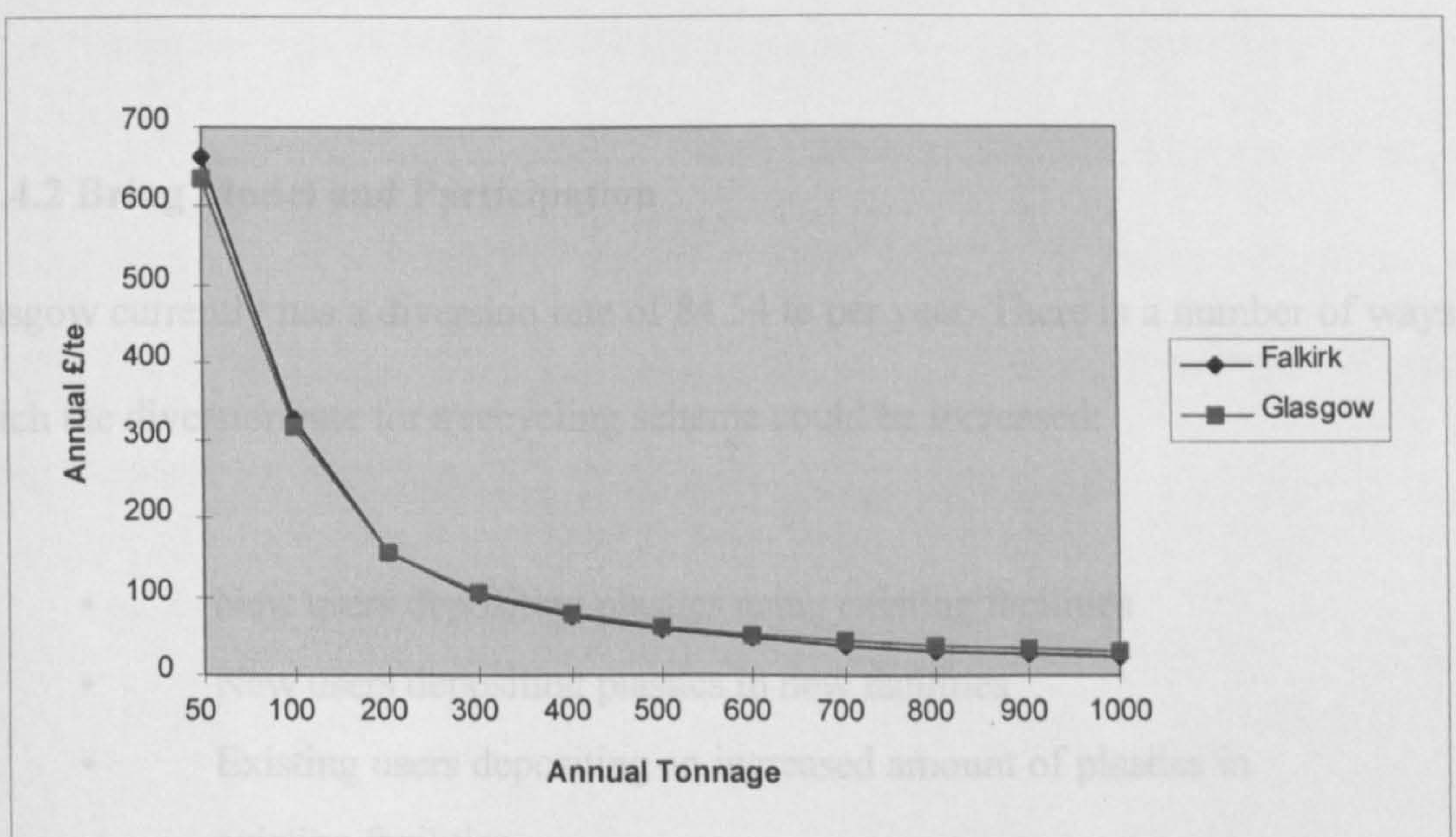
7.2.4.1 Breakeven Analysis

Tables 7.7 and 7.8 show the effects of higher throughputs of plastics on the financial accounts of the two schemes. This was done by gradually increasing the scheme throughput until a zero cost was approached. The full information is summarised in Graph 7.3.

On the basis of the information gained, in order to breakeven, the Glasgow scheme would need to collect 17500 te of plastics, whilst the Falkirk scheme would need to process 3370 te each year. Obviously, these tonnages are well out of the range of the schemes, now or in the future even if they were physically capable of processing these kinds of tonnages without meeting severe capacity problems. From the tables and graph above, it can be seen that there are diminishing returns involved. The steepest drop in costs per tonne occurs between the schemes' current intake levels and 200 tonnes per year. This shows that if the schemes could double or even triple their annual throughput of plastics, they could make a significant impact on their unit costs.

Tonnes Collected	Total Annual Cost (£/te)
50	635.86
84.54	375.33
100	317.02
200	157.60
300	104.46
400	77.89
500	61.95
600	51.32
700	43.73
800	38.04
900	33.61
1000	30.07

Table 7.7 How Glasgow's Total Annual Cost varies with tonnage



Graph 7.3 How cost per tonne varies with throughput

Tonnes Collected	Total Annual Cost (£/te)
50	663.76
72.23	456.40
100	326.88
200	158.44
300	102.29
400	74.22
500	57.38
600	46.15
700	38.13
800	32.11
900	27.43
1000	23.69

Table 7.8 How Falkirk's Total Annual Cost varies with tonnage

7.2.4.2 Bring Model and Participation

Glasgow currently has a diversion rate of 84.54 te per year. There is a number of ways by which the diversion rate for a recycling scheme could be increased:

- New users depositing plastics using existing facilities
- New users depositing plastics in new facilities
- Existing users depositing an increased amount of plastics in existing facilities

The first two scenarios involve an increase in the participation rate as well as in the diversion rate, whilst the third would increase the diversion rate, but not affect the participation rate. Laying aside for a moment the strategies required to produce these effects, the outcomes on annual cost per tonne for the first two scenarios were analysed using the Bring model.

Varying the number of banks

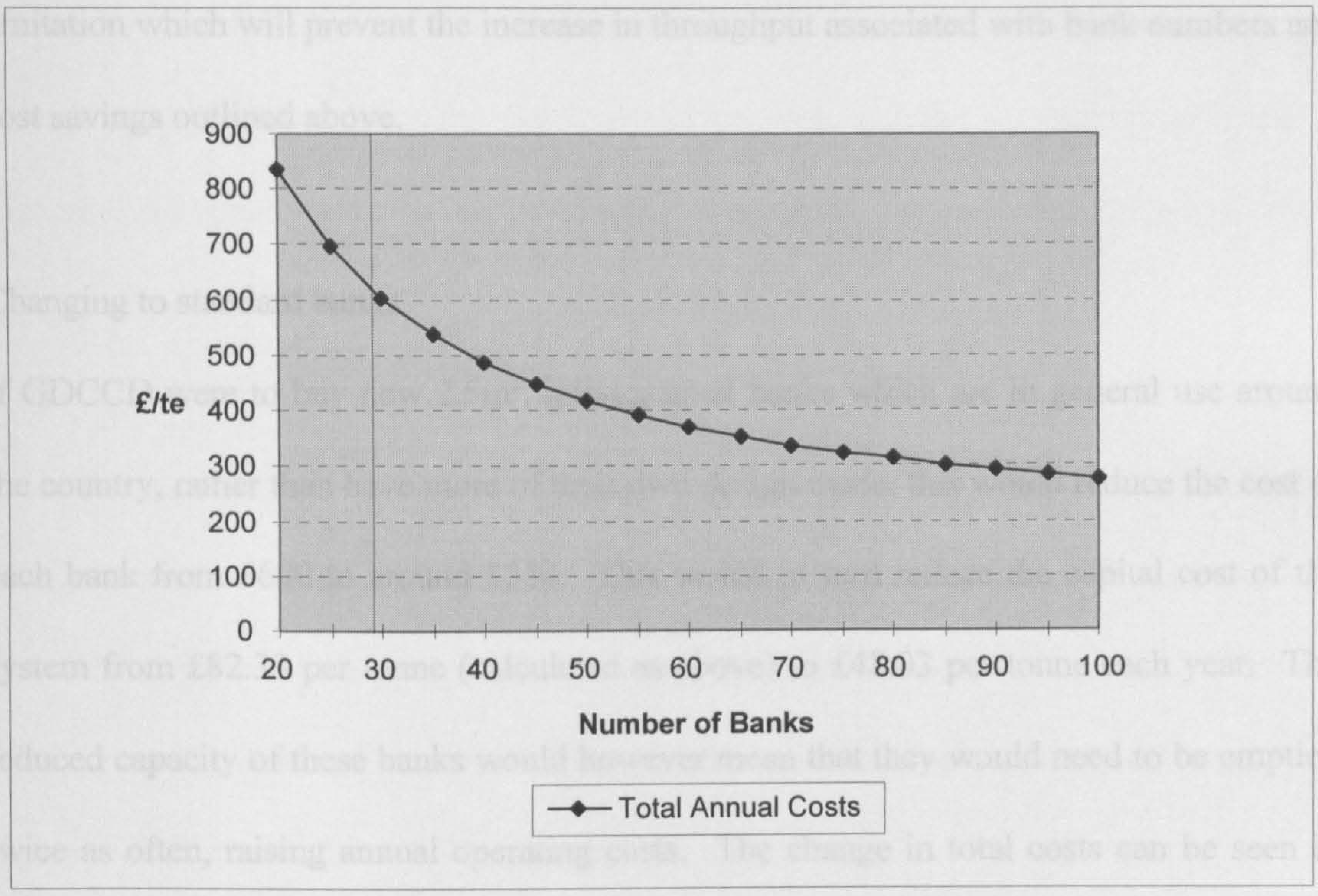
If the Glasgow scheme were to plan an expansion in intake of plastics, one possible option might be to change the number of banks that it provides for the collection of plastics. In this analysis, the assumption was made that each of the new banks would yield the same average tonnage as the existing banks. The change in cost per tonne would be as described in Table 7.9.

If the number of banks run by the scheme were to increase there would be a corresponding rise in the capital cost of banks, bank emptying costs, and all maintenance costs. As the tonnage collected rose, the sorting, baling and delivery of plastics would rise proportionally. There will however also be a rise in income. As can be seen from Table 7.9, this rise in income has offset the rise in costs, making it cheaper per tonne to process higher throughputs of bottles.

Number of Banks	Annual Tonnage	Total Annual Costs (£/te)
20	58.30	835.30
25	72.88	695.82
30	87.46	602.84
35	102.03	536.42
40	116.61	486.61
45	131.18	447.86
50	145.76	416.87
55	160.33	391.51
60	174.91	370.37
65	189.49	352.49
70	204.06	337.16
75	218.64	323.88
80	233.21	312.26
85	247.79	302.00
90	262.37	292.88
95	276.94	284.73
100	291.52	277.39

Table 7.9 How cost/te varies with bank numbers

Graph 7.4 shows that the cost per tonne drops most steeply between the current level of banks and 50 or 60 banks, where it begins to level off. In terms of cost per tonne, there is less to be gained by an incremental increase in throughput after this point.



Graph 7.4 How the cost per tonne varies with the number of collection banks

It is also interesting to note that the steepest gradient in cost change lies between the lowest point of analysis and the current number of banks. This shows that any drop in bank numbers would be detrimental to the cost of each tonne processed.

The only facilities in the bring model which have capacity constraints are the sorting and baling operations. The throughputs of these processes are estimated to be around 1.5te per day for sorting and 2te per day for baling, based on data from the Sheffield system. This means that the sorting operation is the operational capacity constraint. Sorting 1.5te of bottles each day corresponds to an annual throughput of around 350 tonnes. At the current level of donation, this would require 120 banks. There is clearly no capacity limitation which will prevent the increase in throughput associated with bank numbers and cost savings outlined above.

Changing to standard banks

If GDCCD were to buy new 2.5m³, igloo shaped banks which are in general use around the country, rather than have more of their own design made, this would reduce the cost of each bank from £600 to around £350. This would in turn reduce the capital cost of the system from £82.33 per tonne (calculated as above) to £48.03 per tonne each year. The reduced capacity of these banks would however mean that they would need to be emptied twice as often, raising annual operating costs. The change in total costs can be seen in Table 7.10.

Number of $5m^3$ Banks	Number of $2.5m^3$ Banks	Total Number of Banks	Annual Operating Cost (£/te)
20	0	20	475.79
25	0	25	411.05
29	1	30	738.24
29	6	35	720.83
29	11	40	705.94
29	16	45	738.82
29	21	50	724.68
29	26	55	712.22
29	31	60	701.17

Table 7.10 How cost/te varies with bank numbers

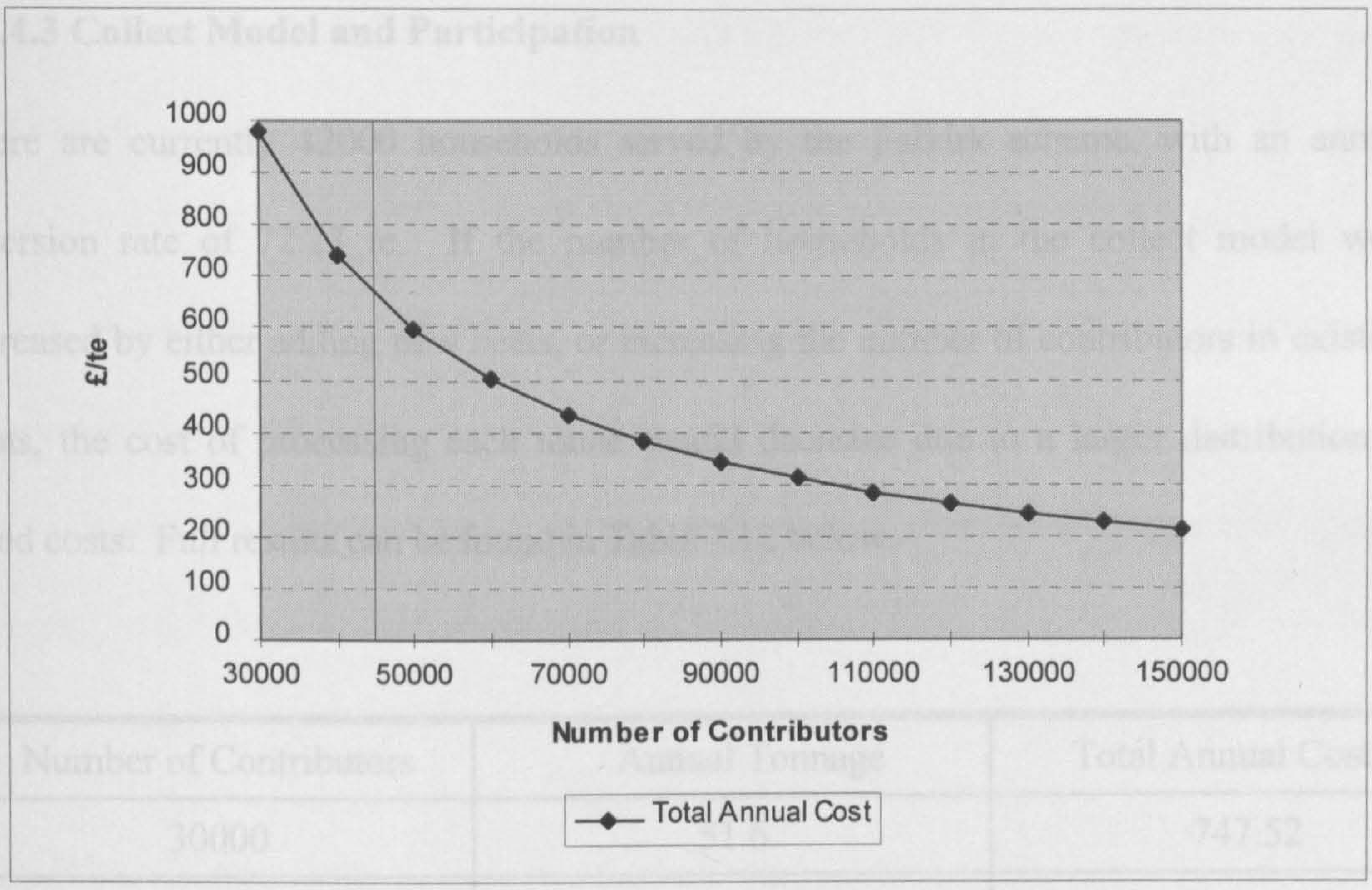
As can be seen from Tables 7.9 and 7.10, the decreased capital costs of the banks is not enough of a saving to offset the rise in emptying costs and the corresponding limits in capacity (and hence yield), making continuing to purchase 5m³ banks the cheaper policy.

Varying the number of contributors

From the results of the survey in Chapter 4, the expected value of plastics donated in Glasgow was calculated to be nearly 7 bottles per household each week. This corresponds to a weight of around 350g of plastics per week. Over a year this would amount to around 17.5kg per contributing household. At the current rate of collection, this would imply that there are 4831 contributors to the scheme.

If the numbers of contributors increase, the costs of processing each tonne will fall (see Table 7.11). As can be seen from Graph 7.5, the steepest part of the cost curve is between 30,000 contributors (which represents a down scaling of the operation) and 50,000 contributors. This bring scheme will find the greatest cuts in cost per tonne to be gained between its current level of operation and about 80,000 (140te).

Although the Recycling Officer estimated that the plastics banks sites serve around 25% of Glasgow's population, the current level of use only represents around 0.7% of the population (Scottish Office, 1993).



Graph 7.5 The effect of more contributors on total annual cost per tonne

Number of Contributors	Annual Tonnage	Total Annual Cost (£/te)
30000	52.5	981.19
40000	70	742.19
50000	87.5	598.79
60000	105	503.19
70000	122.5	434.90
80000	140	383.68
90000	157.5	343.68
100000	175	311.98
110000	192	285.91
120000	210	264.18
130000	227.5	245.80
140000	245	230.04
150000	262.5	216.38

Table 7.11 The effects of numbers of contributors on total annual cost per tonne.

7.2.4.3 Collect Model and Participation

There are currently 42000 households served by the Falkirk scheme, with an annual diversion rate of 72.23 te. If the number of households in the collect model were increased by either adding new beats, or increasing the number of contributors in existing beats, the cost of processing each tonne would decrease due to a larger distribution of fixed costs. Full results can be found in Table 7.12 below.

Number of Contributors	Annual Tonnage	Total Annual Cost (£/te)
30000	51.6	747.52
40000	68.8	558.14
50000	86	444.51
60000	103.2	368.76
70000	120.4	314.65
80000	137.6	274.07
90000	154.8	242.51
100000	172	217.26
110000	189.2	196.60
120000	206.4	179.38
130000	223.6	164.81
140000	240.8	152.33
150000	258	141.50

Table 7.12 The effects of numbers of contributors on total annual cost per tonne.

Like the Bring scheme, the only parts of the operation with capacity constraints are likely to be the sorting and baling systems. This means that once again the constraining factor is the throughput of the sorting operation, which is a daily rate of 1.5te. This corresponds to an annual throughput of 350te. The major constraint on this model then would be the number of households in Falkirk which is certainly less than the number shown on Table 7.12 above.

As can be seen from the preceding analyses, participation rates make a big difference to the unit cost of collecting post-consumer plastics for recycling. However, these are seldom made explicit, treating the system as a production operation, in which optimal efficiency can be calculated, rather than a social process.

7.3 Other Measures

Although it is important for the manager of a scheme to ascertain and monitor its financial situation, it should not be judged on its finances alone. Since collecting plastics for recycling has an associated cost which has been shown to be quite substantial and funds available to scheme operators are often limited, it is understandable that the primary measuring stick is likely to be a financial one. Minimising cost (or even maximising profit!) is not however generally the sole objective of collection schemes. The following section outlines a number of possible aims of post-consumer plastics waste collection systems and suggests measures which will help monitor their progress towards those aims.

To divert post-consumer plastics waste from the domestic waste stream.

This is measured by the diversion rate. This can be defined as the amount of post-consumer plastics waste diverted from the traditional waste stream by a scheme, and can also be calculated as a proportion of the total plastics waste produced by the population that the scheme serves. This gives a better picture for comparison, as for example the

Glasgow and Falkirk schemes studied had diversion rates of a similar order, (84.54 te and 72.23 te per year respectively) but serve very different scales of population.

Since all of the schemes in the UK are in the voluntary or public sector, increasing the diversion rate can be regarded as a primary aim. If legislation from the EC makes plastics recycling necessary for all EC countries, the legislation will be expressed in terms of diversion rate. As shown above, the number of tonnes processed by a system also has an effect on the costs of an operation, as economies of scale are available.

To get as many people to contribute to a plastics recycling scheme as possible.

This is measured by the participation rate, which can be defined as the proportion of a population who participates in a scheme, again, this can be made more meaningful for comparison by calculating it as a proportion of the total population who have the opportunity to participate. Estimated participation rates, based on the proportion of the population covered by each scheme, and the number of contributing households indicated by the diversion rates, would be 0.7% for Glasgow and 9.83% for Falkirk.

The number of people who participate in a scheme will influence the viability of an operation in two ways: the more people who contribute, the greater the diversion rate; and the lower the processing costs will be for each tonne of waste.

Provide a sustainable waste management system

Quite apart from the fact that recycling will soon be a legal requirement, a simple financial evaluation of recycling fails to consider that "the way we generate, throw out and dispose of waste is unsustainable" (Wright, 1990).

In order for a recycling operation to be financially viable, the costs of collection and sorting must be less than the amount that the collected material can be sold for. However, as Turner points out, the amount that a tonne of sorted plastics is worth in terms of market prices, or what Deyle and Schade define as "private financial analysis", does not take into account the value that the resources may have to future generations (Deyle & Schade, 1991). This introduces the concept of 'option value' which can be defined as "the value given to a resource which is over and above the willingness to pay because, for example the resource is irreplaceable, the decision cannot be reversed by future generations or outputs may be replaceable only at high cost if current action is not taken" (Haveman & Weisbrod, 1977).

Dispose of domestic waste in ways which have the least possible impact on the environment

It is important to measure the environmental impact of a recycling scheme. It should not be assumed that because recycling is a practice associated with the green movement that introducing a recycling scheme will automatically reduce the environmental impact of plastics packaging or of waste disposal practices. One of the concerns of the EC is that the environmental costs and benefits of a number of waste management options should continue to be examined, so that if another option should become more environmentally acceptable in the future, it should be allowed to replace recycling as their recommended treatment of packaging. (EC, 1994).

As well as establishing the environmental impact of material recycling as compared with traditional waste management and other options such as incineration with heat recovery or chemical recycling on a national level, it is also necessary for individual schemes to monitor their impact in environmental terms. Measuring the environmental impact over time will help a scheme be aware of and reduce the costs of its efforts in terms of the environment.

It is possible that the environmental impact of pilot schemes or new ventures will be as high as, or even higher than the previous waste management practice. This is because the small amounts of material diverted from the waste stream will not have much short term effect on the existing waste services (DOE, 1991). Until the amount and range of materials grows and the learning curves of the consumers and collectors are climbed, the environmental impact of the scheme may well be higher, in that it represents the introduction of a second system, which is to some extent parallel to the first.

Important environmental measures might include the amount of material and energy resources utilised in the processing of each tonne of plastics. The gathering of this sort of information is however a complex and difficult task. Studies which undertake to measure the resource use of different options (e.g. recycle, landfill, incinerate) are often called Life Cycle Analyses or Cradle to Grave analyses (Klöpffer & Rippen, 1991).

Create new/more flexible/specialist employment in an area.

As a new industry, plastics recycling obviously has the potential for the creation of many new jobs. There is often a link made between the provision of recycling services and the creation of jobs for the unskilled. Some schemes have job creation as an equal objective to the diversion of waste, whilst some, although they believe it to be an important aspect of their scheme's contribution, do not express this explicitly.

Bollard (1982) estimates that if 10% of post-consumer plastics waste were to be collected and separated, "it could spawn a recycling industry capable of generating another 20000-40000 jobs".

Quigley (1988) calculated that in Ontario, one full time job was created for every 245 tons of material recycled per year. For Nebraska, there was a job created for every 660 tons per year and per 1306 tons per year in California. For collection of recyclables only, he found that a scheme in Texas had created one full time job per 133 tons per year and in Philadelphia, there was a job for every 250 tons per year. Estimates for schemes which only process recyclables ranged from 156 tons per year for each new job in Philadelphia, 208 in New York, 577 in Chicago up to 650 tons per year for a new job to be created in New Jersey.

Some UK schemes have purposely used their job creation powers to benefit groups who would otherwise find obtaining work difficult. These include the long term unemployed, mentally and/or physically handicapped individuals and arranging special work shifts for mothers with school age children.

To run an efficient/productive/quality operation.

A scheme might also be interested in internal operational measures, such as

Efficiency/Productivity

The cleanliness of each bank site (perhaps determined using photographic indicators)

The efficiency of each route or bank, measured by determining the yield of plastics for each.

The amount of plastics processed each day. This could be also be expressed per worker.

The number of tonnes processed or sold each year could also be a crude measure of efficiency, as could the number of households covered by the scheme.

The turn around time for a bale or tonne of plastics, expressed in man hours might be a measure of the efficiency of the internal process organisation.

The time taken to complete a round of door to door pickups, or empty a set of banks might also be measured.

The number of bins between 85 and 95 per cent full at the time of emptying would indicate the efficiency of the bank emptying programme design.

The number of plastics recycling banks per head of population, or conversely, the population served by each bank might also give an indication of efficiency.

When comparing bank sites, a measure of sphere of influence might be appropriate.

Quality

a crude measure of service quality might be the level of customer complaints

The level of customer satisfaction could however be sought in a more active way by surveying the scheme users in a similar way to that described in chapter 4.

A related issue is the quality of information given out by the scheme. Again, a crude measure might be the number of customers seeking clarification, but a better test might be the determination of how well the information had been followed. This might include analysing the unsorted plastics to determine the percentage of bags which had been tied, bottles which had been squashed, lids removed, plastics and non-plastic contraries present, and for those schemes which require the public to pre-sort its plastics, the accuracy of the sort.

The quality of the sort undertaken by the organisation could also be measured, by asking reprocessors to state the percentage contraries present amongst the segregated polymers they receive.

A similar indicator might be the number of bales accepted by the reprocessor as a proportion of the total bales presented.

These sorts of measures are not ones which could be easily adopted by or even meaningful to small scale operations. They are aimed at larger, stable state schemes, or perhaps bodies like RECOUP who oversee a number of operations and have access to resources for this sort of research and an interest in the long term future of plastics recycling. It is perhaps important for schemes to consider the possibilities of data collection and process analysis when they are still at the design stage.

It is important for schemes to decide at the beginning of their operation which kinds of goals they will have, what sort of relative priorities goals will have and how any progress towards these goals will be measured. This will allow schemes to begin to collect data which is relevant to other goals as well as the necessary financial ones and have a sense of achievement and purpose.

7.4 Conclusions

An examination of the literature shows that there has been little evidence of, or regard given to, the possible transferability of research outcomes between different recycling schemes. This may be due in part to differences in some of the characteristics of the schemes studied, such as the culture they operate within or the material, or combination of materials they are aimed at. The main problem however seems to lie in the range of methods of calculating cost data and the reluctance to be explicit about these methods.

Many studies appear to declare marginal or operational costs per tonne without specifying whether capital or start up costs, for example have been included. Optimistic estimates which do not give the full cost of a scheme can be misleading. It is vital that the full costs of recycling are assessed and explained so that existing schemes can measure their progress and potential operators have a realistic view of the financial commitment involved in different scheme designs. This will become particularly pertinent once a requirement to undertake the recycling of all materials has been incorporated into UK legislation.

If the effects of different practices are measured and shared, then good practice can be identified. If similar measures are used by a number of like processes, then their outcomes can be compared. The evaluation of post-consumer plastics waste recycling systems in a consistent and systematic way will mean that the experience of the disparate schemes can be shared and applied, benefiting the whole industry and lowering the investment required by individual schemes for each improvement.

The financial evaluation of the Glasgow and Falkirk schemes showed that both operations make a considerable loss for each tonne of plastics they process. The general models developed from the framework of the case study models both showed greater losses per tonne than the original models. The general models also showed the bring operation to be more expensive per tonne than the collect operation.

Financial analyses have a vital contribution to make to the management of plastics collection schemes. As well as the more traditional uses, they can be used to explore issues of scheme design. The example given above of comparison of Glasgow's larger plastics banks with the more conventional choice illustrates the kind of decision support that can be derived from a marginal cost model such as employed in this chapter.

Analyses showed that the participation rate has a significant effect on the financial viability of a scheme, regardless of its chosen method of collection. Both schemes had a huge propensity to cut marginal costs per tonne of plastics processed by increasing their throughput. Table 7.7 shows that an increase in Glasgow's annual tonnage by less than 20% to 100te per year would give a cost saving of around 40% per tonne. Table 7.8 demonstrates that a rise in throughput to 100te per year, which would represent a rise of just under 40% on their current material handling rate, would result in a cut in costs per tonne of around 30%. Although the savings per tonne are potentially high for both schemes, Glasgow clearly has the most to gain from even a very small increase in its throughput.

Both schemes also had considerable scope for increasing their capacity considerably without changing the basic equipment or processes currently employed. The illustrations above of the possible savings associated with a target throughput of 100 tonnes per year are certainly within the reach of both schemes. Strategies to increase participation should be pursued by operators in an attempt to instigate these economies of scale. In order to reach this level of throughput Glasgow should continue to invest in the larger banks and aim to increase their spread across the city, perhaps locating a further five in sites that are known to be well patronised by the recyclers of other materials. In order to achieve the more substantial proportional increase in throughput, Falkirk should consider growing each of their current beats by a few streets, or adding a new one. The effects of such changes to the schemes could be assessed financially through the use of the models constructed above.

Increasing the diversion rate and participation rate of a scheme should be considered important objectives of any post-consumer plastics waste recycling operation. They should be declared as such and attempts made to estimate them on a regular basis to allow staff and contributors to assess their progress.

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Chapter 8: Conclusions and Recommendations

8.1 A Review of Research Aims

The purpose of this thesis has been to investigate the management of post-consumer plastics waste recycling in the UK. This has been undertaken through the pursuit of a numbers of research objectives which are:

- to create and summarise knowledge about post-consumer plastics waste recycling;
- to look for ways that plastics recycling can be promoted by creating powerful and interested stakeholders;
- in particular, to research the nature and extent of public participation in post-consumer plastics waste recycling schemes, and how this can be improved;
- to take a practical and empirical research approach to these objectives with the hope of influencing practice;
- to include a number of stakeholder viewpoints and research methods when addressing these issues.

The following sections review the programme of research, considering how each of these objectives has been approached, and evaluates how successful the studies have been in meeting these objectives.

8.1.1 The Creation and Presentation of Knowledge About Plastics Recycling

The objective of creating and presenting more knowledge about post-consumer plastics waste recycling has been pursued throughout these studies. It has been tackled through fieldwork visits, extensive literature search and review on general, motivational, legislational and economic issues as well as the empirical studies presented in Chapters 4, 6 and 7. The thesis provides a great deal of new information to the field as well as bringing together and summarising much information which has not previously been treated in this way.

8.1.1.1 New Information

Examples of contributions to knowledge about post-consumer plastics waste recycling include the attitudes and behaviours of plastics recyclers and the costs associated with collecting bottles for recycling in the case study schemes, presented in Chapters 4,6 and 7 respectively.

Whilst the results of the survey in Chapter 4 are constrained in terms of generalisability by the make up of the sample taken, they give a great deal of insight into the 'who, what, where, when and how' of plastics recycling in these two schemes. The more in depth consideration of the 'what and how' which Chapter 6 gives represents important exploratory research into the reality of recycling for individuals. This points to the need for a reconsideration of the way the donor should be considered and addressed. It also frames the recycling act in a domestic context. Chapter 7 addresses an equally important issue for plastics recycling, on which information is scant and confusing: how much does it cost? Through the building of first specific and then general cost models, information has been gathered and generated to address that question. What is most interesting about the result of this modelling is not the cost estimates themselves, but the huge difference between them and all previous cost reports. This work has uncovered the full cost of recycling and makes clear the need to collect more information and measure more aspects of performance.

8.1.1.2 Present and Review Existing Information

The main contributions to this area are the results of the various literature reviews and field work visits undertaken. The programme of fieldwork visits has provided a lot of information about what is actually happening in terms of recycling plastics from domestic waste in the UK. The collection of pictures and descriptions presented in Chapter 2 provides a comprehensive outline of the many activities and possibilities that exist, as well as providing context and background to the studies that follow. Knowledge about each stage in the recycling process had tended to become localised within that stage and is not flowed to or from the upstream or downstream processes. This account transcends the stakeholder boundaries and takes a systems level view of the industry. The picture is completed by reference to general information from a wide range of sources.

The summary and review of legislation that is included in Chapter 3 brings a systematic and thorough approach to this important body of knowledge. Obviously, legislation does exist and is debated in the waste management literature. However, in its original form it is inaccessible both in terms of location and language. Also, where it is reported or discussed in the literature, the focus tends to be on individual pieces of information or countries. The summary approach then provides a wealth of information about different forms of legislation and the policies of other governing bodies around the world which has not previously been attempted.

The literature review contained in Chapter 5, which is concerned with psychologists' approaches to increasing the motivation of recyclers is another example of a large body of knowledge being summarised in one place and being made available to an audience that would not have necessarily consulted it.

The review of literature pertaining to the costs and/or economics of recycling has also stepped outside boundaries in this way. It brings together, compares and evaluates approaches to costing that hail from many different sources. It does not take the viewpoint of Cost Benefit Analysis, of financial breakeven, or of the practitioner, but locates and compares the outcomes of as many different studies as possible. This strategy leads to a discussion of what is often left unsaid in accounts written for a peer audience.

In summary then, although this thesis has by no means located or generated all the different kinds of information that might be relevant to the management of post-consumer plastics waste recycling, it has successfully met its objective of increasing the amount and accessibility of information in this field.

8.1.2 Promote Plastics Recycling

Some of the stakeholders identified in Chapter 1 have been paid more attention than others. As has been stated above, and is discussed in the next section, the rôle of the public in post-consumer plastics waste recycling has been a particularly important focus for this thesis.

As the main impetus for the introduction of plastics recycling schemes in the UK, Collectors have also been considered in this study. The fieldwork presented in Chapter 2 gives background to the issues that Collectors face and the scheme design options that they may choose. The most thorough examination of their practices has been conducted through the financial modelling included in Chapter 7. This highlights the costs of their operations and explores the links between marginal cost and participation. An increase in the level of participation in a recycling scheme is identified as a key to an increase in stakeholder power.

The other main body that is considered here is the Government. Like the general Public, the Government have a potentially pivotal rôle in the future success of recycling plastics from domestic waste. The work that is outlined in Chapter 3 on legislative moves by other governments looks for appropriate ways for the UK government to make changes to the profile and success of post-consumer plastics waste recycling in this country. The introduction of legislation could result in changes in both the power and interest for many of the other stakeholders.

In order to make clear the significance that the studies described in this thesis have for the various stakeholders in UK plastics recycling, this Chapter provides a summary of action points for each of them. Translating the research outcomes into policy advice and addressing each stakeholder explicitly in this way is a direct attempt to make possible the shifts in power and interest described in Figure 1.5.

Although these studies do deal to an extent with each of the plastics recycling stakeholders, they have selected some to be treated in a much more comprehensive way. The Public, the Collectors and the Government have been identified as particularly important and the issues relevant to them have been studied more thoroughly. Whilst the various means employed to study these stakeholders has indeed highlighted ways in which they can achieve the necessary movements towards interested, empowered parties, the other bodies identified in Chapter 1 have not been so closely studied and therefore are less well understood.

8.1.3 Investigate Public Participation

Public participation was first identified as a central and underestimated element of successful recycling through the work carried out for Chapter 4. This chapter took up the viewpoint of the general public and sought to discover their perceptions of plastics, their recycling behaviour and what motivated them to recycle. The study was successful in illumination of the first two aims, but unsatisfactory in terms of the third. The importance of motivation in relation to recycling and the difficulty of obtaining data about it were both made apparent by this study. Much of the remainder of the work for this thesis was dedicated to the pursuit of understanding public participation. The theme was first developed through the review of literature presented in Chapter 5 and then through the ethnographic study of recyclers which is outlined in Chapter 6.

Together these studies provide a significant insight into the issue of participation and uncover a new understanding of post-consumer plastics recycling as an act grounded in domestic routine. They highlight the need for convenient schemes and define convenience in terms of scheme consistency, accessible instructions and their ability to be absorbed into the pattern of household tasks. These studies of participation are a major contribution to the field and afford a basis for both practical advancements and further academic study.

8.1.4 A Practical and Empirical Approach

During the early stages of this study an effort was made to interview individuals who were involved in various aspects of plastics recycling. Information about the industry was gathered from Ron McLaren, Director of Dundee Plastics Manufacturers Ltd, Ann Whitehead of SWAP, John Simmons, Director of RECOUP, John McKendrick, Recycling Development Officer for UK2000 Scotland, Mark Powell, Manager of Sheffield Reclamation Limited, Dr Rolf Matthews, Recycling Officer for Glasgow District Council, Adrian O'Dell, Operations Manager of SCP Action Recycle, Bill Moffitt, Environment Consultant for The British Plastics Federation, Terry Taylor-Brown, Director of Recovery Plastics Ltd, Rita Crowe of Scottish Conservation Projects, Jim McLeary, Manager of JW Hannay Paper and Plastics Recyclers' Broxburn

Plant, Mike Tomlinson, Group Leader of the Polyolefins Research and Development Section of BP Chemicals and the Manager of Reprise Technologies, the Liverpool based Reprocessor. To supplement this information and provide a first hand understanding of the collection processes, a week's voluntary work was done with both Action Recycle in Falkirk, and Sheffield Reclamation Ltd. This system of fieldwork visits ensured a thorough grounding in the real issues affecting members of the packaging chain and forms the basis of much of the information presented in Chapter 2 and the case study cost data that the Glasgow and Falkirk models are built from in Chapter 7.

The views and behaviours of the general public have been extensively researched through the complimentary studies that are presented in Chapters 4 and 6. Both of these studies have taken an empirical approach in order to determine the patterns of recycling behaviour and attitudes towards the recycling processes of members of the public.

Overall, the studies that combine to make up this thesis include a combination of practical and empirical approaches to the issues surrounding the recycling of plastics from domestic waste. The outcome of the thesis is therefore a set of recommendations to each of the stakeholders which is based not on library research or theoretical development, but on the analysis and synthesis of information provided by the stakeholders themselves. It is a work which is well grounded in the reality of post-consumer plastics recycling.

8.1.5 Multiple Approaches and Viewpoints

This thesis presents the accounts and findings of several different research strategies which have been aimed at learning about the management of post-consumer plastics waste recycling. One of the strengths of allowing the stakeholder viewpoint and research method to change over the course of the thesis is that it facilitates the presentation of a rich picture of the issues relating to post-consumer plastics waste recycling. Whilst these studies have sought the practical focus common to Operational Research, the combination of different research approaches has avoided their tendency to make simplifying assumptions about the research subject in order to apply modelling techniques. This has resulted in the complexity of the issues being addressed in a more satisfactory way. It is felt that the practical significance of the research findings has been enhanced through this strategy.

8.1.6 Changing Research Purpose

The studies reported here represent a learning experience for the author both in terms of knowledge about the field of Waste Management and also about the research process itself. As my understanding of the issues involved has deepened and my experience of research techniques has widened, my views on what is important in this field and how that might be tackled have changed. It has truly been a research apprenticeship.

It is important that the doctoral research process allows for an emergent research purpose. The expectation that research purpose will or may change liberates the role of learning within the context of the thesis. It means that the refining of views and skills can be incorporated into the thesis and allowed to influence subsequent work. A view that purpose will be emergent rather than static and pre-determined also means that research objectives must be constantly reflected on and re-evaluated and are never allowed to become implicit or assumed. This ensures that the researcher's mind is kept open to new possibilities and has the potential to foster research which is less restricted by the researcher's own historical experience.

8.2 Research Findings: An Overview

Waste Management in the UK is changing. Legislation which aims to reduce the environmental impact of waste disposal throughout Europe, such as the EC Directives on Incineration Emission Control (EC, 1989), Landfill Practices (EC, 1993), and Packaging and Packaging Waste (EC 1994) is combining strategies of making traditional waste disposal safer (and also more expensive), and carving out new routes for domestic waste. The introduction of large scale domestic waste recycling has been selected by the EC as an important strategy for improving waste management practices and enabling sustainable waste management in its member states (EC, 1992).

In the UK, in accordance with, and in anticipation of, legislative moves from the EC, these principles are also being realised through national legislation. The Environmental Protection Act introduced new responsibilities for those handling and storing waste in the form of duty of care and landfill licensing measures. The EPA was also responsible for separating the disposal and regulation duties of local authorities (DOE, 1990(a)). The introduction of these measures has rendered domestic waste disposal practices safer and more accountable. The EC emphasis on recycling as a new priority strategy for waste management has been translated into the UK recycling policy outlined in the 1990 White Paper on the Environment. In *This Common Inheritance* the Government specified a national recycling target of 25% of domestic waste by the year 2000. It also asked local authorities to produce recycling plans and pay recycling credits as part of the means of facilitating this objective (DOE, 1990(b)).

The adoption of these policies has undoubtedly helped the growth of recycling. It shows an increased interest in recycling on the part of the government and designates the local authorities as responsible for the introduction and planning of recycling developments. In that the development of legislation can be taken as evidence that the government is focusing on waste management issues in general, and recycling strategies in particular, the generation of recycling policy must be seen as a positive contribution to the recycling industry.

These policies are not however backed by the funding, legislation, standards or research required to underpin a recycling industry capable of meeting the targets that have been set. A 25% diversion rate may be within the grasp of a few councils, but it is extremely unlikely that the average UK recycling rate will be approaching 25% at the turn of the century. Achievement of the EC targets, which specify a percentage of each material to be recycled as well as an overall target, will certainly require a comprehensive program of support and resource investment. This is perhaps particularly true for plastics recycling where the industry is more fragmented, markets are less well developed, the recycling process is more complex and public sympathy is lower than for other materials.

As a result of industry collaboration in response to increased pressure to support recycling, post consumer plastics waste recycling facilities are becoming available to more and more people throughout the UK. The process of co-ordinating research efforts and pooling information has also been initiated.

In order to consolidate this progress, the flows of information must be increased, formalised and standardised. The information available is not sufficient in terms of either quantity or quality. This is perhaps exemplified by the fact that neither the DOE nor CIPFA know how much domestic waste is produced in this country each year. In order to begin to assess the costs and effects of different collection strategies, for example, more information must be gathered on a much bigger scale and systematic manner than is currently being undertaken. It is important that transparent and agreed measures are developed and implemented by the industry.

At the moment, there is not enough movement of knowledge and experience:

- between the different stages of the plastics packaging lifecycle;
- between similar plastics recycling operations in different geographical locations, in this country and abroad;
- between similar operations aimed at different materials.

If information can be shared by as many parties as possible, then this will reduce the isolation that is felt by each link in the chain. It will also help promote the standardisation of the recycling services available and prevent individual schemes investing their constrained resources in expensive mistakes and in reinventing the wheel.

Despite the problems that are unique to the plastics recycling industry, such as low weight to volume ratios, and the need to achieve efficient and thorough separation of polymers, the technology and systems to collect and reprocess large volumes of plastics from the domestic waste stream **do** exist. What the system lacks is market pull to provide an impetus for large scale expansion. Market development is required to encourage the use of recycled plastics by consumers, fillers and manufacturers alike. Perhaps the key to this is the promotion of primary recycling of plastics containers. Economic instruments could be utilised to differentiate between manufacturers who have and have not invested in the technology to make use of recycled feedstocks, those who have and have not made efforts to design their packaging with a view to facilitating recycling, or packaging products containing different levels of recycled material, for example. This is in line with the stated preference of the UK Government for economic instruments as a method of intervention in *This Common Inheritance*.

Education will be required for all members of the packaging chain, in order to dispel myths and build confidence in recycled plastics, but it is perhaps most greatly needed by the general public. It is important to make people aware that plastics can be recycled, that their properties do not deteriorate with this process, that there are only a few polymers in common household use, and that these can be easily identified.

This thesis has studied post-consumer plastics waste recycling in detail and would characterise it as an important new waste management strategy. EC legislation will soon make recycling a requirement in the country, but the importance of implementing effective and timely strategies for the realisation of the recycling of plastics from domestic waste lies beyond a need to meet legislative targets. Recycling is a significant part of a sustainable waste management strategy for the future. This thesis has emphasised the rôle of the public in diverting plastics from the municipal waste stream and thereby reducing the environmental impact of waste management practices.

Participation should be regarded as a central issue for any recycling venture, and is best studied using qualitative research methods. The collection of domestic waste for recycling is heavily influenced by social processes. Collectors **cannot** buy their raw materials, but are dependent on the good will of the general public for their supply. The key to this does not lie in the selection of bring or collect systems, but in the development of convenient and consistent recycling services. This will probably mean combining bring and collect strategies in order to provide uniform access and opportunity across the population. Participation should be measured and monitored and published as part of normal operations.

To say that post-consumer plastics waste recycling is not currently financially viable, and that the EC target for 15% by weight of plastic packaging waste to be recycled by July 2001 will simply not be met is too gloomy an epitaph for a thesis which is concerned with an enthusiastic, committed, robust and innovative community of schemes. The small scale of current projects and fragmentation of, and lack of resource within, the industry mean that the targets will be difficult for the UK to meet, however it should not be forgotten that tremendous progress has already been made in many aspects of plastics recycling. It is important for the industry to recognise both the market instability and the public's aversion to change as typical reactions to new ventures which may be resolved over time and not let these sway its resolve to provide and promote more environmentally acceptable and sustainable waste management services.

8.3 Conclusions and Recommendations

The following sections present the substantive findings of the studies outlined in Chapters 1 to 7 of the thesis and outline the specific recommendations for each of the various stakeholders involved in the post-consumer plastics waste recycling industry.

8.3.1 Industry Bodies

An important conclusion of the programme of fieldwork and literature review outlined in Chapter 2 is that the post-consumer plastics waste recycling industry in this country is highly fragmented. The various members of the packaging chain are not used to regarding themselves as part of a larger system. They do not have contacts with other stakeholders which allow them to understand or to debate the requirements and opinions of those further up or downstream from their own processes, nor a means of reflecting on the effectiveness of the system as a whole. Industry bodies, such as RECOUP and

BPF should continue and intensify their work towards stimulating information flows and providing forums which will tackle the parochial views of individual stakeholders.

8.3.2 Government

The stakeholder analysis presented in Chapter 1 identifies the Government as one of the groups who have the greatest potential to affect the future of the post-consumer plastics waste recycling industry in the UK. From the analysis in Chapter 3 the UK Government can be seen to be much less proactive in terms of intervention than the governments of many other areas. This work concludes that the Government should take account of developments and outcomes of policies elsewhere in Europe and the US, as other countries have already got considerable experience, and can provide examples, of effective interventions. It goes on to recommend that the Government must provide more specific and concrete commitment to the recycling of all materials if the targets that have been set by itself or the EC are to be met. Rather than simply making policy and delegating the responsibility for recycling to the Local Authorities, the Government should allocate resources and put legislation in place to support the plastics recycling industry.

The Academic Community was characterised in Chapter 1 as having a lack of interest in waste management and recycling issues. Financial support for research in this area would help promote academic interest in this field, and should be part of the Government's strategy of support for the industry.

Chapter 3 reviews the current Government stance towards recycling and concludes that legislative intervention will be required to instigate market development and the promotion of primary recycling that will provide a stable environment for future industry expansion. In line with current Government preference, this Chapter goes on to recommend that this stimulation would be best done through the application of economic instruments such as VAT or taxation differentiation between virgin and recycled polymers. A further recommendation of Chapter 3 is that the effectiveness of this intervention would be compounded by the hypothecation of these funds to schemes which support the development of the ability of the stakeholders to scale up their contribution to the establishment of a well functioning industry. This might be done, for example through the provision of grants to fund improvements by all members of the packaging chain. Other contributions might include the organisation of cross industry conferences aimed at addressing the problems of isolation and fragmentation outlined in Chapter 2. In order to address the issues raised by Chapter 4 concerning the Public's perception of plastics as environmentally damaging and unrecyclable, and the theme uncovered in Chapter 6 of no value being associated with packaging items once their contents have been consumed, another use of such funds might be to invest in a general and wide ranging educational publicity campaign which would raise the profile of recycling in general and address these perceptions specifically.

Chapter 7 concludes that there is no uniform support of recycling in terms of recycling credits paid by Local Authorities to Collectors. The Government should seek to take a direct role in the production and promotion of standards for recycling credits, rather than leaving it to the discretion of individuals. This should include an attempt to address the issues of whether standard or volume related credits should be paid to Collectors of different materials.

One of the conclusions of the literature review presented in Chapter 5 was that the success of recycling schemes was more likely for schemes which were run by experienced and well trained individuals. The Government could have a positive effect on the success of recycling schemes through the provision and funding of training programmes for collection scheme operators.

An important insight from the analysis of US policy in Chapter 3 is that the best results appear to be associated with well established policies. This implies that the Government must be prepared to make long term commitment to support and development of the post-consumer plastics waste recycling industry if lasting and effective changes are to be realised.

8.3.3 Local Authorities

The local authorities should begin to take a proactive rather than reactive attitude to establishing recycling programs in their areas. This might involve taking an active role in the co-ordination of schemes that already exist in an area, as well as providing support and encouragement for those setting up schemes and becoming involved in the provision of recycling services themselves. They ought to concern themselves with **how** recycling targets are to be met in their areas and produce plans and allocate resources in order to realise these.

The other important role for the local authorities is in the education of the next generation of recyclers, through schools, community centres and youth services. Young people were identified by Chapter 4 as a group which does not contain a high proportion of recyclers.

8.3.4 Manufacturers

There are two main strategies that should be adopted by the manufacturers in order to promote recycling. The first was highlighted by the accounts of recyclers given in Chapter 6 which concludes that Manufacturers should be designing their packaging products with recycling in mind. This means standardising the polymers used in packaging and promoting a system of polymer marking in order to reduce problems of separation and contamination outlined in Chapter 2. The elimination of the use of laminates that preclude recycling, and the reduction of fused sections and labels that mean incompatible polymers are combined in a way that is difficult to separate are other important contributions to recyclability.

Chapter 2 concluded that primary recycling is the only truly sustainable form of recycling and as such should be the aim of the post-consumer waste recycling industry. The other major potential contribution of the Bottle Manufacturers then, is in the large scale acceptance of recycled plastics as feedstocks for their processes. This would enable the widespread primary recycling which is needed to stimulate and support the plastics recycling industry.

8.3.5 Reprocessors

Chapters 5 and 6 both conclude that the convenience of a recycling scheme is extremely important for members of the Public. Reprocessors need to develop the technology for sorting polymers so that the onus, and resource required, for this process is reduced for the collectors and the general public. They must also intensify the marketing of their output and seek acceptance by a wider range of manufacturers. Developing products in partnership with manufacturers might be one strategy which would serve this objective and help achieve the shifts in interest and power, as outlined in Chapter 1, of both groups.

8.3.6 Collection Schemes

The conclusions of Chapters 4 and 7 point to neither Bring nor Collect as inherently better ways to collect plastics for recycling. Both have advantages and disadvantages and the decision of which strategy to adopt is best informed by attention to local factors such as population density and prevalent housing types.

Chapter 4 found that, for a Bring scheme, seeing the banks themselves is the most powerful means of raising public awareness and promoting the recycling scheme. This was reiterated by findings in Chapter 5 and points to a need for careful consideration of bank siting with this in mind. A related recommendation would be for schemes to conform to the orange bank colour used widely in the UK with a view to presenting a consistent image and raising the profile of the industry nation-wide.

For Collect schemes on the other hand, Chapter 6 has important conclusions about the instructions that are given to the Public. This work advocates that instructions should be justified and placed in context in order to help participants understand them and presented in an unambiguous form. Bottles should be described by their contents rather than polymer types in order to ease understanding of what is to be included, and information should also include categories of packaging that should not be included. Schemes should provide a contact number and encourage the Public to contact them if they have queries or comments about the scheme.

Rogers (1983) states that only behaviour which has the expected consequences will be maintained. This raises issues for both the management by collection schemes of public expectation through promotion literature and their fulfilment of promised contracts of service. The results of Chapters 4, 5 and 6 show that provision of a consistent and convenient service, and the centrality of the role of the public, cannot be over stressed. A great deal of attention must be given to the design of the schemes themselves and the instructions that are given to the public. Despite the fact that schemes often start very small and on extremely limited finances, a professional service must be maintained. These issues are important lessons from the ethnographic study presented in Chapter 6.

The other important conclusion of Chapter 5 is that most of the interventions which have been used in studies of motivation and recycling have only short term effects on recycling behaviours. This means that schemes should direct their resources towards attaining and maintaining convenient services and providing a constant flow of information rather than one-off promotions or competitions.

Chapter 7 concludes that in order to improve and refine practices, it is important for schemes to collect more information on the costs of their processes and the effects of their promotional strategies. A further conclusion is that few studies are currently assessing the full costs of recycling or being explicit enough about the assumptions and objectives which are informing their analysis. Collection schemes must aim to share their information and experiences with other schemes, as well as providing feedback to the public and requiring it of the reprocessors they serve. As recommended by Chapter 7, they should consider measuring non-cost data such as participation and diversion rates to broaden their definitions of success and profiles of achievement. Attention to issues of aim, context and scope of the decisions that data is generated to support will facilitate comparison between studies and help combat the fragmentation highlighted by Chapter 2.

Consideration should be given to ways of combining the collection of different materials and sources in order to improve collection economics. This could be done by collecting from post-industrial or commercial sources of plastics, which are often found to be of a more homogenous and concentrated nature, in order to support domestic collection. Another variant is to collect a number of materials together with the hope of using the income from collecting more established or valuable materials to support the collection of plastics.

8.3.7 Public

This group is framed by the stakeholder analysis in Chapter 1 as having a pivotal role to play in determining the success of post-consumer plastics waste recycling in the future. The exposition of the crucial nature of this role is perhaps one of the most important conclusions of this research. Another extremely important conclusion is the insight from Chapter 6 that the recycling process should be regarded as part of a domestic routine and that widespread recycling activity will only be achieved through change in household routines.

Education must be aimed at this group to help them understand the importance and relevance of sustainable waste management. They need to stop equating 'discarded' with 'worthless' and learn new domestic routines associated with "reduce, reuse, recycle". They must be made aware of the dual powers they have as consumers to safeguard the future of the industry by participating in collection schemes and buying products that contain recycled material. Neither the necessity nor the difficulty involved in affecting these changes should be underestimated.

As well as the general education advocated by Chapter 6 and outlined above, which is aimed at realigning their values, the Public also needs more specific education in the nuts and bolts of being a recycling participant. Chapter 4 concludes on one hand that there is no apparent 'jam jar' effect for plastics bottles, however on the other hand, it uncovers a significant proportion of plastic contraries amongst the items recycled by the Public. This finding illustrates the need for improved instructions.

The conclusions of Chapters 4 and 5 also suggest that it is not enough to treat the Public as a uniform or homogeneous population. Both studies show that recycling behaviours and attitudes vary between groups. One example is the finding in Chapter 4 that people over 60 are more likely to recycle if they know facilities are available than other age groups. Differentiated promotion strategies will be required to inform different groups within the population.

8.3.8 Research Community

Chapter 1 concludes that this group have little interest and hence little power in the fate of the post-consumer plastics waste recycling industry. The research community could however provide an important resource and source of support for the plastics recycling industry. Despite the public interest in green issues, academics and other institutions lag behind in their attention to waste management. This may be partly due to the fact that it fails to fall neatly within the domain of environmental, management or social sciences. Multidisciplinary research will be needed to address some of the complex and interrelated problems facing the industry.

The plastics recycling industry is in need of practical help in the form of transparent and explicit solutions. Effort should be made to communicate research results to, and translate them for, the practitioners. It is important to concentrate on areas of concern to those working in the field, and guard against sole emphasis on economic measures, or other facets which lend themselves to measurement. The crucial role of the consumer should not be ignored in models of the mechanisms and processes of the industry.

Researchers may have the unique opportunity provided by their independence from and access to many parts of the packaging chain that will allow them to bring them together in order to solve problems. This could prove an effective catalyst for the flow of information and perceptions between stakeholders.

8.4 Dissemination Strategy

The dissemination strategy for this work is intended to span both the practitioner and academic communities. The interest from many of those who have provided access or information during the course of this research has been considerable, and it will be both a duty and a pleasure to provide these individuals and institutions with as much help as possible in their quest for the improvement of the post-consumer plastics waste recycling industry.

It is also an aim to raise the profile of plastics recycling research in particular, and waste management issues in general, in a range of academic disciplines. If it can also be used as a vehicle for the advocation of multidisciplinary or cross boundary research in this and other questions, then so much the better.

8.5 Further Research

There is much scope for further work in this area. Research which focuses on the issue of participation is especially significant for the future large scale success of post-consumer plastics waste. This subject is particularly well served by qualitative research methods and work done with members of the public. Possible areas might lie in the development of different strategies for forming and maintaining recycling behaviours. More work needs to be done in the identification of different groups within the population and how these can be reached and encouraged to recycle. The effect of different levels of sorting responsibility for the general public is also an interesting issue which needs attention in order to inform the decision of whether it will be more effective to ask the public to sort its plastics by polymer (like the net cage example), or to develop the technology, or invest in the manpower to sort polymers once they have been collected. The development of simple and powerful performance indicators to help the industry monitor their operations and identify best practice is another possible area for further work.

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Appendix 1: Bale Specifications

RECOUP

RECYCLING OF USED PLASTIC (CONTAINERS) LIMITED

9 Metro Centre, Welbeck Way
Shrewsbury Avenue, Woodston
Peterborough, PE2 7WH

Telephone : (0733) 390021
Fax : (0733) 390031

PVC BALE SPECIFICATION

The details below form a specification for baled polyvinyl chloride (PVC) post consumer plastic bottle materials.

Bales

Size: Each bale shall confirm to nominal and agreed dimensions of 1.2m long and a cross section of 1 m x 0.8m.

Weight: Each bale shall be compacted to an agreed density based on its nominal weight. This is to allow ease of bottle separation once the bale straps are removed. Bale weight should fall within 150 to 200 kgs.

Quality: Bales shall be tied off using steel strapping or wire. The tie off should not present a snagging or safety problem by protruding sharp ends. Only plastic bottle materials shall be baled and other materials such as cardboard end pieces should be avoided. Ideally bales should be tied off with four straps to provide the best retention system. (Suitable strapping is 19mm wide x 0.8mm deep black flat band metal strip. Recoup would be pleased to supply details, if requested).

Baled material should be in a clean condition free from any secondary contamination such as dirt, oil and non requested materials. Baled materials should remain compact and of sufficient dimensional accuracy to ensure safe stacking before and after delivery. Bales should also be compacted so that safe and efficient transportation is achieved.

Caps:

Plastic caps should be removed if possible. Collection schemes should seek to avoid caps being left on bottles when being deposited.

Bottle Materials for Baling:

PVC bales should consist of compacted PVC plastic bottles normally used in the home, eg. cordial bottles, mineral water bottles, clear shampoo bottles. Bales should not include paper, metal or glass products or other non-requested plastic items such as film or sheet, yogurt cartons, ice cream tubs, margarine containers, PE and PET bottles, lubricating oil or horticultural/ pesticide bottles. Collection details are specified in instruction labels which are updated at the reprocessors request. We advise that all collection points should display the latest instructions to depositors.

Acceptance of bales will be based on achieving 95% of requested plastic bottle materials by unit analysis.

Any hazardous materials including broken glass found in baled material will lead to the rejection of the bale. Payment will be made only on the basis of bales that meet the specification. Where baled material has been found to be unsatisfactory Recoup reserves the right to suspend collections of baled material until the bale quality meets the above specification.

RECOUP

RECYCLING OF USED PLASTIC (CONTAINERS) LIMITED

9 Metro Centre, Welbeck Way
Shrewsbury Avenue, Woodston
Peterborough, PE2 7WH

Telephone : (0733) 390021
Fax : (0733) 390031

PE BALE SPECIFICATION

The details below form a specification for baled polyethylene (PE) post consumer plastic bottle materials.

Bales

Size:

Each bale shall confirm to nominal and agreed dimensions of 1.2m long and a cross section of 1 m x 0.8m.

Weight:

Each bale shall be compacted to an agreed density based on its nominal weight. This is to allow ease of bottle separation once the bale straps are removed. Bale weight should fall within 150 to 200 kgs.

Quality:

Bales shall be tied off using steel strapping or wire. The tie off should not present a snagging or safety problem by protruding sharp ends. Only plastic bottle materials shall be baled and other materials such as cardboard end pieces should be avoided. Ideally bales should be tied off with four straps to provide the best retention system. (Suitable strapping is 19mm wide x 0.6mm deep black flat band metal strip. Recoup would be pleased to supply details, if requested).

Baled material should be in a clean condition free from any secondary contamination such as dirt, oil and non requested materials. Baled materials should remain compact and of sufficient dimensional accuracy to ensure safe stacking before and after delivery. Bales should also be compacted so that safe and efficient transportation is achieved.

Caps:

Plastic caps should be removed if possible. Collection schemes should seek to avoid caps being left on bottles when being deposited.

Bottle Materials for Baling:

PE bales should consist of compacted PE plastic bottles normally used in the home, eg. washing-up liquid, fabric softeners, laundry liquids and milk bottles. Bales should not include paper, metal or glass products or other non-requested plastic items such as film or sheet, yogurt cartons, ice cream tubs, margarine containers, PVC and PET bottles, lubricating oil or horticultural/ pesticide bottles. Collection details are specified in instruction labels which are updated at the reprocessors request. We advise that all collection points should display the latest instructions to depositors.

Acceptance of bales will be based on achieving 95% of requested plastic bottle materials by unit analysis.

Any hazardous materials including broken glass found in baled material will lead to the rejection of the bale. Payment will be made only on the basis of bales that meet the specification. Where baled material has been found to be unsatisfactory Recoup reserves the right to suspend collections of baled material until the bale quality meets the above specification.

RECOUP

RECYCLING OF USED PLASTIC (CONTAINERS) LIMITED

9 Metro Centre, Welbeck Way
Shrewsbury Avenue, Woodston
Peterborough, PE2 7WH

Telephone : (0733) 390021
Fax : (0733) 390031

PET BALE SPECIFICATION

The details below form a specification for PET baled post consumer plastic bottle material.

Bales

Size: Each bale shall conform to nominal and agreed dimensions of 1.2m long and a cross section of 1 m x 0.8m. Any variations should be agreed with RECOUP.

Weight: Each bale shall be compacted to a high density to minimise unit transport costs. Bale weight should ideally be 300-350kg based on the above dimensions, although bales will be acceptable above 250kg.

Quality: Bales shall be tied off using steel strapping or wire. The tie off ends should not present a snagging or safety problem by protruding sharp edges. Only PET bottle materials shall be baled and other materials such as cardboard end pieces should not be used. Ideally bales should be tied off with four straps to provide the best retention system. (Suitable strapping is 19mm wide x 0.6mm deep black flat band metal strip. Recoup would be pleased to supply details, if requested).

Baled material should be in a clean condition free from any secondary contamination such as dirt, oil and non-requested materials. Baled materials should remain compact and of sufficient dimensional accuracy to ensure safe stacking before and after delivery. Bales should also be compacted so that safe and efficient transportation is achieved.

Caps:

Plastic caps will be accepted but should be removed if possible. Collection schemes should seek to avoid caps being left on bottles at the point of deposit.

Bottle Materials for Baling:

PET bales should consist of compacted PET plastic bottles normally used in the home, i.e. squashes, mineral water, edible oil and fizzy drinks bottles. Note that coloured PET bottles are not acceptable. Bales should not include paper, metal or glass products or other non-requested plastic items such as film or sheet, yogurt cartons, ice cream tubs, margarine containers, lubricating oil or horticultural/pesticide bottles. Instructions are specified through display labels which are updated to reflect latest reprocessing requirements. We advise that all collection points should display the latest instructions to depositors.

Acceptance of bales will be based on achieving 95% of requested plastic bottle materials by unit analysis.

Any hazardous materials including broken glass found in baled material will lead to the rejection of the bale. Payment will be made only on the basis of bales that meet the specification. Where baled material has been found to be unsatisfactory Recoup reserves the right to suspend collections of baled material until the bale quality meets the above specification.

Appendix 2: Exchange Rates

Currency	£1 Sterling
Japanese Yen	154
American Dollars	1.53
Irish Punts	0.99
Deutcshe Marks	2.37
French Francs	8.11
Belgian Francs	48.5
Danish Kroner	9.32
Egyptian Pounds	4.9699

Table A2.1 Exchange rates used to convert foreign currencies

Appendix 3: BXL Products

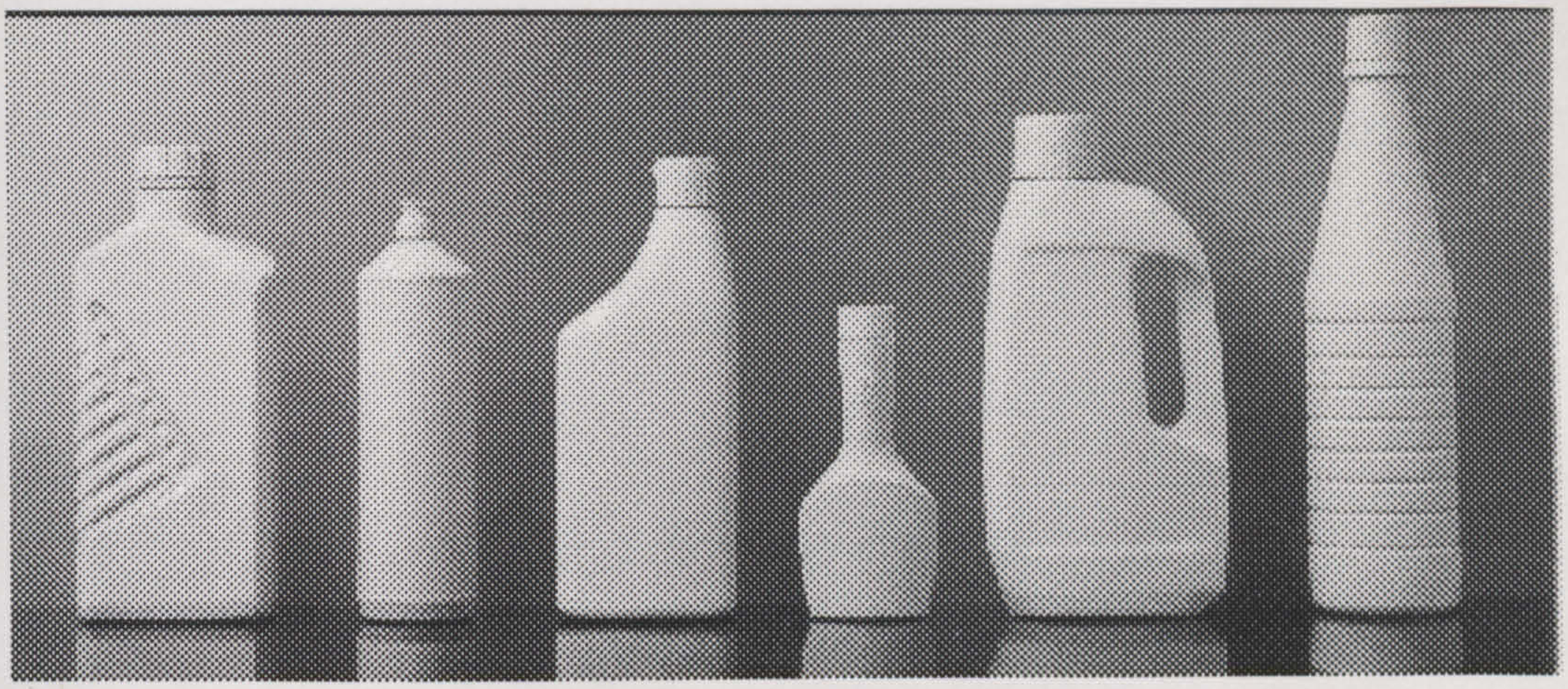


Figure A3.1 Some unfinished BXL products

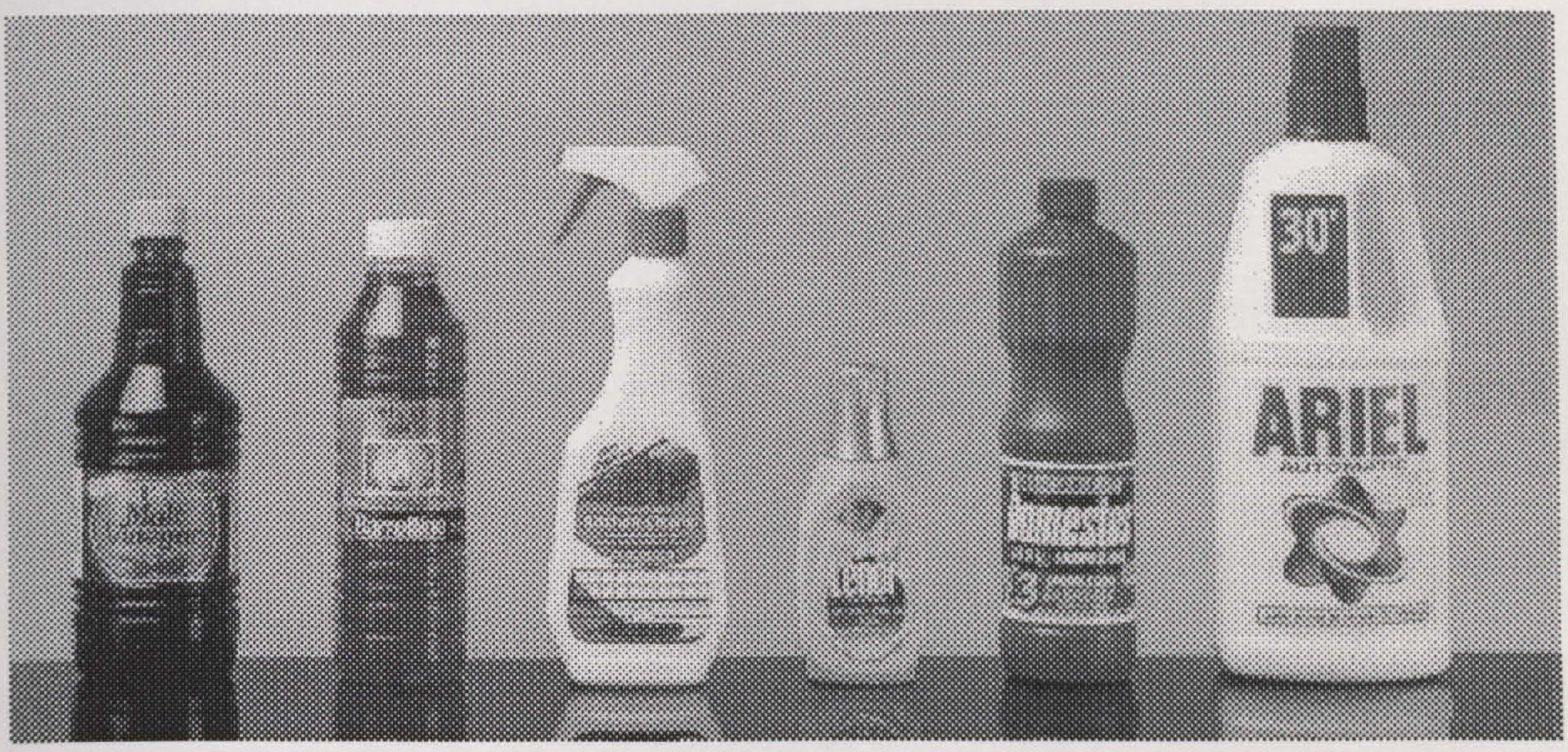


Figure A3.2 Some BXL products labelled, filled and ready to be sold

Appendix 4: Launch Publicity for Glasgow

20 February 1991.

City of Glasgow

Public Relations Department

City Chambers George Square Glasgow G2 1DU Tel 041-227 4157/8/9 Telex 777762 Fax 041-227 5456

Glasgow's recycling centres expand into plastics

You are invited to send a reporter/photographer/crew to the Satinwood Suite, City Chambers at 10.00am on Wednesday 27 February when the Lord Provost, Mrs Susan Baird, will launch Scotland's first public plastics recycling network.

There will be a photo call, around 10.30am, in John Street, adjacent to the Italian Centre when the Lord Provost place the first plastic bottles into the new banks.

Plastic banks are being installed at 23 of the Council's existing 29 recycling centres. A further 26 plastic banks will be placed on new sites as the first phase of a progressive extension to 70/100 multi-purpose recycling sites throughout the city. Can banks will be added to these new sites from March.

The plastic banks are being provided by BXL Limited, a subsidiary of BP. While BXL are primarily interested in high density polyethylene (the plastic used to contain shampoo, detergent, clothes washing liquid and similar products) the banks will accept all forms of plastic. ~~bottle.~~

Although not the first in Britain, Glasgow's plastic recycling scheme is the largest scale and most comprehensive to date.

ends

City of Glasgow

Public Relations Department

City Chambers George Square Glasgow G2 1DU Tel 041-227 4157/8/9 Telex 777762 Fax 041-227 5455

Opening remarks by Bailie James Barr, at launch of plastics banks

Good morning.

Lord Provost, distinguished guests, ladies and gentlemen, welcome.

It gives me great pleasure to see you all here for the launch of the Cleansing Department's plastics banks, in association with Recovery Plastics Limited.

Today is a watershed in the Council's recycling programme - the arrival of the plastics banks means that our multi-purpose recycling sites now cater for all major readily recyclable product groups.

It also marks the beginning of the phased extension of our recycling network to 100 sites throughout the city with plastics banks inaugurating 26 new sites in addition to the 29 which are already in operation.

This is a dramatic development from the 38 glass banks which the Council ran a year ago. It is the Cleansing Department's response to the new found enthusiasm for recycling.

more

The Council has operated large scale recycling projects in the past, but the amounts collected dropped to the point where it was no longer economic to continue with the service.

This time the Council has adopted a different approach - foregoing door to door collection in favour of establishing the multi-purpose recycling sites through which people can recycle a range of household products.

Other initiatives in place include a full-time Recycling Officer with clerical support and a one-off promotional budget of £34,000; a CFC recycling service and a scheme for recycling the Council's office paper.

Projects still being evolved by the Council include developing and managing a network of eight civic amenity/recycling sites providing services on a larger scale than at multi-purpose sites; introducing on a trial basis a glass collection service for all licensed premises in the City Centre and establishing a Recycling Forum.

In total the Environmental Protection Committee devoted nearly £400,000 to recycling and associated projects during 1990/91.

This does not include the significant investment of our partners in the various recycling banks, without which the development of the network would not have been possible.

more

Plastics have long been seen as one of the major stumbling blocks to recycling an even greater proportion of the waste in the domestic refuse bin.

I congratulate Recovery Plastics Limited on their positive approach to overcome this problem. I am pleased that they decided to embark on large scale public plastics recycling in Glasgow. By having a comprehensive range of banks at every site we increase the effectiveness of recycling as a disposal option. People recycling one product, for example glass, can also dispose of their drinks cans, plastics and newspapers at the same time.

Given that plastics comprise 7 percent, by weight - 30 percent by volume, of the average domestic rubbish bin, the Council is now providing the opportunity for Glaswegians to recycle more than a half of their household waste.

The volumes being recycled are nowhere near this potential figure and that is why the thrust of our efforts are now directed towards extending the network of sites so that recycling centres are so much closer to home. We want to make it as easy as possible for people to adopt the recycling habit.

I now call upon Jane Simmonds, Plastics Recycling Manager Europe, BP Chemicals Limited to say a few words on Recovery Plastics role in this exciting development.

ends

OPENING REMARKS

PRESENTED BY: JANE SIMMONDS
PLASTICS RECYCLING MANAGER, EUROPE
BP CHEMICAL LTD

I am particularly pleased to be here representing BP Chemicals and to be closely associated with the project launch today.

The widespread use of plastics in packaging and its impact on our living environment is such an important and topical matter that we feel that we have to understand and be involved, directly and indirectly in its disposal after it has completed its prime purpose.

Because it is so widely used, plastics form a significant part of domestic refuse. We in the plastics industry feel we can do a great deal to help local authorities in setting up schemes to recover the reclaimable plastics from the domestic refuse stream. In fact, plastics make up about 7% by weight and 30% by volume of the materials we dispose of each year.

Over one million tonnes of plastics are used annually in the UK and we believe that with planning, organisation and cooperation between public and private sectors, the major proportion of this waste can be reclaimed and recycled to potentially useful raw materials. At least sufficient to meet recently published government guidelines on the subject.

I emphasise the importance of cooperation in achieving this objective. We bring different and specific skills and knowledge to the task - local authorities, waste disposal companies, the plastics industry and consumers of plastics products, the packers and the retailers. For example, as part of its day to day business the plastics industry already collects and reuses more than 90% of its' own waste products and it has built up significant experience and technology in dealing with waste plastics and turning them into quality assured products. It is only if each understands the part they can play and is committed to overall objective of maximising the recycling of non-replaceable resources that we will succeed.

Projects like this one in Glasgow are a start, a beginning of the learning process that needs to go on to show us what we have to do on an increasing scale in the future to make a significant impact on recycling of post consumer waste.

If each of the 100 banks that will be sited in Glasgow is filled and emptied each week this will yield approximately 10 tonnes of plastics weekly. This may not sound a lot - but it is enough to contribute towards the manufacture of more than 2 million new bottles on the supermarket shelf, for example.

We still have a great deal to learn. We have to learn how to recover the material from the user or householder, and how to encourage the householder to present the waste in the form that is most valuable. Not all plastics are the same and the mixture we get from recovery projects has to be sorted. We can then prepare recycled materials of known composition. This helps us to maximise its usefulness and also its' value - which, when realised, can them be put towards the costs of its collection and treatment.

Much of this sorting is still done by hand but research programmes are under way to develop the technology that will help us clean up the input waste and develop a consistent stream of useful raw materials.

Consistency of finished product is one reason why we are particularly keen to see lots of plastic bottles and household chemical containers in these collection banks. These can be most easily sorted and the recycled material directed into the manufacture of further bottles thereby maximising its' usefulness.

To close the loop also, we have to learn how to make the best use of recycled material. There are some existing outlets such as refuse bags, garden ware, land drainage pipes and loose fill for thermal insulation, for example, but I am confident that as we become more adept at the recover of consistent material with known properties then the industry will reflect this confidence by making more use of the recycled material.

At Recovery Plastics which is part of and backed by the considerable resources of BP Chemicals, we will do our best to ensure that the hard work the Cleansing Department have put into this scheme is complemented by the efficient operation of our part of the project.

We have made a significant start today in the recycling process and please be assured that the recovered containers will be make good use of. They will be converted into materials that genuinely make a real contribution to the more effective use of our resources. Together the plastics recycling industry, linked to recovery programmes such as this, will lead to greater public awareness that we can, and should be recycling a much greater proportion of what is so easily described and considered today as 'waste'.

YOUR G.C.C. RECYCLING SITES

The Department currently operates multi-purpose recycling sites in the City for the collection of cans, paper, bottles and plastics at the following locations.

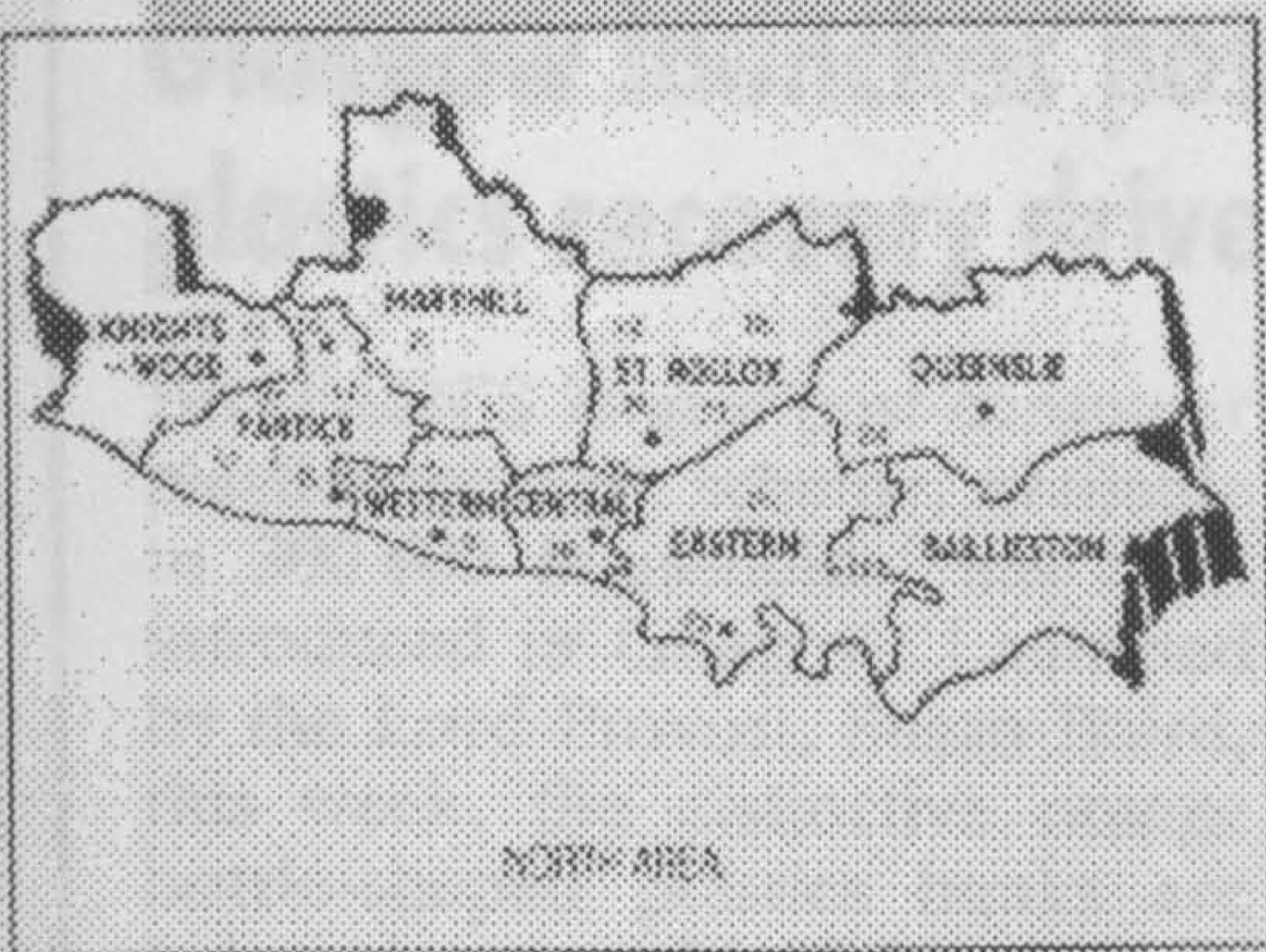
NORTH AREA

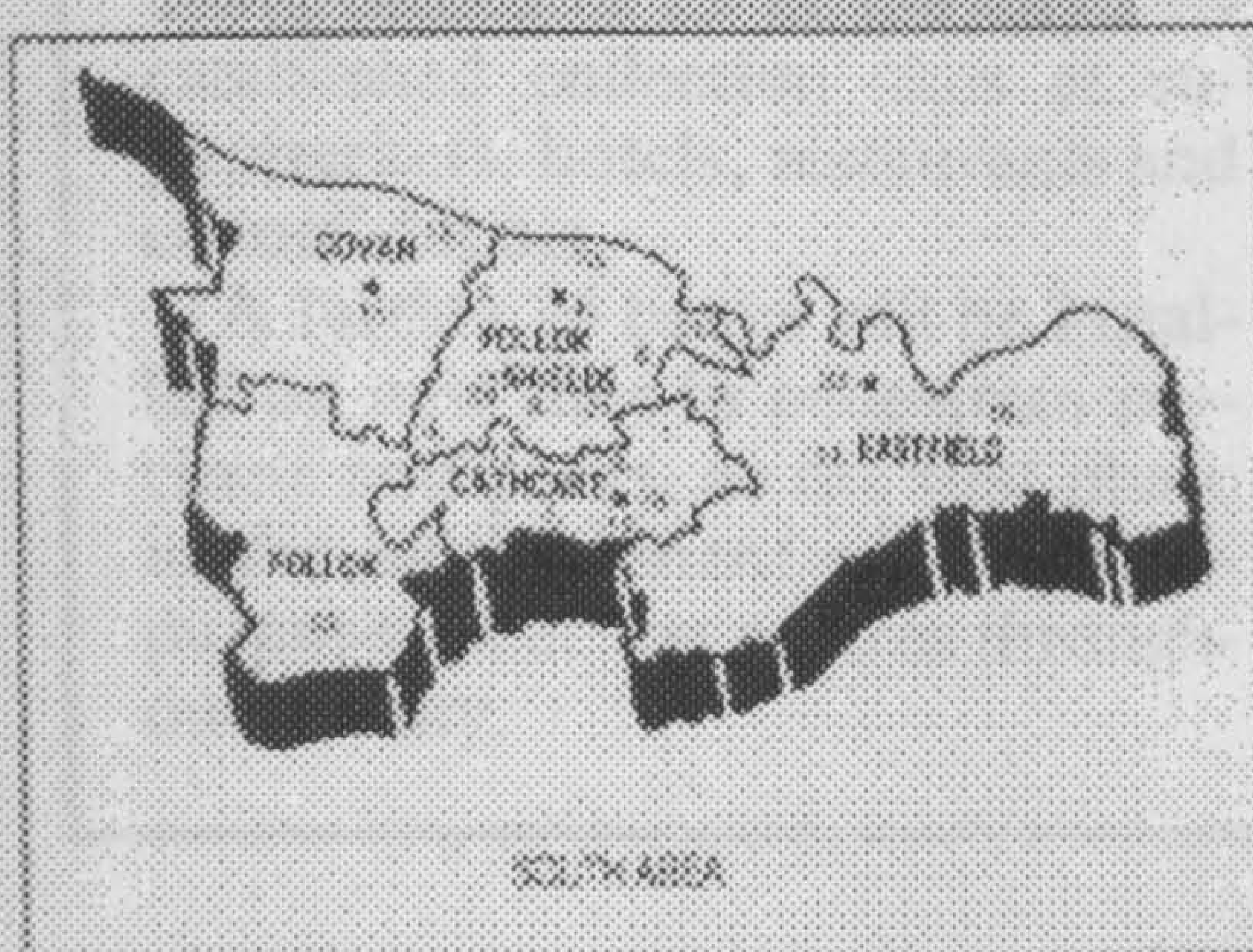
1.	ASDA Car Park, Summerston	B	P	C	Pl	
2.	Maryhill Coop, Maryhill Rd	B	P	C	-	
3.	Esquire Lounge, Great Western Road	B	-	C	-	
4.	Ashton Rd Car Park	B	-	-	-	
5.	Maryhill Rd/Hopehill Rd	B	-	C	Pl	
6.	Knightswood Shopping Centre, Anniesland Rd	B	P	C	Pl	
7.	Broomhill Shopping Centre, Norby Rd	B	-	C	Pl	
8.	GCC Partick Cleansing Depot, 26 Sandy Rd*	B	-	C	Pl	
9.	GCC Western Cleansing Depot, 40 Kelvinhaugh St*	B	-	C	Pl	
10.	GCC Dawsholm Works, Dawsholm Rd**	B	P	C	Pl	O
11.	B&Q Anniesland	B	-	C	-	
12.	Peckhams, Clarence Dr	-	-	C	Pl	
13.	Lauderdale Gdns/Queensborough Gdns	-	-	C	Pl	
14.	Dowanhill St/Highburgh Rd	-	-	C	Pl	
15.	Safeways, Partick	B	-	C	Pl	
16.	Lord Todd, Weaver St	B	-	-	-	
17.	[illegible], Scotstoun Showground	-	-	-	Pl	
18.	Springburn Shopping Centre	B	-	-	-	
19.	Kings Place, Balmore Rd	B	-	-	-	
20.	Cambridge Street/Buccleuch St	B	-	C	-	
21.	Gartcraig Rd	B	-	C	Pl	
22.	Cardowan Dr	B	P	C	Pl	
23.	GCC St Rollox Cleansing Depot, 110 Charles St*	B	-	C	Pl	
24.	GCC Easter Queenslie Works, Easter Queenslie Rd**	B	-	C	Pl	O
25.	GCC Eastern Cleansing Depot, 400 Baltic St*	B	-	C	Pl	
26.	Sighthill Shopping Centre, Huntingdon Square	B	-	-	-	
27.	Jordanhill College	B	-	C	-	

SOUTH AREA

1.	Beechwood Restaurant, [illegible] Crescent	B	-	-	Pl		
2.	Tinto Firs Hotel, Kilmarnock Rd	B	-	C	Pl		
3.	Shawlands Arcade Car Park, off Pollokshaws Rd	B	-	C	Pl		
4.	Gateway Car Park, Victoria Rd	B	P	C	-		
5.	Co-op Superstore, Maxwell Drive	B	P	C	Pl		
6.	Pollokshaws Rd/Balvicar St	B	P	C	-		
7.	GCC Polmadie Works, Polmadie Rd**	B	-	C	Pl		O
8.	Shawbridge St	B	-	C	Pl		
9.	GCC Cathcart Cleansing Depot	-	-	-	Pl		
10.	GCC Pollokshields Cleansing Depot*	-	-	C	Pl		
11.	Nithsdale Rd/Nithsdale St	-	-	C	Pl		
12.	Safeway, Muirend	B	P	-	-		
13.	Kinross Ave/Paisley Rd West	B	-	C	Pl		
14.	Sun Inn, Halfway	B	-	-	-		
15.	GCC Govan Works, Craigton Road**	B	P	C	Pl	T	O
16.	Allach Drive Car Park, Cambuslang	B	-	C	-		
17.	Safeway, Riverford Rd	B	P	C	-		
18.	Merrylee Rd/Ardle Rd	-	-	C	Pl		
20.	Terregles Ave/Nithsdale Rd	B	P	C	Pl		
21.	Safeways, Crossmyloof	B	P	C	Pl		
22.	GCC Eastfield Cleansing Depot, 236 Cambuslang Rd*	B	P	C	Pl		
23.	Sainsburys, Darnley	B	P	C	-		

KEY:
B = bottle bank
C = can bank
P = paper bank
Pl = plastics bank
T = textile bank
O = Oil Bank
* = 7.00AM-5.00PM (MON-FRI)
** = 8.00AM-8.00PM (MON-SUN)





If you have a business or are an employee of a company that thinks green, contact us on **041 227 4493** to find out about sponsoring a Paper Bank.

THE RECYCLING CODE

BEFORE YOU GO TO THE SITE PLEASE DO THE FOLLOWING:

1. Sort out all the deposit bottles and milk bottles and return them to the place of purchase.
2. Please remove tops and lids of glass items only. Plastic bottle tops can be recycled.
3. Please rinse out all glass bottles and jars, aluminium cans and plastic bottles.

ONCE YOU ARE AT THE SITE:

4. GLASS
Separate the glass bottles and jars into the different colours and put them in the appropriate coloured banks - white, brown or green.
5. PAPER
Paper banks are for both newspapers and magazines. Please do not put cardboard in the bank.
6. ALUMINIUM CAN BANKS
These banks are for Aluminium drinks cans only. The aluminium cans are the ones with the shiny bottoms. Also look for the Aluminium recycling symbol on the side of the cans.
7. PLASTICS BOTTLE BANKS
Plastics Banks are for the recovery of clear, white and coloured plastics bottles only.
8. Please DO NOT leave your emptied cardboard boxes or bags around the Banks - take them home to re-use.
9. Please be considerate to other people. Do not use the Banks at night.

The banks are emptied weekly. However, if a Bank is too full then use the FREEPHONE NUMBER, 0800 181 571 and let us know.

The multi-purpose recycling sites change from time to time. Please telephone the FREEPHONE NUMBER 0800 181 571 for up to date information.

Glasgow launches post-consumer plastics recovery drive

BRITAIN'S largest post-consumer plastics recovery scheme, available to 300 000 households, has been introduced in Glasgow. Launched by the Lord Provost, Susan Baird, this week, the distinctive orange bottle-shaped plastics banks are being placed at 23 of the city's 29 established collection sites at supermarkets. hotels, restaurants and council depots.

A further 26 banks will be installed on new sites in pedestrian precincts and parks, as the first phase in the establishment of 100 multi-purpose collection centres throughout the city.

The banks — which will accept most plastics materials — have been supplied by Recovery Plastics Ltd (RP), a BP Chemicals subsidiary. The high-density polyethylene recovered will be processed by Impex, at Runcorn, and the other materials will be passed on to other plastics processors, explained RP's spokesman John Acres.

The scheme will enable city dwellers to participate in the reeling chain through use of facilities that are sited more closely to homes, said Bailie James Barr, convenor of Glasgow's Environmental Protection Committee.

Materials Reclamation Weekly, 21st March 1991

BANK ON IT

GLASGOW is going one step further in the quest to become the greenest city in Britain by introducing new plastic recovery banks to 23 of its 29 existing recycling sites.

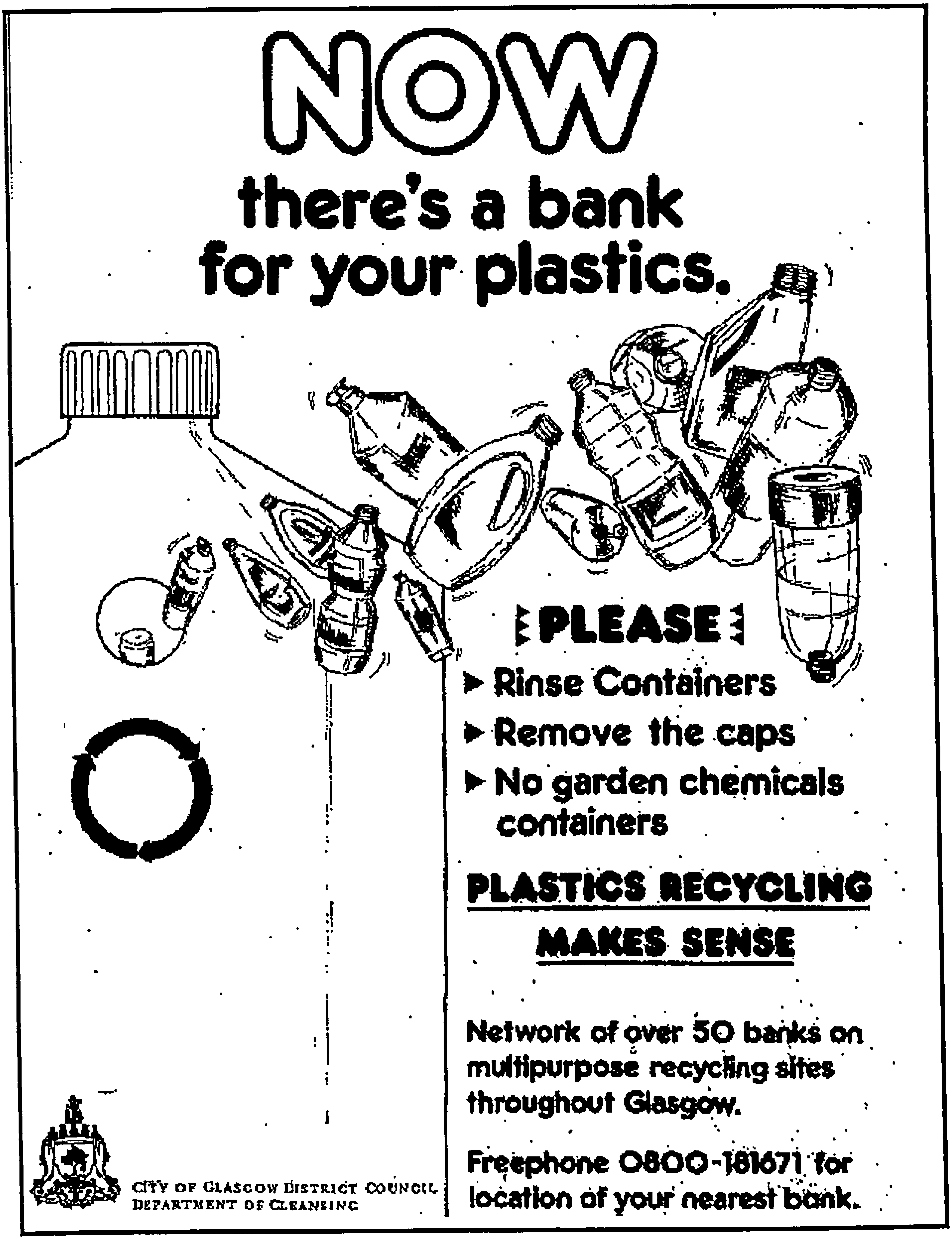
The distinctive orange bottle-shaped banks are being provided on a six-month trial basis by Recovery Plastics Ltd.

If there is a good response to the scheme the banks will become permanent city landmarks.

They can take all kinds of plastic but people using the banks are asked to rinse out their bottles and remove the caps before placing both cap and bottle in the bank.

For information on your nearest recycling site, call the cleansing department on 227 4493.

Article in the Glasweigan, 2nd March 1991.



Advert placed in The Bulletin, The Glasgow Herald, The Evening Times and the Glasweigan.

Glasgow's recycling centres expand into plastics

GLASGOW'S 300,000 households became the source of supply for the largest post-consumer plastics recovery scheme in the United Kingdom when Lord Provost, Mrs Susan Baird, placed the first bottles into the new plastics recycling banks last month.

The distinctive orange coloured, bottle-shaped plastics banks have been installed at 23 of Glasgow City Council's existing 29 recycling sites. A further 26 plastics banks are placed on new sites as the first phase of a progressive extension to 100 multi-purpose recycling sites throughout the city. Can banks are now being added to these new sites.

The plastics banks are being provided on a six month trial basis by Recovery Plastics Limited, a subsidiary of BP Chemicals Limited. If viable volumes are placed in the plastics banks, they will become a permanent feature of the city's multi-purpose recycling sites.

"I am sure that the plastics banks will prove as successful an addition to our multi-purpose recycling sites as the paper banks when they were introduced last September," said Bailie James Barr, convener of the Environmental Protection Committee.

"By having a comprehensive range of banks at every site we increase the effectiveness of recycling as a disposal option. People recycling one product, for example glass, can also dispose of their drinks cans, plastics and newspapers at the same time.

"Given that plastics comprise 7 percent, by weight, of the average domestic rubbish bin, the Council is now providing the opportunity for Glaswegians to recycle more than a third of their household waste.

"The amounts being recycled are nowhere near this potential figure and that is why the thrust of our efforts are now directed towards extending the network of sites so that recycling centres are so much closer to home and it then becomes easier for people to adopt the recycling habit," said Bailie Barr.

The rapid development of the council's recycling network makes it difficult to keep the public informed of the location of every site and the range of banks available at each.

For example, can banks are being installed this month at the 26 sites which are currently limited to plastics banks.

To make it easier for people to get into the recycling habit a free phone service is now operating to advise the latest details on all the Council's multi-purpose sites.

Simply call FREE 0800-181 671 for the location and the range of banks at your nearest site.

While Recovery Plastics is primarily interested in high density polyethylene (the plastics used to contain shampoo, detergent, household cleansers and similar products) the banks will accept all forms of plastics.

The plastics banks will be emptied on a regular basis by dedicated vehicles and the recovered material delivered to the recycling industry.

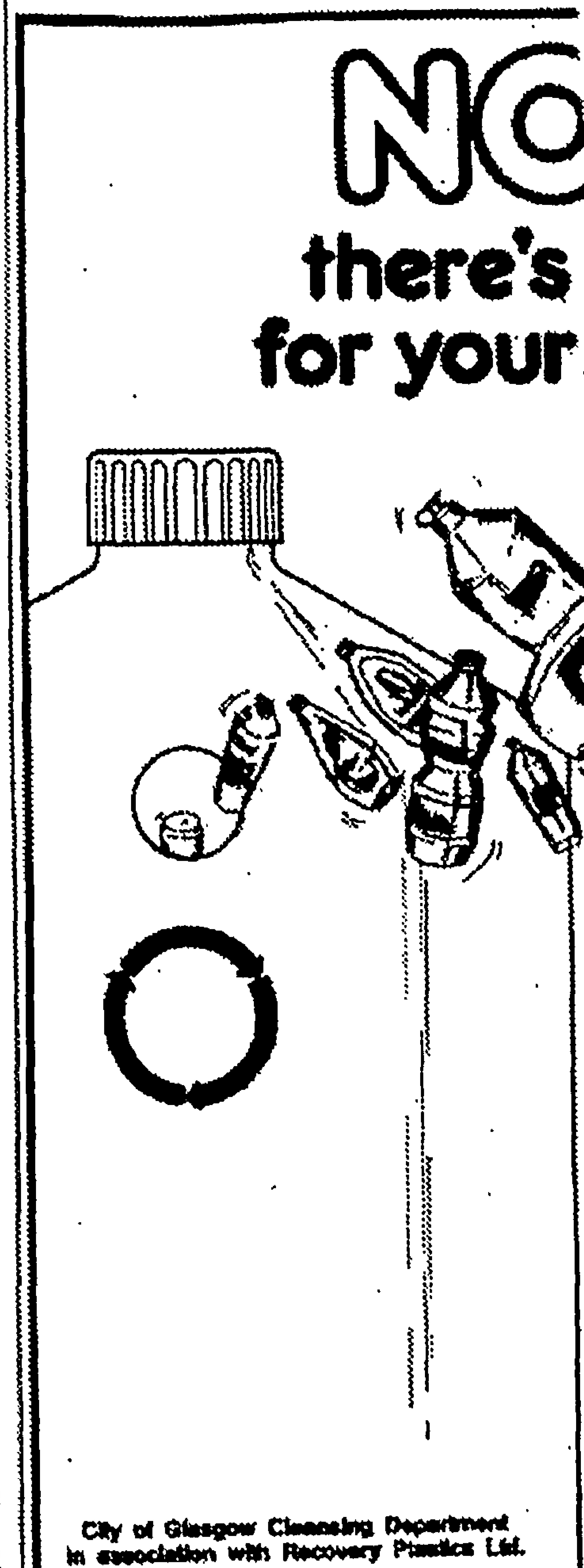
The public can help improve the quality of the recovered material by rinsing the bottles before disposal. They can further assist by removing caps which aids bulk reduction during baling. Once separated, the caps can still be placed in the banks.

Unique

The award scheme will also operate in Superbowl but with £100 and £50 cheques for silver and bronze certificate winners.

Other modifications to the competitions include bringing the start date forward by a month to the first week in

Lord Provost, Mrs Susan Baird, places the first bottle into one of the 49 new plastics banks which have been placed at multi-purpose recycling sites throughout the city.



Article from the March 1991 issue of The Bulletin

RECYCLING CENTRES

At the following locations you will find **BOTTLE BANKS, ALUMINIUM CAN BANKS, PAPER BANKS AND PLASTICS BANKS** situated in Glasgow City Council's **RECYCLING CENTRES**. Please use the coding system to find out which types of banks are available at each location.

If you require further information please telephone the **DEPARTMENT OF CLEANSING** on 041-227 4495

NORTH WEST AREA

SOUTH WEST AREA

SOUTH EAST AREA

NORTH EAST AREA

◊ NEW LOCATIONS FOR PLASTICS BANKS ONLY ◊

NORTH WEST AREA

SOUTH WEST AREA

* Hours of opening: 8.00am - 3.00pm, Monday to Friday.
◊ Hours of opening: 8.00am - 5.00pm, Monday to Sunday.

CITY OF GLASGOW DISTRICT COUNCIL
DEPARTMENT OF CLEANSING

Appendix 5: Falkirk Leaflet and Calendar

WORKING TOGETHER TO IMPROVE THE ENVIRONMENT

You are familiar with the blue bag household newspaper collection scheme which has been organised successfully in the Falkirk area by The Scottish Conservation Projects Trust (SCP) for the past two years. This scheme will be continuing and is helping to improve your local environment. SCP now collects about 120 tonnes of paper each month from local households which we could not have achieved without your help.

GREEN BAGS FOR PLASTIC BOTTLES

From 1 July 1991, SCP is extending its service to include the collection of plastic bottles. This new initiative is supported by Falkirk District Council and is being sponsored by BP Chemicals Limited. It is the first kerbside plastics collection service in Scotland

With this leaflet you will have received a special green bag in which you should save your plastic bottles. At this stage, we are only able to re-process plastic bottles (not margarine tubs or other plastic items). The bag will be collected from the end of your path in the same way that SCP regularly collects your newspapers.

REMEMBER: Blue bag for Paper and Magazines
Green bag for Plastic Bottles (definitely no glass please!)

You will also have received a Collection Calendar showing the days on which we will be collecting your plastic bottles. PLEASE NOTE IT IS VERY IMPORTANT TO REMOVE THE CAPS. PLEASE ALSO WASH OUT THE BOTTLES AND WHEN THEY ARE IN THE BAG, PLEASE TIE UP THE NECK OF THE BAG BEFORE PUTTING IT OUT FOR COLLECTION.

WHY RECYCLE PLASTIC BOTTLES?

In the UK most waste is disposed of in landfills. This eliminates many useful materials which could have a valuable second life — plastics, glass, paper, metal and even organic matter which can be composted. Plastics are made from oil, and although only 2% of the world's oil consumption is used for plastics packaging, recycling will contribute to conserving a finite natural resource.

Plastic bottles and containers are elements of the waste stream which, with co-operative effort from local authorities, industry and the consumer, can be recovered and recycled effectively. In this way, we can all play our part in the preservation of our environment, and help reduce the need for unsightly landfills, which are becoming more scarce and more costly.

ARE PLASTICS AN ENVIRONMENTAL PROBLEM?

The simple answer is no. They offer many benefits to packaging — prevent food spoilage and contamination, are shatter and corrosion resistant, lightweight, allow wide design options etc. — AND THEY ARE RECYCLABLE. Plastics make up only 7% of domestic waste (the rubbish in your dustbins), which in turn is only 4% of the total waste stream. A German study concluded that if plastics packaging was replaced by traditional materials, the weight of packaging would increase by 3 times, the volume of waste would increase 1½ times, and energy use and costs would double.

Plastics are not an environmental problem — in fact they make a positive contribution — and recycling will reduce still further their impact on the environment.

WHAT WILL HAPPEN TO THE BOTTLES COLLECTED?

After collection, the bottles will be compacted, baled and taken over by Recovery Plastics, a BP subsidiary, who will send them by lorry to Impex, its recycling company based in Runcorn, Cheshire. At Impex the bottles will be sorted into the different types of plastics, chopped into small flakes and then washed. The flake will then be reprocessed ready for re-use.

HOW IS THE PLASTIC RE-USED?

Many different types of plastic are used to produce bottles and each type has its own particular re-use. The table below shows the types of plastic used in bottles and also an indication of the plastic's re-use after recycling.

PLASTIC	TYPES OF BOTTLES	TYPICAL RE-USES
Polyethylene	Bleaches Washing-up liquids Laundry liquids Fabric softeners Cream cleaners Shampoos Talcs Hand creams Milk (plastic)	Laundry liquid bottles Fabric softener bottles Bleach bottles
Polyvinyl-chloride (PVC)	Non-carbonated drinks Other foods Shampoos Bubble baths Floor cleaners	Flower pots Seed trays Drainage pipes
Polyethylene Terephthalate (PET)	Carbonated drinks Shampoos	Fibres for quilts and coats
Polystyrene	Foods Talcs	Coat hangers Seed trays

Recycling of polyethylene is particularly worthwhile as it is re-used in similar, if not identical, applications to its original use.

HOW DO I HELP?

Start saving your plastic bottles ready for 1 July. It can never be too soon to start making your contribution to conserving your environment.

The Scottish Conservation Projects Trust is the leading charity involving people in improving the quality of Scotland's environment through practical conservation work. Already the newspaper collection recycling initiative in the Falkirk area, backed by UK 2000 (Scotland), Falkirk District Council and Central Regional Council, is recognised as one of the best examples of its type in Britain and has already created 5 new jobs. SCP and BP Chemicals are working together in this pilot scheme for the recycling of your plastic bottles in the hope that we can extend the service more widely in the future. Recycling is now recognised as the way forward by Government as an important way of improving the environment for ourselves and our children's children.

THE SUCCESS OF THE PAPER COLLECTION DEPENDED ON YOUR SUPPORT. PLEASE HELP MAKE THIS PLASTIC COLLECTION A SUCCESS BY SAVING ALL YOUR PLASTIC BOTTLES.

Scottish Conservation Projects

SCP

BP CHEMICALS

Supported by
BP Chemicals Ltd.
Grangemouth

25A Russel Street, Falkirk FK2 7HS Tel: 0324 32556
Printed on re-cycled paper
Inglis Allen Falkirk

Scottish Conservation Projects

SCP

PAPER AND PLASTIC CALENDAR 1991-92

SPONSORED BY BP CHEMICALS GRANGEMOUTH

Working together to help the environment

YOUR NEWSPAPER AND PLASTIC COLLECTION DAYS

1991

JULY

M	T	W	T	F	S	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

AUGUST

M	T	W	T	F	S	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

SEPTEMBER

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23	24	25	26	27	28	29
30						

OCTOBER

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	1	2	3	4	5	6
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28	29	30	31			

NOVEMBER

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DECEMBER

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						1
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23	24	25	26	27	28	29
30	31					

1992

JANUARY

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6	7	8	9	10	11	12
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20	21	22	23	24	25	26
27	28	29	30	31		

FEBRUARY

M	T	W	T	F	S	S
					1	2
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17	18	19	20	21	22	23
24	25	26	27	28	29	

MARCH

M	T	W	T	F	S	S
						1
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23	24	25	26	27	28	29
30	31					

APRIL

M	T	W	T	F	S	S
		1	2	3	4	5
6	7	8	9	10	11	12
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20	21	22	23	24	25	26
27	28	29	30			

MAY

M	T	W	T	F	S	S
				1	2	3
4	5	6	7	8	9	10
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18	19	20	21	22	23	24
25	26	27	28	29	30	31

JUNE

M	T	W	T	F	S	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

Your Collection Day is Every 2nd Wednesday On the Dates Highlighted In Red

[illegible]

1. Newspapers — [illegible] Bags 2. Plastic Bottles — [illegible] Bags

[illegible]

PLEASE REMEMBER — [illegible] COLLECTION NEWSPAPERS AND MAGAZINES ONLY

[illegible]

PLEASE REMEMBER — PLASTIC BOTTLE COLLECTION BOTTLES ONLY

[illegible]

Christmas and New Year Public Holidays No Collection

The Scottish Conservation Projects Trust

[illegible]

Appendix 6: Launch Publicity for Falkirk

SCP

Scottish Conservation Projects

PRESS RELEASE

Balallan House, 24 Allan Park, Stirling FK8 2QG Telephone (0786) 79697

NEWS RELEASE · NEWS RELEASE · NEWS RELEASE · NEWS RELEASE · NEWS RELEASE

Embargo: 12 noon 24 June

SCOTTISH CONSERVATION PROJECTS KICKS OFF SCOTLAND'S FIRST KERBSIDE PLASTICS COLLECTION FOR RECYCLING WITH THE HELP OF PETER HETHERSTON

On 1 July The Scottish Conservation Projects Trust will commence Scotland's first Kerbside Plastics Collection for Recycling. This pilot scheme, sponsored by BP Chemicals Limited, Grangemouth, and supported by Falkirk District Council, will cover 15,000 households in Falkirk District.

The project was kicked off on Monday 24 June at BP Social and Recreation Club, BP (Grangemouth), by Falkirk Football Club 1st team player, Peter Hetherston. Present on the occasion were: Lt Gen. Sir Norman Arthur, President of The Scottish Conservation Projects Trust; Nicholas Cooke, Director, SCP; Kate Smith, Assistant Director, SCP; Mr E L Ferguson, Works General Manager, BP Chemicals and Mr R G Read, Manager, BP Chemicals (Polyolefins), plus other representatives from BP Chemicals. Guests included representatives of Falkirk District Council, Central Regional Council, the Scottish Office, Scottish Enterprise, Forth Valley Enterprise and Stirling Fibres.

over

The service will provide for the collection of plastic bottles only at this stage. Households will receive a special green plastic bag in which to save their bottles, along with a calendar showing the collection dates for their street.

The plastic bottles collected will be crushed and baled and taken over by Recovery Plastics, a BP subsidiary who will send them by lorry to Impex, its recycling company based in Runcorn, Cheshire, where they will be sorted into the different types of plastic, chopped into small flake and washed. The flake is then re-processed, ready for use.

Kate Smith, Assistant Director of The Scottish Conservation Projects Trust, said today:

"We are delighted that SCP is able to extend its recycling services already provided to householders in Falkirk. Our Newspaper Collection Scheme, backed by UK 2000 Scotland Ltd. and Falkirk District Council is recognised as one of the best examples of its type in Britain. It has already created five new jobs, with the possibility of a further eight. We could not have achieved our success without the help of local people. We would like to thank everyone for their support."

She continued:

"We are most grateful to BP Chemicals for their sponsorship of the Plastic Bottle Recycling Scheme. Recycling is now recognised by Government as the way forward and an important way of improving the environment for ourselves and our children's children. We hope everyone will help to make the Plastics Collection as successful as our Paper Collection. Householders should start saving up their plastic bottles now for the first collection."

over

3/

Richard Read, Manager, Polyolefins (UK), BP Chemicals, explained: "When we talk about plastic bottles, we mean every type of plastic bottle from milk and other drink containers through to household items such as washing up liquid, bleach or shampoo. Plastics offer many benefits to packaging and items made from them can be recycled. The difficult bit is to find a practical and economic method of collecting them for the consumer. This project is aimed at finding out more about the viability of house to house collection of such items. We are really pleased to be able to support Scottish Conservation Projects in this venture. Their house to house paper collection has been very efficient and I feel confident that they will be equally successful with this pilot Plastics Collection Scheme."

BP Chemicals, Grangemouth, will be carrying out an educational campaign in local schools using a video to tell children about the value of the recycling of plastic bottles. It is hoped that children will reinforce the message at home and learn to save their bottles for collection by SCP instead of throwing them away.

The Plastic Collection Scheme is co-ordinated by Susan Whyte, Recycling Project Co-ordinator at Scottish Conservation Projects' local office - 25a Russell Street, Falkirk, Tel 0324 32556.

The Scottish Conservation Projects Trust is the leading charity involving people in improving the quality of Scotland's environment through practical conservation work.

over

This press release resulted in articles in The Falkirk Herald (18/7/91, p8), The Advertiser (24/7/91, pp18&19, 27/11/91 p10), Waste Watch Newsletter (Sept 91) as well as the Scotsman and Glasgow Herald on the day following the launch.

SCOTTISH CONSERVATION PROJECTS
Balallan House, 24 Allan Park, Stirling FK8 2QG

GUEST LIST

Mrs I Adkins, Project Manager, Falkirk Town Centre Management

Lt Gen Sir Norman Arthur, KCB, DL, President, SCP

Arthur Barnes, Depute Cleansing & Transport Manager, Hamilton D.C.

David Campbell, Senior Planning Officer, Central Regional Council

Colin Campbell-Brown, Hon Secretary, SCP

Nick Cooke, Director, SCP

Rita Crowe, Press & Publicity Officer, SCP

Catherine Cushley, Operations Director, Training Craft Ltd

Tom Dickie, BP Chemicals

Mr Andrew Ditty, BP Chemicals

John Ferguson, Recycling Officer, Perth & Kinross District Council

Steve Forrest, BP Chemicals

Councillor Gerry Goldie, Chairman Environmental Health Committee, Falkirk D.C.

Anne Harper, External Affairs Manager, The BP Company PLC

Daniel Henderson, Divisional Environmental Health Officer, Cumbernauld & Kilsyth District Council

Steve Hendry, BP Chemicals

Peter Hetherston, Falkirk Football Club

Alex Janetta, Director of Finance, Falkirk District Council

M Kitchener, BP Chemicals

Steve Lawrence, BP Chemicals

Mr Peter Lewis, Asst Director, Scottish Business in the Community

Malcolm MacDonald, OBE, Director of Environmental Health, Falkirk D.C.

John McKendrick, Recycling Officer, UK2000 Scotland Ltd

Councillor F B McKeever, Falkirk District Council

Adrian Mahoney, Chief Reporter, Falkirk Herald

Prof Aubrey Manning, Scottish Wildlife Trust

Councillor Martin, Falkirk District Council

Mr Rolf Matthews, Recycling Officer, Glasgow District Council

Jacqueline Mitchell, Reporter, Falkirk Herald

John Moorhouse, Director, Scottish Business in the Community

Stuart Ogg, Senior Policy Executive, Forth Valley Enterprise

Gordon Rae, Clydesdale Bank PLC

Richard Read, BP Chemicals

Mr S Reid, BP Chemicals

Gordon Robb, Clydesdale Bank PLC

Robert Ross, Foreman/Driver - Recycling Team, SCP

Nicholas Sinclair, British Coal Enterprise

Kate Smith, Assistant Director, SCP

Geoff A Smith, BP Chemicals

Prof T C Smout, University of St Andrews

Mr J Stacey, BP Chemicals

Sir Jamie Stormonth-Darling, Vice President, SCP

Sam Toy, Chairman, UK2000, Scotland Ltd

Walter Weir, Chief Executive Designate, Falkirk District Council

Dave Westwood, Director, UK2000 Scotland

Susan Whyte, Recycling Development Officer, SCP

Tony Williams, Fundraising & Promotions Manager, SCP

Mr C P Wilkins, Chairman, Stirling Fibres Ltd

Mr D Woodhead, BP Chemicals

Paul Zealy, Project Manager, Green Action, CSV Media

AGENDA FOR THE DAY

Assemble in grounds of BP Social and Recreation Club, Little Kerse, Grangemouth

12.00	Lt Gen Sir Norman Arthur, KCB, DL welcomes everyone and introduces special guest
12.05	Peter Hetherston of Falkirk Football Club First team launches SCP Plastics Recycling Scheme
12.15	Move indoors into BP Social and Recreation Club Collect Name badges

SPEAKERS

12.25	Sir Norman Arthur, KCB, DL
12.30	Councillor Gerry Goldie, Falkirk District Council
12.35	Richard G Read, Manager, BP Chemicals, Polyolefins UK
12.40	Sam Toy, Chairman, UK2000 Scotland Ltd
12.45	Buffet Lunch

Where to Recycle in Falkirk District

Bottle & Can Bank Sites

Car Park	Gateway Supermarket	Airlie Drive	Polmont	Glass & Cans
Car park	Wm. Low	Dock Street	Bo'ness	Glass
Kinneil Kerse	Civic Amenity Site	Grangemouth Road	Bo'ness	Glass & Cans
Car Park	York Lane		Grangemouth	Glass
Car Park	Tesco Supermarket	Callendar Road	Falkirk	Glass
Car Park	Hope Street		Falkirk	Glass
Car Park	Co-op. Superstore	Ronades Road	Falkirk	Glass
Car Park	Shopping Precinct	Main Street	Stenhousemuir	Glass
Car Park	Shopping Precinct	Church Walk	Denny	Glass
Roughmute	Civic Amenity Site	Bogton Road	Bonnybridge	Glass & Cans

Save-A-Can banks accept all types of cans not just aluminium.

Oil Bank Sites

Kinneil Kerse Civic Amenity Site	Grangemouth Road	Bo'ness
Roughmute Civic Amenity Site	Bogton Road	Bonnybridge

Household Appliances

If you have a fridge or freezer for disposal, and you want to be sure that the ozone harmful C.F.C. gases are recovered, telephone 483456 and arrange a free special uplift. The free special uplift service can also be used for bulky items of furniture or large amounts of refuse not handled by the normal weekly collection.

Recycling Contacts

Falkirk District Council Contract Services Department
Seabegs Road
Bonnybridge FK4 2BU
Telephone 0324 814231
Contact: Graeme Cunningham

Scottish Conservation Projects
Unit 27, Winchester Avenue
Denny
Telephone 0324 826826
Contact: Adrian O'Dell

What can I do to help ?

Here are TEN ways in which YOU can take part in recycling:-

1. Put bottles and jars into their colour compartments at Bottle Banks.
2. Wash and squash all your cans and put them into Can Banks.
3. Put newspapers out for collection by Scottish Conservation Projects.
4. Put plastic bottles out for collection by Scottish Conservation Projects
5. Take waste engine oil to an oil bank.
6. Compost your kitchen and garden waste.
7. Buy products containing recycled materials when you go shopping.
8. Collect aluminium cans to raise cash.
9. Telephone for a free uplift of unwanted domestic appliances.
10. Tell a friend to take part in recycling.

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Where to Recycle In Falkirk District

Textiles

A pilot kerbside textile collection will operate in selected areas. This will be carried out on the same days as the S.C.P. blue bag (paper) and green bag (plastic bottle & aluminium drinks can) collections. Textiles will be collected in orange bags. The textile collection is supported by Nathans Wastesavers. If you have a large amount of textiles then these can be taken to Nathans Wastesavers, Unit 12/13, Winchester Avenue, Denny, telephone 0324 826633.

Coming soon to an area near you

Watch out for new can banks and neighbourhood recycling sites each with 4 special recycling containers for green glass, clear glass, brown glass and cans. The new sites will be at Bonnybridge, Camelon, Grangemouth, Slamannan, Banknock, Hallglen, Laurieston, Airth, Falkirk, Whitecross and Shieldhill.

Contract Services Department

RECYCLE FOR THE FUTURE WITH FALKIRK DISTRICT COUNCIL

0324
814231

Where to Recycle In Falkirk District

Textiles

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Contract Services Department

RECYCLE FOR THE FUTURE WITH FALKIRK DISTRICT COUNCIL

0324 814231

SCP

ACTION RECYCLE

(0324 826826)
27 WINCHESTER AVENUE - DENNY FK6 6QE

BP CHEMICALS

KERBSIDE COLLECTION DAYS FOR

Newspaper & Magazines
Plastic Bottles & Aluminium Drinks Cans
Textiles & Clothing

1993 — BEAT 5

January

M	T	W	T	F	S	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	$\boxed{15}$	16	17
18	19	20	21	22	23	24
25	26	27	28	$\boxed{29}$	30	31

February

M	T	W	T	F	S	S
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8	9	10	11	$\boxed{12}$	13	14
15	16	17	18	19	20	21
22	23	24	25	$\boxed{26}$	27	28

March

M	T	W	T	F	S	S
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8	9	10	11	$\boxed{12}$	13	14
15	16	17	18	19	20	21
22	23	24	25	$\boxed{26}$	27	28
29	30	31				

April

M	T	W	T	F	S	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	$\boxed{23}$	24	25
26	27	28	29	30		

May

M	T	W	T	F	S	S
					1	2
3	4	5	6	$\boxed{7}$	8	9
10	11	12	13	14	15	16
17	18	19	20	$\boxed{21}$	22	23
24	25	26	27	28	29	30
31						

June

M	T	W	T	F	S	S
	1	2	3	$\boxed{4}$	5	6
7	8	9	10	11	12	13
14	15	16	17	$\boxed{18}$	19	20
21	22	23	24	25	26	27
28	29	30				

July

M	T	W	T	F	S	S
			1	$\boxed{2}$	3	4
5	6	7	8	9	10	11
12	13	14	15	$\boxed{16}$	17	18
19	20	21	22	23	24	25
26	27	28	29	$\boxed{30}$	31	

August

M	T	W	T	F	S	S
						1
2	3	4	5	6	7	8
9	10	11	12	$\boxed{13}$	14	15
16	17	18	19	20	21	22
23	24	25	26	$\boxed{27}$	28	29
30	31					

September

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		1	2	3	4	5
6	7	8	9	$\boxed{10}$	11	12
13	14	15	16	17	18	19
20	21	22	23	$\boxed{24}$	25	26
27	28	29	30			

October

M	T	W	T	F	S	S
				1	2	3
4	5	6	7	$\boxed{8}$	9	10
11	12	13	14	15	16	17
18	19	20	21	$\boxed{22}$	23	24
25	26	27	28	29	30	31

November

M	T	W	T	F	S	S
1	2	3	4	$\boxed{5}$	6	7
8	9	10	11	12	13	14
15	16	17	18	$\boxed{19}$	20	21
22	23	24	25	26	27	28
29	30					

December

M	T	W	T	F	S	S
		1	2	$\boxed{3}$	4	5
6	7	8	9	10	11	12
13	14	15	16	$\boxed{17}$	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

YOU DO NOT NEED A SPECIAL BAG TO TAKE PART!

On the days shown, put your Recyclables [(1) Newspapers & Magazines, (2) Used Textiles/Clothing and (3) Plastic Bottles together with Aluminium Drinks Cans] in separate plastic bags and we'll collect them and replace with a special bag. Save up more and repeat the process!

* **PLACE BAGS AT KERBSIDE (OR FRONT GATE) BY 8.00 AM**
* **NEWS/MAGS ONLY: NO CARDBOARD OR GUMMED BOOKS**
* **WASH OUT BOTTLES & DISPOSE OF TOPS - THEN TIE UP BAG**
* **DRY TEXTILES AND CLOTHING ONLY - THEN TIE UP BAG**
* **PLEASE *FILL* BAGS BEFORE PUTTING OUT FOR COLLECTION**
* **RECYCLING HELPS THE ENVIRONMENT & CREATES JOBS**

PRINTED BY INGLIS ALLEN ON COUNTRY COLOURS 100% RECYCLED PAPER

THE SCOTTISH CONSERVATION PROJECTS TRUST

ACTION RECYCLE

NEW! SCP **NEW!**

KERBSIDE COLLECTION SCHEME FOR RECYCLING

WE ARE NOW COLLECTING THE FOLLOWING:

NEWSPAPERS & MAGAZINES

+

PLASTIC BOTTLES TOGETHER WITH ALUMINIUM DRINKS CANS

+

TEXTILES & CLOTHING

* PUT YOUR NEWS/MAGS IN ANY PLASTIC BAG AND WE'LL SWOP IT FOR A BLUE BAG

* PUT YOUR PLASTIC BOTTLES TOGETHER WITH ALUMINIUM CANS IN ANOTHER BAG AND WE'LL SWOP IT FOR A GREEN BAG

*PUT YOUR TEXTILES/CLOTHING IN THE ORANGE BAG AND WE'LL SWOP IT FOR ANOTHER

BP Chemicals support recycling in Falkirk

Arlene Speirs, Richard McKendrick and Lisa Smith showing their haul of plastic bottles with Susan Whyte, SCPT Recycling Development Officer.

It's been received wisdom that, while paper and glass can be recycled, plastics present an altogether trickier proposition.

True up to a point – by their very nature, plastics can be notoriously difficult to break down and re-use. But a new, BP-backed project is helping to challenge long-held assumptions and provide a more optimistic pointer to the future.

The Scottish Conservation Projects Trust (SCPT) is operating Scotland's first kerbside collection for empty plastic bottles. It's limited – only certain types of plastic container can be accepted for recycling and the area covered is small – but it's a start.

Fittingly, the place chosen for the innovative new scheme is in Falkirk, virtually on the doorstep of BP Chemicals in Grangemouth. BP, as a major producer of the raw materials which go into the manufacture of plastic containers, is putting its weight behind the recycling scheme which is attempting to change entrenched public perceptions. BP Chemicals are covering all the costs of the scheme, including plastic collection bags and publicity leaflets outlining to householders how the scheme works.

BP is also running an educational programme in five local schools (with more to come) alongside the nine-month pilot project. Working on the "get 'em young" principle, BP Chemicals personnel officer Andrew Catty drew up a programme of school visits to talk to youngsters about the use of plastics in the home and the benefits of recycling.

The 45-minute programme delivered by Andrew, Karen Walker, a teacher on secondment to BP Chemicals in Grangemouth, and BP's education links officer Syd Reid, included a showing of BP's award-winning film *Plastics can be Recycled* and was aimed at children of all ages, with plenty of opportunity for pupil involvement.

"I was impressed," said Andrew, "with how environmentally aware many of the children were. Some of the questions they asked were very well thought out."

BP Chemicals have now published Unwrapping the Truth: The Facts about Polyethylene, *a brochure which should interest schools and BP staff wanting to know more about plastics and recycling. Copies shortly available from BP Educational Service, PO Box 30, Alton, Hants GU34 4PX.*

Article in BP in Education, Autumn 1991

Appendix 7: Questionnaires

Date Place Time Number

GENERAL SECTION

1. Of the following materials, which do you believe has the most environmentally damaging production processes? (please rank)

glass [ ] plastic [ ] paper [ ] metal [ ]

2. When disposed of, which of these do you believe is the most environmentally damaging? (please rank)

glass [ ] plastic [ ] paper [ ] metal [ ]

3. Which of these materials do you believe can be recycled from domestic waste?

glass [ ] plastic [ ] paper [ ] metal cans [ ] none [ ]

4. Which of these materials do you believe is the easiest to recycle?

glass [ ] plastic [ ] paper [ ] metal cans [ ] none [ ]

5. Which of these materials do you actually recycle?

glass [ ] plastic [ ] paper [ ] metal cans [ ] none [ ] **>go to 7**

6. By what method do you recycle?

collection bank [ ] door to door collection [ ] other [ ]

(if other, please specify:)

7. What do you consider to be the most common plastics in your home?

8. How much of your total rubbish do you consider to be plastic?

very little [ ] less than half [ ] more than half [ ] almost all [ ]

9. When your plastic containers are empty, what proportion would you say you

reuse for other things [ ] > **go to 10.**

put in the rubbish bin [ ] }

put aside for recycling [ ] } **go to 11.**

other [ ] (please specify:) }

10. Do you reuse the container,

in the house [ ]

in the garden [ ]

11. What do you do with your containers after reuse?

reuse for other things [ ]

put in rubbish bin [ ]

put aside for recycling [ ]

other [ ] (please specify:)

GLASGOW USER SECTION

1. What is your main reason for using the plastic recycling bin today?

to have less rubbish in the bin [ ]

reduction of waste/environmental reasons [ ]

wish to conserve resources [ ]

other [ ] (please specify:)

2. How often do you use this recycling bin?

more than once a week [ ]

once a week [ ]

once/twice a month [ ]

less [ ]

3. What types of plastic containers do you recycle?

4. How many containers do you normally bring each visit?

1-5 [ ]

6-10 [ ]

11-20 [ ]

more than that [ ]

5. What sort of containers have you brought today?

6. How much of your total plastics rubbish is this?

very little [ ]

less than half [ ]

more than half [ ]

no idea [ ]

7. What would encourage you to recycle more plastics?

8. How did you become aware that you could recycle plastics in this bin?

publicity campaign	[ ]
friend/word of mouth	[ ]
saw the bin	[ ]
other	[ ] (please specify:)

9. Do you think there is enough publicity about the bins?

Yes [ ] No [ ]

10. Do you have any suggestions as to how the publicity might be improved?

11. When do you use the bin?

on the way to work	[ ]
on the way to the shops	[ ]
on the way to other activities	[ ]
make a special trip	[ ]
other	[ ] (please specify:)

12. How far have you come to use this bin today?

13. How do you travel to the recycling bin?

by car [ ]

on foot [ ]

by bus [ ]

by train [ ]

other [ ] (please specify:)

14. Why are you using this particular bin?

it is the most convenient [ ]

nearest [ ]

other bins are full [ ]

do not know of any other bins [ ]

other [ ] (please specify:)

15. Where do you think the best type of place for the bins to be sited would be?

16. Why do you believe this plastics collection system has been set up?

FALKIRK USER SECTION

1. What is your main reason for using the recycling scheme?

to have less rubbish in the bin [ ]

reduction of waste/environmental reasons [ ]

wish to conserve resources [ ]

other [ ] (please specify:)

2. How often do you use the recycling scheme?

every collection [ ]

every second collection [ ]

occasionally [ ]

3. How did you become aware of the kerbside recycling scheme?

through leaflet/advertising campaign [ ]

friend/word of mouth [ ]

saw the collections [ ]

other [ ] (please specify:)

4. Did you find the information and instructions in the leaflet clear?

Yes [ ]

No [ ]

did not read the leaflet [ ]

5. Do you think there is enough publicity about the scheme?

Yes [ ]

No [ ]

6. Do you have any suggestions as to how the publicity might be improved?

7. What types of plastic containers do you recycle?

8. How do you prepare your plastic bottles for recycling?

9. How many bottles do you put out for each collection?

1-10 [ ]

11-20 [ ]

21-30 [ ]

more than that [ ]

10. Do you find the collection timing suitable?

Yes [ ]

No [ ]

11. Why do you believe this plastics collection scheme has been set up?

12. Can you suggest any improvements to this scheme?

GLASGOW NON-USER SECTION

1. Do you believe that plastics can be recycled?

Yes [ ]

No [ ]

2. Are you aware of any plastics collection schemes?

Yes [ ]

No [ ] **>go to 4**

3. How did you become aware of them?

advertising/publicity	[ ]
saw a bin/roadside collection	[ ]
heard about it from a friend/relation	[ ]
other	[ ] (Please specify:)

4. Why do you not currently recycle plastics?

it is inconvenient	[ ]
it is not necessary	[ ]
there are no facilities to recycle in this area	[ ]
I didn't know you could recycle plastics until today	[ ]
I have no interest in recycling	[ ]

5. Knowing that plastics are recyclable, what would encourage you to do so?

6. Are you prepared to use a plastics bottle bank?

Yes [ ]

No [ ] **>go to 8**

7. What distance are you prepared to travel to do so?

8. Are you prepared to sort your plastics waste for kerbside collection?

Yes [ ]

No [ ] **>go to 10**

9. At what frequency would you want this collection?

10. Why do you think plastics recycling schemes are being set up?

FALKIRK NON-USER SECTION

1. Do you believe that plastics can be recycled?

Yes [ ]

No [ ]

2. Are you aware that there is a roadside collection of certain plastics in this area?

Yes [ ]

No [ ] **>go to 5**

3. How did you become aware of it?

through leaflet/publicity	[ ]
saw a bin/roadside collection	[ ]
heard about it from a friend/relation	[ ]
other	[ ] (Please specify:)

4. Did you find the instructions and information in the leaflet clear?

Yes [ ]

No [ ]

5. Why do you not currently recycle plastics?

it is inconvenient [ ]

it is not necessary [ ]

there are no facilities to recycle in this area [ ]

I didn't know you could recycle plastics until today [ ]

I have no interest in recycling [ ]

6. Are there any alterations in the kerbside recycling scheme which would encourage you to recycle plastics?

7. Would you prefer to use a plastics bottle bank?

Yes [ ]

No [ ] **>go to 9**

8. If so, what distance would you be prepared to travel to do so?

9. Why do you think plastics recycling schemes are being set up?

CLASSIFICATION SECTION

Age	0-15	[ ]
	16-30	[ ]
	31-45	[ ]
	46-60	[ ]
	61+	[ ]

Gender	Male	[ ]
	Female	[ ]

Occupation ______________________________

Number in Household ______________________________

Postcode ______________________________

Thank you for your help.

Appendix 8: Glasgow Site Diary

Main 16 Sites

Knightswood Shopping Centre

Broomhill Shopping Centre

Maryhill Co-op

Shawbridge Street

Kinross Avenue

Woodlands Road

Dawsholm Works

Sinclair Drive

Leslie Street/Kenmure Avenue

Lauderdale/Queensborough Gardens

Peckhams at Clarence Drive

Terregles Drive/Nithsdale Road

Shawlands Arcade

Sites which yield less that 15kg per week

Ardale/Merrylee/Coylton Road

Cathcart Cleansing Department

Springkell Avenue

Mannering Court

Hillington Gardens

Chaplet Avenue/Great Western Road

Whitefield Road

Western Depot

Beechwood Restaurant (Ardmay Crescent)

Scotstoun Showground

Methil Street/Dumbarton Road

Chamberlain Road

Maxwell Drive

Partick Cleansing Depot

Pollockshields Depot

Date: 23/7/91

Address: Shawbridge Street

Comment: The bank was situated outside a small shopping precinct in a residential area. It is beside 3 glass banks (2 clear, 1 coloured), a paper bank and a metal cans skip. The bank appeared to be full of clear PET bottles (e.g. lemonade, coke), a few metal cans and margarine tubs. There was very little PE visible. There were no instructions or markings of any type on the bin.

Date: 23/7/91

Address: Mannering Court

Comment: The bottle bank was located in a car park behind tenement buildings. The bin was fairly full, but it contained mainly clear PET and PVC packaging. There were also a few glass bottles. The bin had no markings on it at all. It was placed next to an aluminium cans only bank.

Date: 23/7/91

Address: Christian Street

Comment: We were unable to locate the bank

Date: 24/7/91

Address: Kinross Avenue

Comment: The bin was located opposite private garages on a street corner near local shops in a residential area. It had one information sticker ripped off and of the other two, one was obscured by a second sticker. The bin contained mostly milk and clear PET and PVC bottles.

Date: 24/7/91

Address: Hillington Gardens

Comment: Hillington Gardens is a one way street in a residential area. We were unable to locate the bin.

Date: 25/7/91

Address: Woodlands Drive

Comment: The bin was located at one end of a street lined with tenement flats with a grass area in the middle. It is situated just off a busy road next to an aluminium cans bank. Two out of three of its stickers were intact. It contained mostly clear PET bottles and milk bottles. A resident who came down to complain told us that it had once been set on fire.

Date: 25/7/91

Address: Western Cleansing Depot, Kelvinhaugh St

Comment: The bin was located at the rear of the car park behind the cleansing depot, along with a can and a paper bank. Access was through the main gates of the depot and there was no sign posting.

Date: 29/7/91

Address: Knightswood Shopping Centre

Comment: The bottle bank is situated in the car park opposite the shops. It is one of the new banks and has three moulded labels. These do not have any information about the plastics required. The bin contained mainly soft drinks bottles and plastic bags with a small amount of detergent bottles.

Date: 29/7/91

Address: Chamberlain Road

Comment: The bin was situated in a dead end. It was a quarter full with drinks bottles, milk bottles and plastic bags. The bin was of the smaller type and had no form of labelling.

Date: 29/7/91

Address: Chaplet Avenue

Comment: This was a residential area just off Great Western Road. There was no evidence of the bin.

Date: 30/7/91

Address: Broomhill Shopping Centre

Comment: A new, large bin was situated in the car park of this small shopping centre. It was sited next to two paper banks, an aluminium can bank and a glass bottle skip. The bin contained plastic bags, margarine tubs and soft drinks bottles. The bin was clearly labelled.

Date: 30/7/91

Address: Methil Street

Comment: The bin was situated at the no entry end of this dead end street near shops on Dumbarton Road. It contained mostly soft drinks bottles as well as aluminium cans, foil trays, pieces of carpet, paper and card. Its contents were spilling out from the bottom and there was no labelling.

Date: 30/7/91

Address: Scotstoun Showground

Comment: The recycling bin stood outside the main gates to the showground, opposite a residential area. It was sited next to an aluminium can bank. The bank was fairly full with plastic bags, soft drinks bottles and a few contraries. There was spillage from the bottom of the bin. This bin had no official form of labelling, but a couple of pieces of A5 paper with the words "This bin is for plastic" had been attached to it, presumably by a member of the public.

Date: 31/7/91

Address: Maryhill Co-op

Comment: This was a large bin, situated near the side entrance of a large shopping centre, opposite a residential area. The bin was placed next to two paper banks, three glass banks, and an aluminium can bank. It contained a few detergent bottles, but mainly soft drinks bottles. There were a few contraries. It was labelled with three stickers of each type.

Date: 2/8/91

Address: Peckhams, Clarence Drive

Comment: This bin was situated round the corner from a small local shopping area along with an aluminium can bank. The bin was very full, but had no whole labels attached. It contained soft drinks bottles, a few detergent bottles (all with their tops still on), as well as plastic bags. There seemed to be few contraries.

Date: 2/8/91

Address: Queensborough Gardens

Comment: This bank is situated on a street junction in a residential area next to an aluminium can bank. This bin contained soft drinks bottles and a few contraries. Only one recycling label was attached to it.

Date: 3/8/91

Address: Asda, Rothes Drive

Comment: This was a large bank situated in the furthest corner of the car park. It was placed with three paper banks, one can bank, one aluminium can bank, five glass banks (two green, two clear, one brown). These were all highly visible from the road. The plastic bin contained mainly coloured drinks bottles and plastic bags. It was only around a quarter full. The bin was clearly marked with both types of label. This bin site was maintained by the superstore.

Date: 4/8/91

Address: Safeway, Crossmyloof

Comment: This was a large bank situated on the exit road of the Safeway car park next to two paper, one aluminium can, and three glass banks. It contained bags and assorted bottles. Three recycling stickers were clearly visible.

Date: 5/8/91

Address: Dawsholm Works

Comment: This bin stood inside the gates of the Glasgow City Cleansing Department works. It was positioned with three glass, one aluminium can, and two paper banks. The bin was fairly full with plastic bags, yoghurt cartons, margarine tubs, and soft drinks bottles. There were three moulded labels.

Date: 5/8/91

Address: Whitefield Road

Comment: Situated at the main road end of a dead end street, this bin was placed next to an aluminium cans only bank. The bin was heavily graffited and had no form of labelling. It was practically empty apart from a couple of spirit bottles, beer cans and paper.

Date: 5/8/91

Address: Elizabeth Street

Comment: This bin was situated in a similar position as the one in Whitefield Road. Again there was no form of labelling and the bin was heavily vandalised and empty.

Date: 5/8/91

Address: Maxwell Drive Co-op

Comment: This bin had been moved from its front-of-shop position a few months ago due to customer complaints. It had been re-sited in the rear car park next to a paper bank and a glass bank. It was subsequently burnt down and there has been no replacement.

Date: 5/8/91

Address: Maxwell Drive/St Andrews Drive

Comment: The recycling bin is positioned behind shrubbery at the closed end of a dead end road. It has been placed next to an aluminium can bank in a residential area. It contained plastic bags and soft drinks bottles and was labelled with one moulded sticker.

Date: 5/8/91

Address: Springkell Avenue/Albert Drive

Comment: Again the bank was positioned in the closed end of a dead end street. This bank contained plastic bags, soft drinks bottles and packaging. There were no labels on the bin.

Date: 5/8/91

Address: Terregles Avenue

Comment: The bank had been sited in a small car park area at the junction of three roads near a station and shops. It had been placed next to an aluminium cans only bank. It contained glass bottles, plastic bags, soft drinks bottles and packaging. Half a sticker was attached to the bin.

Date: 5/8/91

Address: Leslie Street/Kenmure Street

Comment: The bin was situated on a street corner in a residential area near a few shops. It was placed near three glass banks and an aluminium can bank. It contained soft drinks bottles and plastic bags. There was no form of labelling on this bin

Date: 5/8/91

Address: Nithsdale Drive/Nithsdale Street

Comment: Situated at the road end of a dead end street, this bin had a quarter of a label attached to it and contained soft drinks bottles, detergent bottles and a few contraries in the form of glass bottles and a hessian bag.

Date: 5/8/91

Address: Pollockshields Depot

Comment: The bin was just inside the gates of the depot, in a corner of the car park. It had been placed next to a can bank and two paper banks. It was a quarter full with plastic bags and soft drinks bottles and had three labels marking it. The main site entrance had a recycling centre sign.

Date: 5/8/91

Address: Sinclair Drive

Comment: Positioned in a dead end in a residential area, this bank has been sited next to an aluminium can bank. It contained cans, glass, plastic bottles and plastic bags. There was no form of labelling.

Date: 5/8/91

Address: Coylton Road

Comment: This bank was situated in a dead end, next to an aluminium can bank. It had three labels and contained plastic bottles and packaging.

Date: 5/8/91

Address: Partick Depot

Comment: This bin was in the far corner of the depot and was obscured by a parked lorry. It was labelled and contained plastic bags and bottles. The depot itself had a sign on the main entrance gates designating it as a recycling centre.

Date: 6/8/91

Address: Shawlands Arcade

Comment: The bin was situated in the driveway of the multi-storey car park of this shopping centre. The bin was labelled and contained few contraries, although the site itself was heavily littered. The bin was beside a skip for collecting glass bottles, and a paper bank and a metal can bank.

Appendix 9: Falkirk Diary

Date	**Area**
Wednesday, 14th August 1991	Grangemouth South
Thursday, 15th August 1991	Grangemouth South
Friday, 16th August 1991	Bantaskin
Saturday, 17th August 1991	Bantaskin
Sunday, 18th August 1991	Larbert North
Monday, 19th August 1991	Larbert South
Tuesday, 20th August 1991	Stenhousemuir North
Wednesday, 21st August 1991	Stenhousemuir South
Thursday, 22nd August 1991	Polmont North
Friday, 23rd August 1991	Polmont South

Appendix 10: Socioeconomic Groups

The following approximate classifications have been made, based on income and training levels associated with each of the posts

Group 1: Dependants

Retired	(1.1)
Housewife/husband	(1.2)
Unemployed	(1.3)
School	(1.4)
Student	(1.5)

Group 2: Unskilled/Semi-skilled

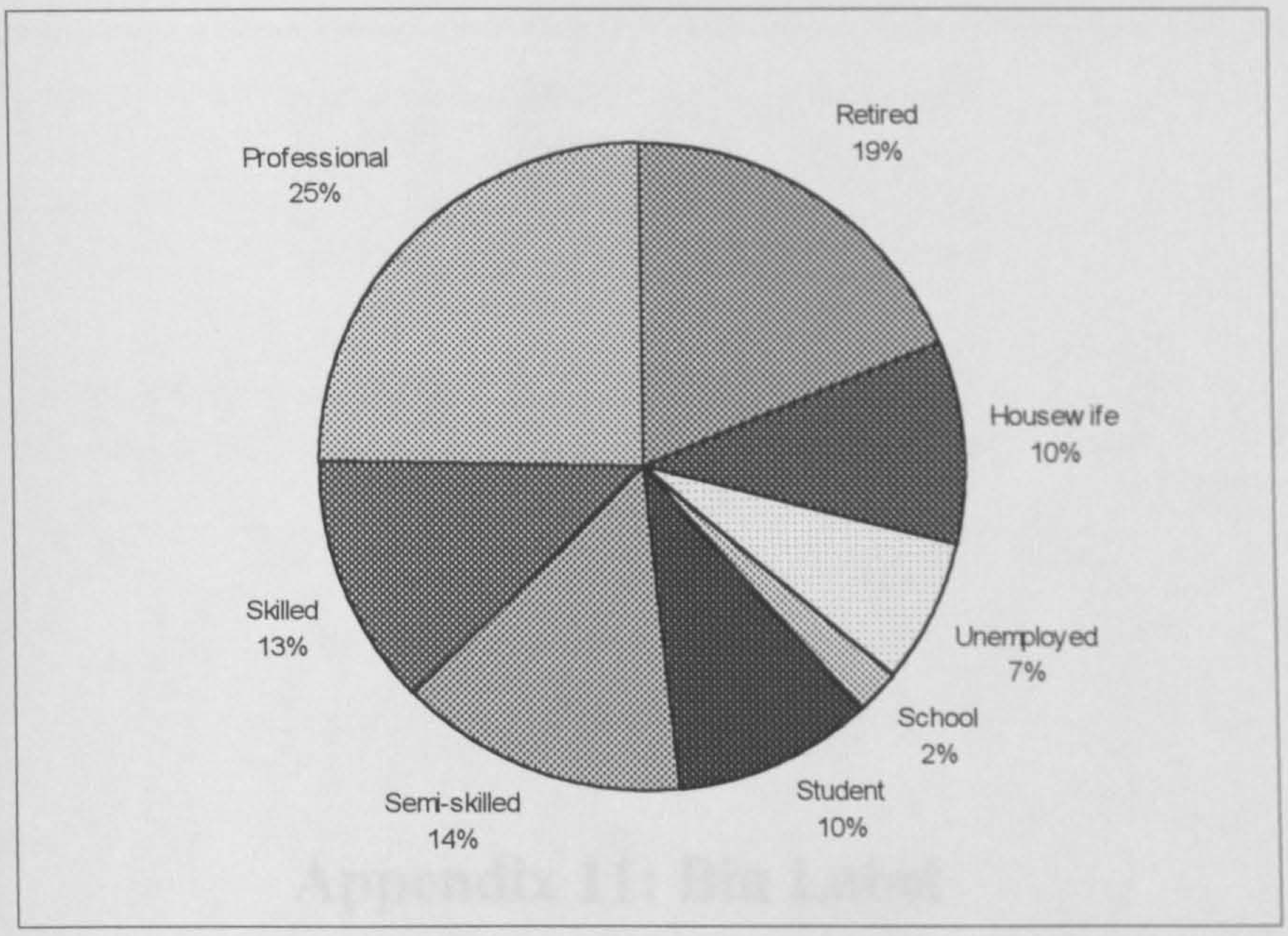
Bar Person
Childminder
Cleaner
Cook
Construction Worker
Domestic
Driver
Home help
Kitchen Assistant
Painter
Postman
Removals
Sales Assistant
Secretary
Stewardess
Storeperson
Travel Agent
Waitress

Group 3: Skilled

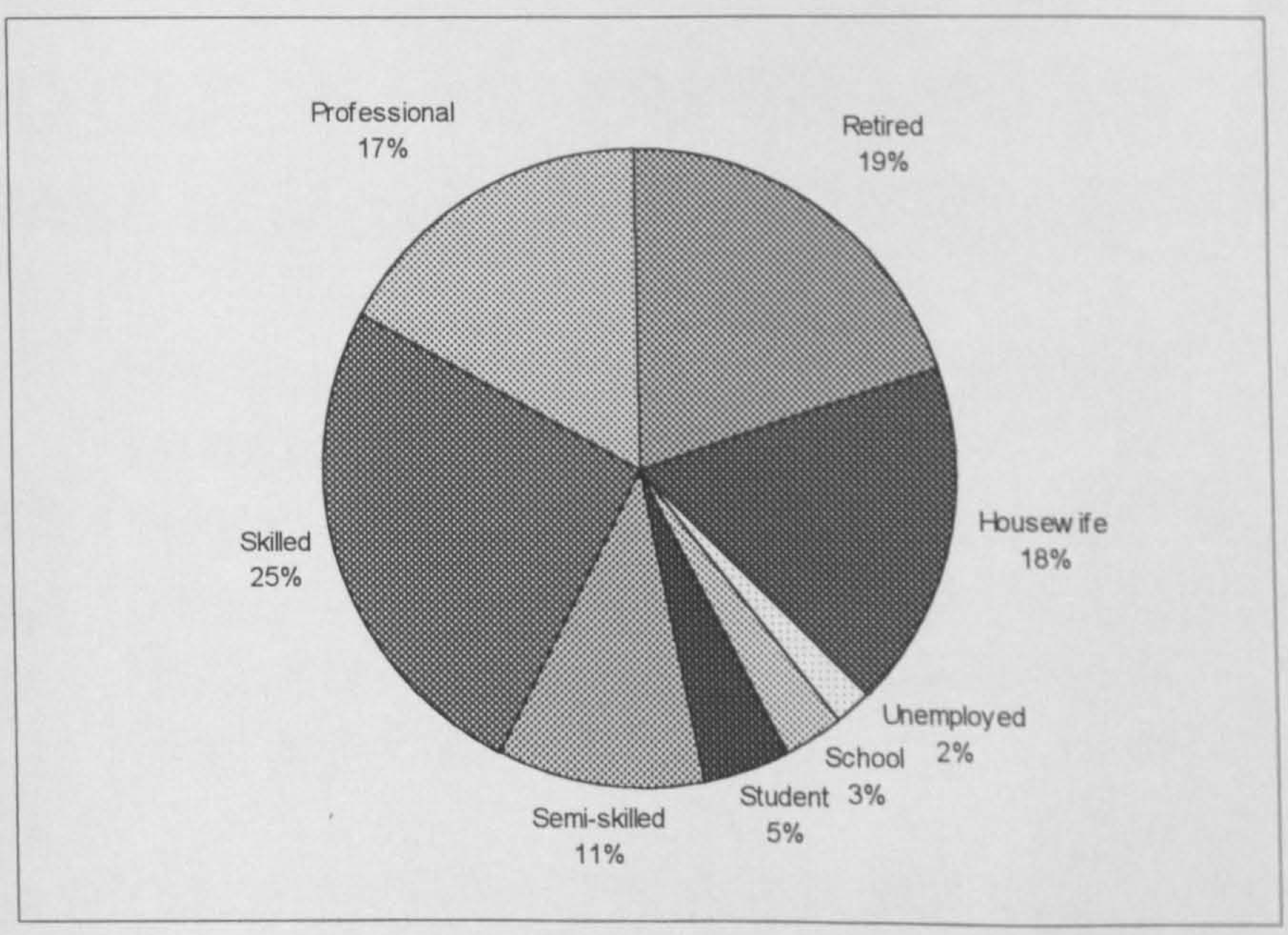
Administrator
Aerobic Instructor
Chef
Clerk
Computer Operator
Electrician
Hairdresser
Health Visitor
Landscape Gardener
Machinist

Mechanic
Midwife
Navy
Nurse
Pest Control
Printer
Prison Officer
Refinery Worker
Self Employed
Social Worker
Technician

Group 4: Professional
Accountant
Artist
Chemist
Chiropodist
Civil Servant
Dentist
Director
Doctor
Engineer
Financial Advisor
Graphic Designer
Inspector
Insurance Sales
Journalist
Lawyer
Lecturer
Licensing Officer
Manager
Minister
Musician
Pharmacist
Physiotherapist
Policeman
Programmer
Publisher
Salesman
Teacher
Writer



Graph A10.1 Distribution of Glasgow Respondents by Socioeconomic Group, with SEG1 broken down

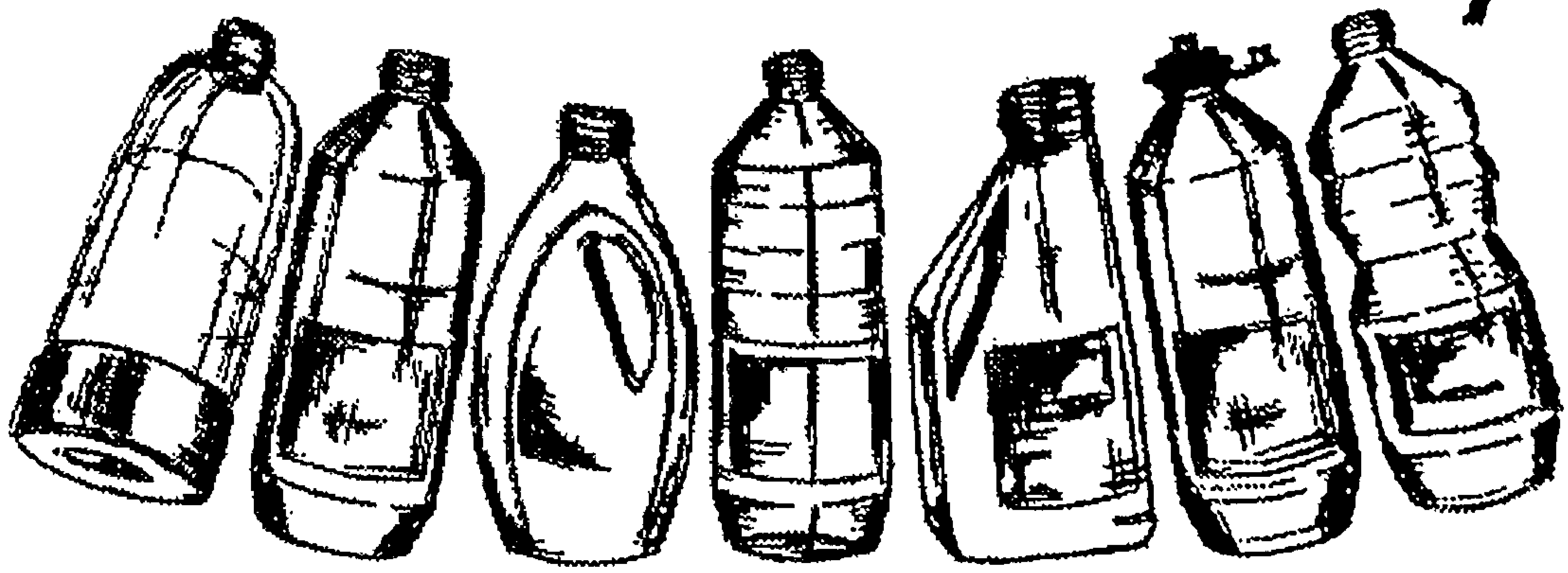


Graph A10.2 Distribution of Falkirk Respondents by Socioeconomic Group, with SEG1 broken down

Appendix 11: Bin Label

PLEASE

Plastics Bottles Only



Washing-up Liquid - Fabric Softeners
Laundry Liquids - Milk - Water
Squashes and Cordials - Fizzy Drinks

- NO GLASS - NO PAPER - NO METAL -

PLEASE REMOVE CAPS AND RINSE BOTTLES

NO

- Horticultural Chemicals Containers
- Lubricating Oil Bottles
- Yoghurt and Ice Cream Pots and Tubs
- Mayonnaise and Tomato Sauce Bottles
- Bath and DIY Sealant Cartridges and Tubes
- Plastics Films or Sheet

PLASTICS BOTTLES CAN BE RECYCLED - MAKE A START NOW!

Appendix 12: Recycling Histories

	Amount recycled (kg per capita)		
Material	1992	1993	1994
Glass	3.13	3.89	4.90
Paper	11.45	12.48	11.20
Plastic	0.32	0.74	0.34

Table A12.1 Annual tonnages of materials recycled in Falkirk 1992-1994 (from British Glass and the Action Recycle Operations Manager)

	Amount recycled (te per capita)		
Material	1991	1992	1993
Glass	2.51	2.61	4.00
Paper	2.14	1.16	1.48
Plastic	0.07	0.08	0.12

Table A12.2 Annual tonnages of materials recycled in Glasgow 1991-1993 (from British Glass and the GDC Recycling Officer)

These tables show that over a similar period, Glasgow's inhabitants consistently recycled less than their Falkirk counterparts for all materials.

Appendix 13: Cards from Ethnographic Interviews

Glass

Metal

Paper

Plastic

collect bottles

finish them

get a new bag

put in green bag

squash them

take bag outside

take green bag outside

take label off

take seals off

take top off

wash them

aftershave bottles

american cream soda

aspirin bottles

body lotion bottle

big juice bottles

butter tubs

cartons of juice

cola

donut tray

fairy liquid bottle

foam bath bottle

hand cream bottle

household cleaning materials

irn bru bottle

kiora blackcurrant juice bottle

large bubble bath bottles

large shampoo bottle

lemonade

lucozade bottle

medium juice bottles

milk bottle

mineral water bottle

mousse tub

orange bottles

plastic deodorant roll-on

plastic jam containers

scotch juice

shower gel bottle

small shampoo bottle

softener bottle

vimto

wee juice bottles

wine bottles

yoghurt tubs

7up bottle

pepsi bottle

orange crush

Diadic Contrast

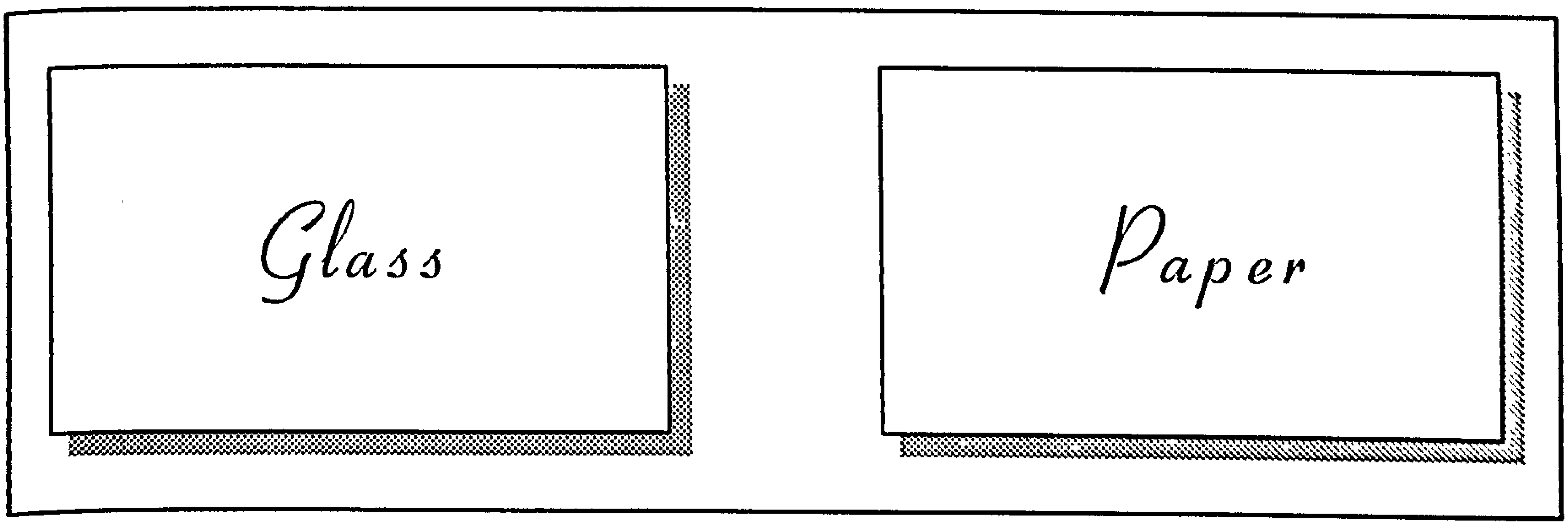


Figure A13.1 Cards laid out for a Diadic Contrast Question

For a Diadic Contrast question, two cards would be laid in front of the informant, as shown in Figure A13.1, and they would be asked to think of a difference and a similarity between Glass and Paper, for example. An answer might be that they can both be broken easily, but one is heavy and the other is light.

Triadic Contrast

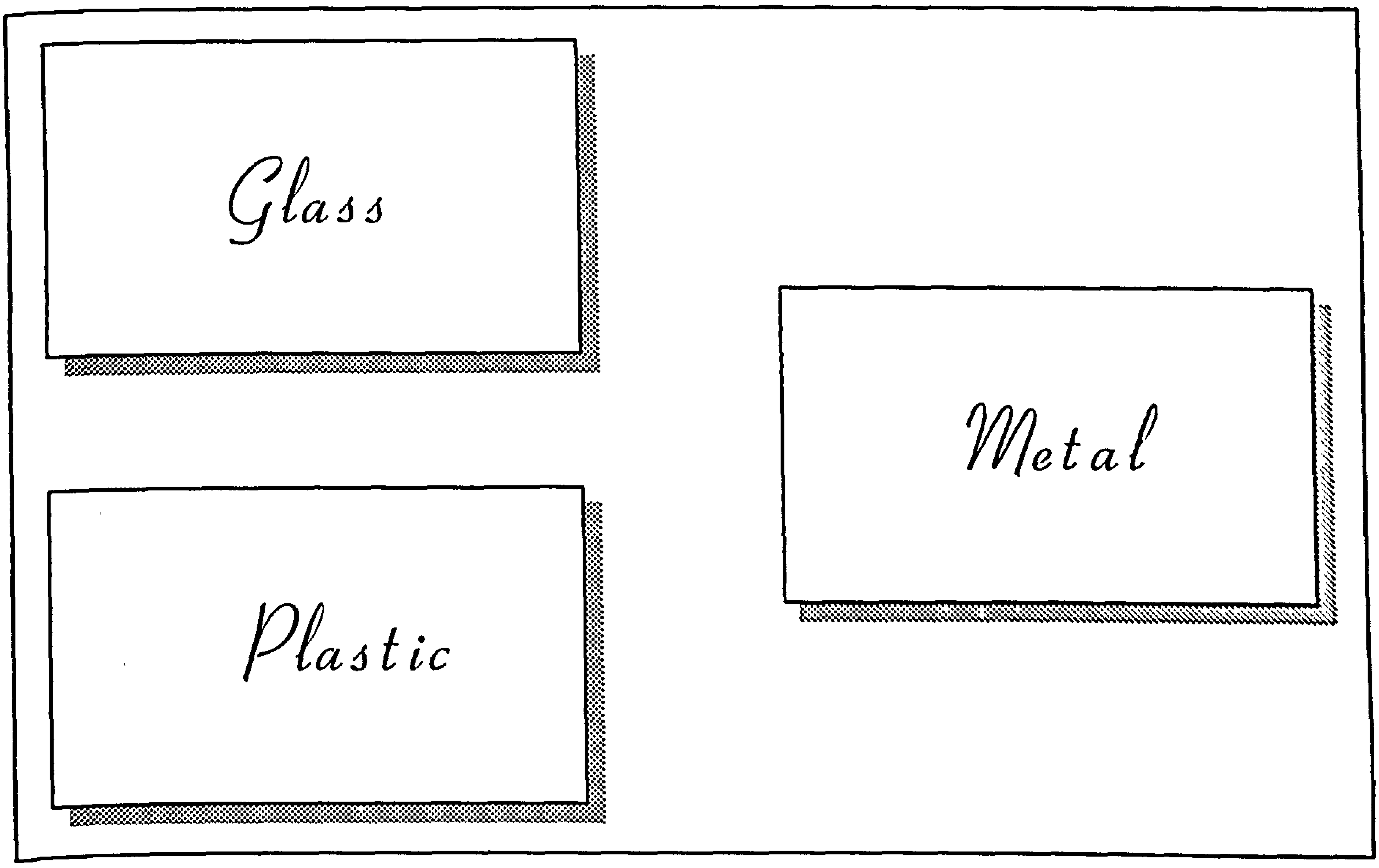


Figure A13.2 Cards laid out for a Triadic Contrast question

The Triadic Contrast question is handled very similarly, but this time three cards are laid before the informant, with one on the right and two on the left, as shown in Figure A13.2. In this example, the informant is solicited for a similarity between Glass and Plastic that also makes them different from Metal. An answer might be that you can see through Glass and Plastic, but not through Metal.

Appendix 14: Examples of Domains for Each Semantic Relationship

DOMAIN ANALYSIS WORKSHEET

Semantic Relationship *Strict Inclusion*

Form *X is a kind of Y*

Example *a Siamese is a kind of cat*

Included Terms	Semantic Relationship	Cover Term
Irn Bru		
Pepsi		
Orangina		
Lemonade		
Tango		
Cola		
Lucozade		
7up		
Vimto	*is a kind of*	*big juice*
Orange Crush		*bottle*
Cream Soda		

Structural Questions *Are all of these big juice bottles?*

Can you think of any more big juice bottles?

DOMAIN ANALYSIS WORKSHEET

Semantic Relationship: *Spatial*

Form: *X is a place in Y*

Example: *a classroom is a place in a school*

Included Terms	Semantic Relationship	Cover Term
cupboard		
fridge		
	is a place in	*kitchen*

Structural Questions

Is cupboard a place in the kitchen?

Is fridge a place in the kitchen?

DOMAIN ANALYSIS WORKSHEET

Semantic Relationship	*Cause-Effect*
Form	*X is a cause of Y*
Example	*smoking is a cause of heart disease*

Included Terms	Semantic Relationship	Cover Term
sticky		
wee nozzle		
opaque		
something		
stuck in the		
nozzle		
can't reach		
the bottom		
	is a cause of	*difficult to*
		clean

Structural Questions

Do these things all make it difficult to clean a bottle?

Is there anything else that makes it difficult to clean a bottle?

DOMAIN ANALYSIS WORKSHEET

Semantic Relationship	*Rationale*
Form	*X is a reason for doing Y*
Example	*hunger is a reason for eating*

Included Terms	Semantic Relationship	Cover Term
remove traces of contents		
it'll start to smell		
shampoo will start mixing with the chemicals in the plastic	*is a reason for*	*rinsing*
they wanted them rinsed		
you might get germs		

Structural Questions

Are these all reasons for rinsing?

Is remove traces of contents a reason for rinsing?

DOMAIN ANALYSIS WORKSHEET

Semantic Relationship	*Location for Action*
Form	*X is a place for doing Y*
Example	*a library is a place for keeping books*

Included Terms	Semantic Relationship	Cover Term
conservatory		
back of the kitchen		
in a cupboard in kitchen		
garden		
leaning up against the house	*is a place for*	*keeping the green bag*

Structural Questions: *What are all the places for keeping the green bag?*

DOMAIN ANALYSIS WORKSHEET

Semantic Relationship	*Function*
Form	*X is used for Y*
Example	*a typewriter is used for typing*

Included Terms	Semantic Relationship	Cover Term
cloth		
wee brush		
running water		
	is used for	*cleaning bottles*

Structural Questions	*What are all the things that are used for cleaning bottles?*
	Is a cloth used for cleaning bottles?

DOMAIN ANALYSIS WORKSHEET

Semantic Relationship	*Means-End*
Form	*X is a way to do Y*
Example	*running is a way to keep fit*

Included Terms	Semantic Relationship	Cover Term
pick at it		
peel		
soak for 5 minutes		
soak in hot water		
	is a way to	*take the label off*

Structural Questions	*Are these all ways to take the label off?*
	What are all the ways to take the label off?

DOMAIN ANALYSIS WORKSHEET

Semantic Relationship: *Sequence*

Form: *X is a step in Y*

Example: *sieving flour is a step in baking*

Included Terms	Semantic Relationship	Cover Term
get green bag		
take tops off		
take labels		
off		
rinse		
take seal off		
squash		
put in the		
green bag	*is a stage in*	*doing bottles*
put out the		
green bag		

Structural Questions: *Is rinsing a step in doing bottles?*

What are all the steps in doing

bottles?

DOMAIN ANALYSIS WORKSHEET

Semantic Relationship — *Attribution*

Form — *X is a characteristic of Y*

Example — *red is a characteristic of post boxes*

Included Terms	Semantic Relationship	Cover Term
label		
screw on top		
coloured		
holds juice		
kept in the		
kitchen		
sparkling		
big		
orange	*is an attribute of*	*Lucozade*
liquid		

Structural Questions — *Is a screw on top a characteristic of Lucozade?*

Appendix 15: Key to Acronyms

Key to abbreviations and acronyms used in the text

Abbreviation	Explanation
APME	Association of Plastics Manufacturers - Europe
BNMA	British Newsprint Manufacturers Association
BPF	British Plastics Federation
BSI	British Standards Institute
BXL	Recovery Plastics Ltd
CBI	Confederation of British Industries
CCT	Compulsory Competitive Tendering
CIPFA	Chartered Institute of Public Finance and Accountancy
CSERGE	Centre for Social and Economic Research on the Global Environment (UCL)
DOE	Department of the Environment
DTI	Department of Trade and Industry
EC	European Community
EFTEC	Economics for the Environment Consultants
ENDS	Environmental Data Services
EPA	Environmental Protection Act
EPS	Expanded Polystyrene
FDA	Food and Drug Administration (US)

GDCCD	Glasgow District Council Cleansing Department
HDPE	High Density Polyethylene
HIAB	Mechanical arm attached to a lorry (see Figure 2.6)
HMSO	Her Majesty's Stationery Office
INCPEN	The Industry Committee for Packaging and the Environment
IWM	Institute of Waste Management
LAWDC	Local Authority Waste Disposal Company
LDPE	Low Density Polyethylene
MRF	Materials Reclamation Facility
PE	Polyethylene
PET	Polyethylene Terephthalate (also PETE)
PIFA	Packaging and Industrial Films Association
PIRA	The Research Association for the Paper and Board, Printing and Packaging Industries
PP	Polypropylene
PS	Polystyrene
PSRA	Polystyrene Recycling Association
PVC	Polyvinyl Chloride
PWMI	European Centre for Plastics in the Environment
RECOUP	RECycling Of Used Plastic (Containers) Ltd
SCP	Scottish Conservation Projects
SWAP	Save Waste and Prosper (Leeds)

te	metric tonnes
VGK	German Society responsible for used plastics packaging
WCA	Waste Collection Authority
WDA	Waste Disposal Authority