RECYCLING POLICY IN AREAS OF LOW INCOME AND MULTI-STOREY HOUSING

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ABSTRACT

The paper considers the participation of households in recycling programmes in areas of multi-storey, low income housing which are often considered unattractive for such programmes. A model of the material recycled is presented together with a review of socio-economic, housing, technological, policy and other factors influencing household recycling. This is followed by a case study of two areas in the city of Edinburgh. Results suggest that the level of recycling is influenced by collection methods, for all materials except glass, with half of the recyclers starting as a result of the introduction of kerbside collection. Housing characteristics (such as the storey-level in buildings without lifts), household size and access to cars all influenced recycling participation rates. Housing tenure was not found to be significant. This suggests that well designed kerbside collection programmes can have a significant impact in areas with high levels of multi-storey dwellings, low-incomes, and public housing.

INTRODUCTION

Improving the level of recycling domestic waste has become a major policy challenge as a number of countries have set new targets, such as the 25% target levels in the UK and the United States (EPA, 1989; Department of the Environment, 1991). Significant increases in household recycling levels require: clarifying the responsibilities of all levels of government, product manufacturers and waste disposers (Macdonald & Vopni, 1994); improving the market for secondary materials (for instance through market support schemes and relative charges for virgin materials and waste collection, Department of Environment, 1992a); and increasing both household participation rates and the amount of material recycled by each household.

Such increases in household recycling levels will be influenced by the physical and socio-economic characteristics of the local area. Collection of recycled material, especially kerbside collection, is particularly expensive and difficult to organise in old cities with many “flats” and narrow street (Cairncross, 1991; Yuhas & Hyde, 1991), and among the 22.8% of the UK population resident in local authority housing (Forshaw *et al*, 1990; Clyde, 1994). Local authority tenants are often concentrated in such inner city areas or in large peripheral estates on the edge of cities. Most studies have, however, concentrated upon recycling programmes covering primarily single household buildings (Katzev *et al*, 1993) and where car ownership is high. Yet in order to achieve the national recycling targets mentioned above, it is necessary to get high levels of participation from households in areas with multi-storey, low-income housing and high levels of local authority housing. This paper analyses the participation of households in kerbside recycling programmes in such areas and the influence of tenure and housing characteristics.

Hence, in developing appropriate policies to increase household recycling levels a range of factors influencing household behaviour must be considered. These include: the socio-economic, housing and demographic characteristics of potential participants to a recycling programme; the values of the potential participants and social pressure; and the characteristics of recycling policies including promotional policies, financial incentives and the collection method. As recycling often involves considerable effort from participants, often with little or no personal financial, social or (given the small impact of any individual's effort) environmental gain, then a range of socio-economic and psychological perspectives are needed to understand the likely effect of recycling programmes. Each of these is considered below.

The next section presents a model of household recycling and considers factors that influence participation in recycling programmes. This is followed by a case study of two areas where hypotheses concerning the participation rates of households in a recycling programme are analysed in terms of certain factors important in such housing areas, particularly the collection method, housing tenure, building characteristics, household size and car ownership. The final section presents the conclusions.

FACTORS INFLUENCING HOUSEHOLD PARTICIPATION IN RECYCLING PROGRAMMES

A number of cross-disciplinary and inter-related factors need to be considered when analysing the level of recycling of household waste[1]. Whether households participate in recycling

programmes, and the degree of their participation will depend upon the characteristics of the households themselves (i.e. socio-economic and demographic factors, the values and beliefs of the members of the household), and the ability to participate in and the ease of recycling (i.e. the characteristics of the recycling policy or programme). The amount recycled will also depend upon the technology and effectiveness of the waste and recycling collection and processing, and the wider policy and economic-technological environments within which the household members live (including the wider characteristics of goods consumed and the effects of technological changes).

Based upon these factors, a model of the amount of material recycled by households in an area can be developed. Each component of this will be affected by the actions of the households, technological change, and public policy.

The amount of waste material recycled by households in the area is:

$$R_{ij}(t) = \sum_{i=1}^{h} \sum_{j=1}^{w} Q_{ij}(t) F_j(t) P_{ij}(t)$$

where $R_{ij}(t)$ is the amount of recycled material collected from all households in period *t*, where *i* represents each household (*i*=1...h) and *j* each category of material in the unsorted household waste (*j*=1...w).

$Q_{ij}(t)$ is the total waste, that a household generates for disposal in time period *t.* This will be based primarily upon their consumer demand and so be a function of income, household size

and structure, other socio-economic factors, decisions on replacement of goods, wider government policies, technological changes etc.

$F_j(t)$ is the fraction of waste that can potentially be domestically separated for recycling. This will largely depend upon product design, collection policies as, for instance, some materials may not be collected, and technology for separating and recycling materials.

$P_{ij}(t)$ is the propensity of a household to recycle, as measured by the proportion of a given material available for recycling that is recycled. This reflects the level of household participation - in theory from zero to 100% - and will be a function of socio-economic, demographic and housing characteristics; values, beliefs and social networks; the characteristics of recycling policies such as those affecting the ease of recycling etc.; and the category of material recycled.

The rest of this section considers research upon factors likely to affect $P_{ij}(t)$, the propensity of households to recycle (i.e. household characteristics, household beliefs etc. and policy characteristics)[2]. It then briefly considers the wider issues of the changing technological and public policy context affecting particularly $Q_{ij}(t)$ and $F_j(t)$.

Socio-economic, demographic and housing characteristics

There is mixed evidence on the influence of socio-economic factors upon recycling behaviour. A UK study of Leeds found that recyclers were more likely to be older, from higher socio-

economic groups, white, married, and to own their own homes (Forshaw *et al*, 1990). Non-recyclers were more likely to be under 24 years old, from lower socio-economic groups, single, and twice as likely to live in council houses or flats. They also found that most people would be willing to participate if recycling was convenient.

However, sometimes conflicting evidence, primarily from the US, has indicated only weak links between socio-economic or demographic variables and recycling behaviour. Vining & Ebreo (1990a and b) argued that recyclers do not differ from non-recyclers in terms of gender, household size, occupation or educational level. Oskamp *et al* (1991) also found no demographic variables which significantly predicted participation in recycling, and McGuire (1984) found no relationship between socio-economic levels and recycling behaviour (although this was based on 'bring to' recycling centres and not kerbside collection). However, Everett & Peirce (1992) and Schnaiberg (1980) found positive relationships with greater recycling success in high-income areas. Wealthier households generate more material to be recycled and other factors such as the opportunity cost of time influence the level of recycling for different materials (Saltzman *et al*, 1993).

Also, it may be important to control for housing type, as storage and ease of collection from the householder perspective may be greater in single dwelling units, and this may be correlated with socio-economic factors. After controlling for concern for the environment, age, education, income and job prestige Derksen & Gartrell (1993) still found that multi-family dwellings recycled fewer items than single-family ones. The key policy issue of whether recycling effort should be concentrated on low rise housing rather than high multi-storey housing, is consider in the case-study below.

Values, beliefs and social networks

The next group of factors that influence recycling behaviour are the values, beliefs and attitudes of people. The link between values and behaviour is not simple, but involves a number of complex links with attitudes/beliefs which can then lead to changes in behaviour (McCarty & Shrum, 1993; Schoemaker, 1993). While values may alter attitudes, they do not necessarily lead to changes in recycling behaviour (Goldenhar & Connell, 1993). Hopper & Nielsen (1991) and Vining *et al* (1992) found that an altruistic motive for recycling (e.g. conserving resources) were extremely important, and was the only factor that was similar across the four communities they studied. Similarly, Oskamp *et al* (1991) found that environmental concern did not necessarily lead to recycling behaviour as other factors such as knowledge etc. were important.

Social networks also have an important part to play in improving the rates of recycling. Burn (1991) found that block leaders provided information and their block of streets improved the recycling rates. The study also found that where the block leader presented a persuasive communication advocating recycling and special recycling bags to one group, then they had a higher recycling rate than a second group where bags and communications were left at the door. Both groups had a significantly higher rate than a control group where there was no treatment. Everett & Peirce (1992) also found that community structures such as block leaders had a positive impact upon recycling, particularly where the residents know each other and where the block leader knows the block residents. Further, the role of imitation is important with the likelihood of recycling behaviour being positively correlated with whether the neighbours also recycled (Oskamp *et al*, 1991). Beliefs and behaviour may also be linked to socio-economic characteristics with studies finding women (Schann & Holzer, 1990), the young, the well

educated, and urban residents all having greater environmental concern (Buttel & Flinn, 1978). In multi-storey dwellings with high resident turnover there may be a low level of social networks which promote recycling, even if values and beliefs support recycling.

Characteristics of recycling policies

In addition to the characteristics and motivations of the potential recyclers, the characteristics of the recycling polices have a significant impact upon the level of participation. Particular characteristics of policies include: organisation, promotion, incentives, and collection. First, concerning organisation, Folz & Hazlett (1991) argued that the success of recycling programmes (in terms of participation rates and amounts of waste diverted) depends upon the policies chosen and how they are selected and implemented rather than upon the characteristics of the community. They found that policies organised as a decentralised consultative process emphasising citizen participation and involving outreach efforts by local officials to residents, which were coupled with educational and publicity campaigns prepared with the assistance of local education personnel, environmental organisations, and other citizen groups, were typical of successful recycling programmes.

Second, De Young (1989) argued that promotional policies are important in increasing the level of recycling as recyclers and non-recyclers were similar in their pro-recycling attitudes, but non-recyclers lacked information on how to recycle. Vining & Ebreo (1990b) similarly found a correlation between knowledge about local recycling and recycling behaviour, and recyclers were more aware of the various means of recycling different materials than were non-recyclers.

Oskamp *et al* (1991) also suggest that it is knowledge of the specific local recycling opportunities that increases the level of recycling. The use of persuasive appeals by promoters of recycling can also increase the participation rates in recycling programmes (Hopper & Nielsen, 1991). However, Ball & Lawson (1990) argue that publicity campaigns to promote glass recycling in Scotland had had little impact. They suggest that campaigns should be better targetted, especially at younger lower socio-economic groups who had low participation rates. Such groups are often 'over represented' in many mulit-storey social housing areas.

Third, an important component of market-based solutions to recycling is often to provide incentives to household recyclers. It is common in many countries to provide financial incentives for the return of disposable packaging such as drinks containers, although less common to provide financial incentives to general household waste. Various types of financial, or quasi-financial, incentives have been used to promote recycling, ranging from money to raffles, contests and other prizes (for example: Geller *et al* 1982; Jacobs & Bailey, 1983; De Young, 1984). However, other research suggests that when incentives are removed then the recycling behaviour is likely to disappear (Couch *et al*, 1978; Luyben & Bailey, 1979). Other financial incentives have been proposed, such as weight or volume-based rubbish disposal rates, including pre-bag pricing for charging households, although these have not been widely used (Everett & Peirce, 1992).[3]

One major market incentive is to replace a flat fee for disposal of household waste with quantity-based pricing systems where the amount paid by a household depends on the amount of waste generated. Hong *et al* (1993) found that a pricing system for waste collection services did increase household recycling effort. However, in multi-unit dwellings which often use common

means of household waste collection, this precludes a quantity-based pricing system (Shumatz, 1990). Folz & Hazlett (1991) also found that collection and tipping fees, together with the ability to issue sanctions or warnings for improper separation, were important for the success of mandatory (rather than voluntary) recycling programmes.

Fourth, the actual means of collecting the recycled material, and people's perception of it are also important. The perception of the inconvenience of recycling is an important motivation for those not recycling (Turner, 1981; Vining *et al*, 1992) although people are also motivated by more than convenience (Vining & Ebreo, 1990b, 1992). Kerbside collection is much more effective in increasing the amount of recycled material collected than 'bring' systems with the former reaching 30% of household waste recycled and the latter potentially only 20% (Bardos *et al*, 1990). However, it is much expensive with estimates for the Department of Environment (Department of Environment, 1992a) suggesting UK kerbside average gross collection costs (without compostables) of £196-252 per tonne compared to £25-75 for 'bring' systems. Net costs after sales revenues and disposal savings were £133-189 and minus £20-25 respectively. Different collection methods produce different results (Everett *et al*, 1991).

Reschovsky & Stone (1994) found that kerbside collection had the greatest impact upon recycling behaviour when compared to quantity-based 'trash-tag' systems used in isolation, except for food/garden waste for composting. Kerbside collection, together with mandatory recycling or quantity-based recycling, significantly increased the probability of household recycling. Comingled recycling, where waste for recycling did not have to be sorted by the household, is one of the collection methods requiring least effort by the household and was found to be an effective way of increasing the diversion of waste from landfill sites (Gamba &

Oskamp, 1994). Much of the material may be contaminated and it may be difficult to sort, although material may be used for refuse derived fuel (Barton, 1985) although this has been criticised because of emission and the disposal of the ash.

Surridge (1992) suggested that wheeled bins had the highest participation rates, partly because the householder has less opportunity to "opt out" of recycling as the normal bin was not able to take the full volume to refuse. Swing box systems, where waste is divided into different types of material, have been popular in North America (Payne-Cook, 1990) and some UK cities (SKCP, 1991). However, neither of these schemes is particularly suited for high-rise housing, due to the storage space required, and difficulty of setting out and collecting containers. Finally, it is worth noting that while participation may increase with ease of recycling, the quality of recovered material is important (Barton, 1990) and the marginal costs of this may outweigh any additional benefits (Judge and Becker, 1993).

Hence, the ease of recycling, the type of container, the frequency of collection, the day of collection, whether the collection of recycled material is on the same day as the ordinary waste, the number and types of materials collected, the presence of 'bin' recycling points, and whether the collection is mandatory, all play a role in the rate of recycling. Multi-storey blocks can pose particular difficulties for collection in terms of long distances to take material to kerbside collection points, mingling of different types of waste (especially if there are central disposal systems, such as 'shutes') and storage capacity within the dwellings or building. Hence collection policies and methods may be move limited and expected recycling potential lower than in other areas.

The public policy and technological change context

Over time, the changing composition of goods consumed in the household will also influence recycling behaviour. These are influenced by factors in the wider society, such as consumer tastes or demand, the manufacturer or supplier of the goods, technology or wider public policies. For example, the operation of retailers or other suppliers to the household will affect the types and levels of waste generated in the household, and hence potential recycling behaviour. For instance, the shops used by the household may only sell goods in certain packaging (e.g. milk in plastic containers), which may or may not be easily recyclable depending upon whether plastics are collected locally for recycling. Hence when considering recycling behaviour there is a need to consider the macro socio-economic structure rather than just aggregating the individual responses to recycling (Derksen & Gartrell, 1993).

Generally, technological changes will influence household recycling behaviour in a number of ways. Product changes, such as goods with longer operational lives (or conversely rapid redundancy) will influence the amount of waste generated. Packaging improvements (such as the reduction in the weight of metal food cans over time) will reduce the amount or toxicity of waste material in households, although other changes (such as the replacement of door step milk delivery and return of used milk bottles, with plastic store bought containers) may have the reverse effect. Improvements in recycling techniques and technology can make it easier for households, and the collection agencies, to sort recycled material. For example automatic separation technology sorting different types of plastic means that a household no longer needs to sort them and store them separately, or refuse derived fuels. The maximum technical recovery from household waste has been estimated as up to 80%, including putrescibles (Young, 1991).

For example, regulations or policies on issues such as those on packaging of goods or the ability of consumers to place outer packaging in containers within shops (such as the German "Green Point" system) or return used goods to the supplier will affect the amount of potential recyclable material in the household (CEC, 1992).

Macdonald & Vopni (1994) identify a number of significant policy barriers to large-scale diversion of municipal solid waste (reduction, re-use, recycling and recovery) in North America and Europe, including administrative issues such as mechanisms for effective liaison amongst all levels of government and co-ordination between reduction and re-use programmes (usually set by higher levels of government, e.g. returnable bottles) and recycling and disposal programmes (usually the responsibility of local government). Gundy (1993) argues that even local recycling policies should be considered within the context of wider policies such as the structure and organisation of local government, the UK government's demunicipalisation of recycling and waste management since the 1970s, and pressure to cut waste management costs while subject to public demand for higher environmental standards. Also he argues that there is a growing emphasis upon energy rather than materials recovery within the hierarchy of recycling.

Policies on fees for the use of landfill sites will influence the attractiveness of improving recycling incentives and collections discussed above. Macdonald & Vopni (1993) also identify the broader need for: incentives for separation of reusable and recyclables materials, incentives for the substitution of recyclables for virgin inputs (including programmes for minimum recycled content in new products); and measures to resolve political conflict over who bears the cost of waste diversion and local opposition to the location of centralised material recovery

facilities. Hence a large range of national and supra-national policies will directly influence local recycling opportunity and options.

In summary, the various factors set out in the model will affect recycling levels, but in most cases the potential recycling levels from households in multi-storey housing would be expected to be less than from single storey or ‘low rise’ housing. This raises the fundamental policy question of whether recycling effort should therefore be relatively focused away from multi-storey housing areas.

THE CASE-STUDY

This case-study seeks to consider factors influencing the propensity of households to recycle that are particularly important for housing areas with multi-storey dwellings and high shares of local authority housing. In particular it seeks to investigate the influence of motives, the collection method, and the socio-economic and housing factors of tenure, building characteristics, household size and car ownership on the level of participation in area of multi-storey housing.

The City of Edinburgh has a population of 419,000, of which 62% live in multi-dwelling housing units. The local district council has a long history of involvement in recycling, and since 1988 it has increased the range of materials collected and widened the number of sites at which materials can be brought (EDC, 1993). By 1994 approximately 8% of the city's refuse stream was being diverted for recycling (Murdoch, 1994) which is better than the national

average of around 5% (Department of Environment, 1992b), but well short of the 25% future target set by government.

The survey in this report concerns a kerbside collection recycling programme in two areas of the city. The first area (part of Leith) consisted of three streets of four-storey tenement blocks (blocks of flats) near the harbour area of the city, comprising 574 households. The second area (part of Wester Hailes) was made up of three 12-storey blocks comprising 408 households. Wester Hailes had particular social problems such as high unemployment and low incomes, and was designated as an Urban Programme area of multiple deprivations. It is a 'peripheral' estate on the edge of the city, and largely made up of Council houses built in the 1960's and 1970's. Particularly in Leith there was little space for storage of material for recycling, and in both areas there were low levels of car ownership. Before the programme was introduced all material for recycling had to be brought to collection centres such as bottlebanks. The survey was carried out nine months after the start of the new weekly recycling collection programme[4].

The survey was carried out in 1994 with a questionnaire delivered to each household and returned by post or directly to local offices. Some 29% of Leith households and 11% of Wester Hailes households responded (164 in Leith and 41 in Wester Hailes). Of these, 92% were participants in the recycling scheme and 8% were not participants (including 1% who were not participants but still used "bring" recycling facilities and 0.5% "spoilt" returns). Based upon the recycling rate reported in the questionnaire and the actual collection of material in the areas, it was estimated that an average of 39% of households in the area recycled, and that the survey response was approximately two-thirds (between 56-78%) of all recyclers (Murdoch, 1994). In Wester Hailes it was estimated that 17% of all households recycled and that approximately half

(between 35-67%) of recyclers participated in the survey. Hence there is a considerable difference in household behaviour between the two areas[5].

The main motivations for participation in the recycling programme were for altruistic reasons, i.e. 'because recycling was important' (65% in both areas). Other reasons were because 'it was more convenient' (31%), and 'because I was asked to' (14%), although the programme was not mandatory. The main reasons cited for non-participation were 'lack of space' cited by 58% of non-participants in Leith but none in Wester Hailes. This indicates that the physical characteristics of the housing stock are extremely important although this has been largely ignored in the literature. Other reasons given non-participation were 'always forget' or 'too difficult' (each cited by 25% overall), and 'nothing to recycle' or 'service problems with the recycling programme' (each 13% overall, but primarily on the Wester Hailes 12 storey buildings).

A number of hypotheses are now tested to consider the effects certain of factors that are likely to be important in housing areas such as these. These are the effect of the collection method, housing tenure, building height, the household size (especially as such areas have increasing concentrations of small households), and access to cars (given the usually low rate of car ownership).

The effect of collection policy

The first hypothesis is that the kerbside collection would increase the level of participation in recycling. The survey found that 56% of the recyclers (55% in Leith and 62% in Wester Hailes) had not been recycling before the programme, so the programme more than doubled participation rate in both areas. This strongly supports the view that the presence of a kerbside recycling programme increases recycling rates in areas, although this must be qualified for one material (glass) as is discussed below.

The percentage of people recycling different materials varied quite considerably. Of those recycling, 99.3% recycled paper (98.4% in Leith and 100% in Wester Hailes), 84.3% glass (83.6% and 91.9% respectively), 81.2% plastics, 82.2% cans, but only 41.4% for textiles (38.8% and 54.1% respectively). Nearly a third (32.5%) of recyclers collected all of these materials (30.1% and 40.5% respectively). The types of materials recycled also showed a relative change due to the introduction of the kerbside collection. Nearly twice as many people were now recycling textiles (54% compared to less than 29% before the programme), plastics 81% compared to 15%, cans 82% compared to 43%, paper 99% compared to 83%, although for glass there was no significant change (remaining at 84%). This may account for Ball & Mathews (1988) finding that municipal glass “bring” collection systems were economically viable.

The results indicate that current glass recycling programmes using bottle banks are as effective as kerbside recycling for that material but not for other materials. This may be due to the characteristics of material (e.g. easy and clean storage for bottles), or widespread knowledge that materials can be recycled at the bottle banks. The percentage of people still using bottle banks fell from 98% before the kerbside collection programme to 8%. There was only a small fall in those using charity shops, from 25% to 18%, reflecting the fact that many materials given to

charity shops are for re-use rather than reprocessing (e.g. used clothes). Not surprisingly during the programme 83% recyclers (84.2% and 81.1% respectively) put out less waste, while 11% stated that the programme had made no difference and the remainder saying that they were not sure. Hence, both the percentage of households and the amount recycled per household rose with the kerbside collection, except for glass. This suggests that differences between glass and other materials need to be more fully considered in policies and research.

Tenure

Based upon earlier observations of low recycling levels in areas of Council housing, the second hypothesis is that tenure influences recycling behaviour, specifically that Council tenants are less likely to participate in recycling programmes than others. The results are shown in Table 1. In order to determine the effect of certain important socio-economic and housing characteristics upon recycling behaviour, Chi-squared tests were carried out based upon people who participated in the recycling trial compared to the population of the area as a whole (using 1991 Census of Population data for the equivalent small output areas). Considering the influence of factors for each area separately allowed variables such as the characteristics of both the normal waste and the recycling material collections, accessibility to "bring" recycling collection points, housing types, the physical environmental and socio-economic characteristics of the area, and the promotion of the recycling programme, to be controlled for[6].

In Leith there appeared to be less willingness on the part of Council tenants to participate, but a Chi-squared statistic of 3.08 (with 3 degrees of freedom) was not significant even at the 10% level. Households in Wester Hailes were mostly Council tenants, but there appeared to be no significant difference between tenants and owner-occupiers in recycling behaviour. People of all types of housing tenures will apparently participate to a similar degree given the opportunity, although further research would be useful.

Building height

Little research has been carried out on the importance of building height to recycling behaviour. The third hypothesis considered the influence of building height upon recycling behaviour, specifically that people living on a higher floor in a building might be less likely to participate in recycling due to the greater effort in bringing extra bags of recycled material. However, as the flats in Wester Hailes have lifts, floor level is likely to make less difference there than in Leith.

The Census can provide data on floor levels for Leith (Table 2). Figures for Wester Hailes were obtained from the Council's housing department, and refer to the high rise apartment blocks exclusively. All floors are identical, except floors 3 and 9.

In Leith, there was an apparently weak inverse correlation between recycling behaviour and building level, with households on the third floor being slightly less well represented among recycling participants than those on the ground floor. However, Chi-squared analysis showed

this not to be significant at the 10% level (the Chi-squared was 0.73). In Wester Hailes, there is no ground floor, but there is access to a lift for most floors. One point to note however, is that the top floor is not served by the lift - these residents would have to walk down to the eleventh floor to catch it. Surprisingly then, the twelfth floor had the second highest percentage of recyclers. In Wester Hailes the Chi-squared was also not significant at the 10% level (2.17). Overall then, the survey found no evidence of a relationship between floor level and willingness to participate.

Household size

There was no correlation between household size and participation in the recycling programme in either area (Table 3). In Leith, two person households appeared to be over-represented among recyclers while all other household sizes were under-represented. This evidence that household size influences participation in recycling is statistically significant (with a Chi-squared of 7.31, which is significant at the 10% level although not at the 5% level). In Wester Hailes households of three or more people were over-represented among recyclers, while one and two person households were under-presented, yet the Chi-squared figure (1.56) suggests no statistically significant relationship between household size and participation in this area.

However, by comparing household size with those households who recycle the full range of materials, it is possible to see an effect upon the range of materials recycled (Table 4). The two areas appear to give differing results. As household size increases in Leith, so does the

incidence of people recycling all materials. There is no clear link in Wester Hailes. Therefore, it would appear that in Leith, as the amount of refuse created increases, so does the willingness to recycle the full range of materials. In Wester Hailes, houses are believed to be more spacious, and if there is a space problem, any excess can be deposited in the refuse chute. This would mean that household size is less of an issue in Wester Hailes. It was interesting to note from additional analysis of the survey that participating households contained people of all age groups. Given that in the majority of cases (over 89%) all residents in a participating household were actively recycling, it is reasonable to assume that people of all age groups are recycling. There was no strong link between age and recycling participation, but generally those under 16 or over 55 were more likely to be 'new' recyclers rather than having also been recyclers before the start of the programme.

Car Access

In both areas, there are low levels of car ownership (or of regular access to a car), typical of many inner city areas and Council estates. Lack of access to a car would be expected to lower the ease of taking material to "bring" recycling points, hence kerbside collection should have a greater impact in areas of low car access. According to the 1991 Census of Population, 70% of those in Leith and 81% in Wester Hailes were without access to a car. The fifth hypothesis is that those with car access are more likely to participate in recycling, previously they had easier access to "bring" facilities, and they are more likely to have higher incomes. In both areas there was higher recycling participation among those people with access to a car (Table 5, columns 1 and 2). This relationship is significant at the 10% level for Wester Hailes (the

Chi-squared was 2.82) but not in Leith (Chi-squared 1.12). This may be linked to the greater time (both to get out of the building and once outside the building) for residents of the high multi-storey buildings in Wester Hailes to reach “bring” points.

It would have been reasonable to assume that car users would have been more likely than average to have been using the existing "bring" facilities in the two areas and so the proportion of those without car access should be larger among the new recyclers. However columns 3 and 4 of Table 5 show that in Leith the relative proportions of those with and those without car access was nearly the same among new and previous recyclers - the programme had similar impact upon each group. In Wester Hailes those without car access made up a larger share of new recyclers (71%) than those with car access, when compared to previous recyclers (where only 64% of previous recyclers had no car access). Thus in Wester Hailes the programme did increase participation among those without car access, as expected. From a policy perspective it is important that around two-thirds of the new recyclers starting recycling as a result of the programme, were without access to a car.

Overall, it appears that contrary to general assumptions of researchers the level of car ownership has not played a part in recycling activity in this area. The differences noted above appear quite small, and were not observed at all in Leith, where new recyclers and previous recyclers exhibit similar levels of car access. This suggests that it may be having the green bag in the house which encourages participation in recycling rather than any inconvenience attached to the "bring" system.

CONCLUSIONS

Overall, a number of different factors were found to influence the participation of households in the recycling programme. Further theoretical and empirical developments are needed to more fully understand the factors behind household recycling levels and their links to wider socio-economic issues.

The first conclusion concerns collection methods and is that the introduction of a kerbside collection programme significantly increased the level of recycling by households in terms of both the percentage of households participating and the amount that they recycled. Over half the recyclers had started as a result of the new programme. This has important policy implications for raising recycling rates in areas of multi-storey dwellings compared to the reliance upon “bring” points for recycling, although cost factors may be important in the introduction of any policy. Interestingly it was found that there was an exception in the case of material glass, where “bring” points were as effective as kerbside collection

The second conclusion is that recycling programmes can be successful in multi-storey dwellings in low-income, public housing dominated areas. This questions assumptions that recycling schemes should be primarily restricted to low-rise, higher-income areas. While the mixed tenure lower level multi-storey housing in Leith did have a higher overall rate of recycling than the predominantly public housing 12 storey housing area of West Hailes, no statistically significant evidence was found that housing tenure influenced participation in the recycling programme, although Council tenants were under-represented among recyclers. This suggests that kerbside recycling programmes have considerable potential amongst all

parts of a city. There was some evidence of an inverse relationship between household recycling rates and which storey of the building the household occupied, although where there was a lift present there was no evidence of a relationship.

The third set of conclusions concerns household characteristics. No significant relationship was found between household size and recycling participation in Wester Hailes, although there was some evidence that in one area, larger households tended to recycle all materials more than smaller ones. In Leith there was a significant influence of household size with two-person household participating more. Given the low car ownership rates in many city areas, it was interesting that while access to cars was positively related to recycling in the area containing high multi-storey blocks, the introduction of kerbside collection had a relatively greater positive impact upon those without access to cars. In the other area, the link between access to cars and recycling behaviour was not statistically significant. Again this suggests that kerbside collection is an important policy when seeking to increase recycling in such areas.

Targeting policies to improve the level of household recycling is important for their efficiency and effectiveness. To aid this further develop of theoretical models must be made to fully take into account the various significant technical, economic, social and behavioural factors. Importantly, the evidence provided in this paper suggests that high-rise dwellings and low-income, local authority housing estates can make a more significant contribution to raising the national household recycling levels than previously considered.

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Table 1: Participation in Recycling Programme by Tenure Of Respondents (Percent)

Leith	Participants	Whole Area
Owner	68.4	66.7
Private Tenant	15.8	15.4
Council Tenant	8.6	13.1
Housing Association	6.6	5.1
Other	0	0.3

Wester Hailes	Participants	Whole Area
Owner	5.4	4.6
Private Tenant	0	1.1
Council Tenant	94.6	92.6
Housing Association	0	1.1
Other	0	0

Sources: Questionnaire/Census of Population
N = 151 (Leith), 37 (Wester Hailes).

Table 2: Participation in Recycling Programme by Floor Level (Percent)

Leith	Participants	Whole Area
Ground	25	22.8
First And Second	54.6	54.2
Third And Fourth	20.4	23.1

Wester Hailes	Participants	Whole Area
First	13.5	8.8
Second	2.7	8.8
Third	0	5.9
Fourth	8.1	8.8
Fifth	8.1	8.8
Sixth	5.4	8.8
Seventh	2.7	8.8
Eighth	18.9	8.8
Ninth	16.2	5.9
Tenth	2.7	8.8
Eleventh	5.4	8.8
Twelfth	16.2	8.8

Sources: see Table 1 and City Housing Department.

Table 3: Participation in Recycling Programme by Household Size (Percent)

Leith	Participants	Whole Area
1	50.7	52.4
2	37.5	32.7
3	4.6	9.7
4	2.6	4.5
More than 4	0	0.8

Wester Hailes	Participants	Whole Area
1	43.2	37.2
2	29.7	35.4
3	18.9	16.8
4	5.4	9.5
More than 4	2.7	1.1

Sources: Questionnaire/Census of Population
N = 145 (Leith), 37 (Wester Hailes).

Table 4: People Recycling Full Range Of Materials By Household Size (Percent)

Household size	Leith	Wester Hailes
1	27.2	43.8
2	33.3	36.4
3	42.9	28.6
4	100	50
>4	-	100

Sources: see Table 1.

Table 5: Participation in Recycling Programme by Car Access (Percent)

Leith	Participants	Whole Area	New recyclers	Previous recyclers
Access	34.2	30.3	34.9	33.3
No Access	65.8	69.7	65	67

Wester Hailes	Participants	Whole Area	New recyclers	Previous recyclers
Access	29.7	19.2	29.2	35.7
No Access	70.3	80.8	70.8	64.3

Sources: see Table 1.

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ENDNOTES

[1] There is an epistemological debate concerning differences in theoretical approaches between and within disciplines. Many studies of recycling use positivist and behavioural analyses. Some argue from a positive approach that economics is exclusively concerned with "exchange values or prices irrespective of the motives of those entering into market transactions". Others argue that disciplines such as psychology can provide insights, especially in choice behaviour (Coates, 1976; see also Simon, 1986), and that the motives of those involved in environmental issues do appear to be significant (see below). However, Gandy, (1993, p. 4) adopts a non-positivist theoretical framework when considering household recycling in London and Hamburg, arguing that the empirical phenomena are the manifestation of historical rather than universal processes or laws. There remains the unresolved discussion as to the nature of broad forces or 'laws' (economic, political historical etc.) which help shape (although not determine) the 'external environment' within which local actions occur and which, together with local factors, influence the empirically observed outcomes.

[2] Where separation of materials occurs centrally than it is possible to substitute $F_j(t)$ with $F_j^*(t)$, which is the potential fraction that it is technologically feasible to separate, and $P_{ij}(t)$ with $P_j^*(t)$, for which is the prosperity for the central body to recycle (and may be a function of the cost of separation, market for the material to be recycled etc.). Hence the factors influencing $F_j^*(t)$ will differ from those influencing $F_j(t)$, for example in terms of technology for sorting and incentives or motivations to recycle (and similarly for P). This model could be generalised to include waste minimisation and re-use by incorporating these into the R, F and P terms. Gilnreiner (1994) developed a model for Vienna which "superimposed" public acceptance of

waste minimisation and recycling upon their potentials (i.e. recoverable portion of household waste fractions in percent or tonnes). The potential for recycling is unavoidably inaccurate as there is no clear dividing line between individual fractions and the recoverable share of fractions cannot be clearly assessed).

[3] According to the polluter pays principle, the producer and consumers should pay the full social costs of their action, leading to an underpricing of the environment's carrying capacity (OECD, 1975; Baumol, 1977). Pearce & Turner (1992) argue that an input package tax (a raw materials levy) or an output packaging tax (a product charge) are more cost-effective solutions than regulatory legislation for the problem of packaging waste and litter in the case of beverage containers.

An unintended alternative to household waste disposal or recycling may be illicit burning or dumping. Fullerton and Kinnaman (1993) put forward an optimising restructure to discourage such burning or dumping as these activities cannot be taxed directly. They propose a tax on all outputs plus a rebate on proper disposal through either recycling or waste collection, i.e. essentially a deposit-refund system. On the basis of cost-benefit analysis there is a case for government financial support for recycling schemes, at least for specific materials such as newspapers, although such schemes may be financially unviable or unattractive to the private sector (Hanley & Slark, 1994).

[4] Figures on the total material collected for recycling in the areas suggest that there was a 'demonstration' or 'Hawthorne' effect influencing people's behaviour during the first eight

weeks of the new programme, when people were most enthusiastic. After this period recycled material collected fell to a relatively constant level.

In Leith the normal refuse collection was twice weekly, with recycling material collected in special bags at the kerbside on a separate day. In Wester Hailes loose refuse is put into chutes which carry the rubbish into large bins on the ground floor. Residents were requested to place recycling bags into a separate special bulk waste storage room on the ground floor. Other "bring" recycling facilities did not change from before the programme.

[5] The difference between the two areas is further suggested by estimating P_{ij} for each area. Shortly before the programme started, the normal household solid waste form the areas was analysed giving an estimate of the total waste for individual recylable materials (Q_{ij}). From the model above an estimate for P_{ij} was calculated as the amount of recycled material collected (for the specified materials of j = glass, paper, metal cans, plastics and textiles) averaged over the first 9 months (R_{ij}), divided by Q_{ij}. This generated an estimate for P_{ij} for all households and recyclable materials of 0.23α for Leith and 0.05α for Wester Hailes (where α is the constant $1/F_i$, and is ≥ 1, assuming that technology etc. had not changed, and is close to one assuming that the materials identified in the total waste (Q_{ij}) were all recyclable). However, these estimates ignore the levels of recycling at "bring" collection points before the programme (when the test on waste was carried out).

[6] The low number of responses to the questionnaire from those not participating in the recycling programme prevented direct comparisons between participants and non-participants.