



Provided by the author(s) and University College Dublin Library in accordance with publisher policies., Please cite the published version when available.

|                                     |   |
|-------------------------------------|---|
| <b>Title</b>                        | Targeted intervention strategies to optimise diversion of BMW in the Dublin, Ireland region   |
| <b>Authors(s)</b>                   | Purcell, M.; Magette, W. L.   |
| <b>Publication date</b>             | 2011-09   |
| <b>Publication information</b>      | Waste Management, 31 (9-10): 2180-2189  |
| <b>Publisher</b>                    | Elsevier  |
| <b>Item record/more information</b> | <a href="http://hdl.handle.net/10197/4139">http://hdl.handle.net/10197/4139</a>   |
| <b>Publisher's statement</b>        | <p>py This is the author s version of a work that was accepted fo<br/>Management. Changes resulting from the publishing process, such as peer review, editing,<br/>corrections, structural formatting, and other quality control mechanisms may not be<br/>reflected in this document. Changes may have been made to this work since it was<br/>submitted for publication. A definitive version was subsequently published in Waste<br/>py Management (Volume 31, Issues 9 10, September October 2<br/>10.1016/j.wasman.2011.05.008 Elsevier Ltd.</p> |
| <b>Publisher's version (DOI)</b>    | <a href="https://doi.org/10.1016/j.wasman.2011.05.008">10.1016/j.wasman.2011.05.008</a>   |

Downloaded 2019-03-21T08:27:22Z

The UCD community has made this article openly available. Please share how this access benefits you. Your story matters! (@ucd\_oa)



Some rights reserved. For more information, please see the item record link above.



TARGETED INTERVENTION STRATEGIES TO OPTIMISE DIVERSION OF BMW  
IN THE DUBLIN, IRELAND REGION

\*M. Purcell<sup>1,2</sup> and W.L. Magette<sup>2</sup>

<sup>1</sup>Green Campus Facilitator, Cork Institute of Technology, Bishopstown, Cork, Ireland

<sup>2</sup>Centre for Water Resources Research, School of Architecture, Landscape & Civil  
Engineering, University College Dublin, Newstead, Belfield, Dublin 4, Ireland

Tel.: +353-(0)21-4335105

E-mail address: [mary.purcell@cit.ie](mailto:mary.purcell@cit.ie)

---

\* Corresponding author

## **Abstract**

Urgent transformation is required in Ireland to divert biodegradable municipal waste (BMW) from landfill and prevent increases in overall waste generation. When BMW is optimally managed, it becomes a resource with value instead of an unwanted by-product requiring disposal. An analysis of survey responses from commercial and residential sectors for the Dublin region in previous research by the authors proved that attitudes towards and behaviour regarding municipal solid waste is spatially variable. This finding indicates that targeted intervention strategies designed for specific geographic areas should lead to improved diversion rates of BMW from landfill, a requirement of the Landfill Directive 1999/31/EC. In the research described in this paper, survey responses and GIS model predictions from previous research were the basis for goal setting, after which logic modelling and behavioural research were employed to develop site-specific waste management intervention strategies. The main strategies devised include (a) roll out of the Brown Bin (Organics) Collection and Community Workshops in Dún Laoghaire Rathdown, (b) initiation of a Community Composting Project in Dublin City (c) implementation of a Waste Promotion and Motivation Scheme in South Dublin (d) development and distribution of a Waste Booklet to promote waste reduction activities in Fingal (e) region wide distribution of a Waste Booklet to the commercial sector and (f) Greening Irish pubs Initiative. Each of these strategies was devised after interviews with both the residential and commercial sectors to help make optimal waste management the norm for both sectors. Strategy (b), (e) and (f) are detailed in this paper. By integrating a human element into accepted waste management approaches, these strategies will make optimal waste behaviour easier to achieve. Ultimately this will help divert waste from

landfill and improve waste management practice as a whole for the region. This method of devising targeted intervention strategies can be adapted for many other regions.

**Key words:** waste attitudinal surveys, Dublin; Ireland; biodegradable municipal waste; targeted intervention strategies.

## **1.0 Introduction**

This research developed appropriate waste intervention strategies for particular areas in the Dublin region with the aim to enhance and promote diversion activities and general ‘optimal’ waste behaviour practices targeted to particular areas. This strategy can be adapted for use in other areas.

This research integrates findings from previous research by the authors (Purcell and Magette, 2009; Purcell and Magette, 2010) in which the residential and commercial sectors were investigated relative to waste generation, waste management behaviour, attitudes and future concerns in the Dublin region. The novel / innovative aspect of this research lies in the premise that socio-economic factors must be integrated into both the strategic design (one or more years planning horizon) and tactical (day-to-day) management of solid waste. With a focus on biodegradable municipal waste (BMW), the first hypothesis proved by this research postulated that BMW generation is spatially variable within a diverse ‘landscape’ of residential areas and commercial establishments (Purcell and Magette, 2009). Research also proved (Purcell and Magette, 2010) that attitudes about the management of BMW are spatially variable. Therefore, this research

reasons that management of BMW can be better accomplished by targeting site-specific intervention strategies rather than by using the “one size fits all” approach characteristic of current design practice. This research describes the integration of attitudinal survey results and accepted solid waste management practice to develop targeted intervention strategies, and evaluates the possible execution and practicality of these strategies.

### **1.1 Residential Sector**

When waste generated by a region is optimally managed, it can have value as a resource, rather than a liability. For example, biodegradable wastes such as food scraps, paper and cardboard, can be recycled into similar products (in the case of paper and cardboard) or new ones, such as compost. The management of municipal solid waste is a responsibility of Irish local authorities and a constant challenge. The challenge to reduce household waste has, according to Fahy (2005), become a priority for policy makers at a national, regional and local level. The urgency of the challenge is compounded by the internationally accepted EU waste hierarchy and the obligations of the EU Landfill Directive 1999/31/EC (EC, 1999). As Ireland is still some distance away from meeting the targets of the Landfill Directive, the imperative to implement the Government’s Biodegradable Waste Strategy fully and quickly cannot be overstated (EPA, 2008c).

Waste “diversion targets” place pressure on households to participate in more sustainable waste management practices, but the success of this system relies on the individual waste manager to enact this policy (Price, 2001). To comply with the EU Landfill Directive, Ireland has accepted restrictions on the quantity of BMW sent to landfill. Individuals and

businesses now need to be in a position to do what is required for these national targets to be achieved. In other words, those that generate waste need to have the specific knowledge and understanding of what is expected from them, in order to participate in optimal waste management activities. Householder involvement is paramount to the success of recycling initiatives (Mosler *et al.*, 2006). This is also true for waste minimisation exercises and general optimal waste practice.

Success of a waste management scheme is also dependent on local characteristics that may affect the reduction and recycling rates, such as cultural, social and physical variations (Price, 2001). “Road shows” (i.e., focused information events held at multiple locations) and personal communication have been found to enhance waste practice and also raise perceptions, but these have to be sustained (Read, 2000) in order for effects to persist long term. Often, waste management is evaluated and shaped according to national targets and statistics, rather than tailored to smaller scale areas, where local demographics and specific situational characteristics are wide and varied. Yet, the success of meeting national targets and implementing policy depends on achievements at the local scale made by individual householders, businesses and the community at large. Gathering information for the waste sector is required not only to facilitate better planning, but also to enable monitoring of successes and failures.

Mosler *et al.* (2006) developed appropriate strategies to enhance and promote recycling for various household types. This research found income and standard of living were factors determining the acceptability of new waste strategies. Fahy and Davies (2007)

carried out a household waste minimisation and action study. Their research investigated household waste management behaviour through active participation of householders in a waste minimisation exercise. This approach offered enhanced learning for participants, but was costly and time consuming.

Residents must be supportive and willing to participate in new waste management strategies, such as waste minimisation, if these are to be successful. A well-informed and concerned public greatly facilitates a programme's success (Sujauddin *et al.*, 2008). Education, advertisements and easily obtainable information are important, and a lack of information influences waste behaviour negatively (Oskamp *et al.*, 1991). Space constraints (Mee *et al.*, 2004) and time available (Perrin and Barton, 2001; Tonglet *et al.*, 2004) also influence waste behaviour. Various studies have shown that attitude and / or knowledge about environmental issues also effects behaviour (Williams and Gunton, 2007).

The success of recycling schemes is dependent on tailoring to local needs (Wilson and Williams, 2007). Accessibility and ease of use are also important variables in the behaviour of individuals (Steel, 1995). Plöchl *et al.* (2003) found that residential structure, bin size and source of waste have a significant influence on waste arisings and also on waste composition. Targeted strategies thus allow for a more efficient allocation of waste management resources. Such targeted intervention strategies should aim at optimising diversion from landfill, as required by the EU.

Wilson and Williams (2007) also point out that it is not possible to develop one specific recycling system that could be adopted uniformly, due to authorities having to adapt to different socio-economic conditions in specific regions. Oskamp *et al.* (1991) found that participation in waste management initiatives is dependent on a series of inter-related factors, rather than one specific factor. Along with demographics such as social class, education, household type and general habits (cooking all packaged foods, buying all fresh foods *etc.*), season and waste behaviour (contamination, waste prevention activities, illegal activities *etc.*) all effect the waste that is presented and collected in a region. DEFRA (2006) point out that different audiences and different segments of society behave differently and therefore require targeted or tailored interventions.

Waste management behaviour is the outcome of the interaction of numerous factors that are social, cultural and contextual on one hand, and personal on the other (Davies *et al.*, 2005). The most effective means to reduce waste is to deal with it at source, through waste minimisation (Tonglet *et al.*, 2004). Therefore behaviour and attitude both need to be addressed if desirable actions – *i.e.* waste prevention is to be achieved on a widespread basis. However, promoting waste minimisation strategies can be a difficult concept to communicate. Waste reduction requires more effort and greater lifestyle change (Price, 2001) than, for example, some recycling activities. Waste minimisation is documented less in the literature than is research on recycling (Read *et al.*, 2008), although waste minimisation holds a more important position in the waste hierarchy.



Logistic parameters such as convenience (Wilson and Williams, 2007), time required (Tonglet *et al.*, 2004) willingness to participate (Parizeau *et al.*, 2006) and knowledge (Bolaane, 2006) of a scheme are all important factors in a successful integrated waste management system. Involving the public in decision-making about the design of waste management systems could help close the gap between value and action (Robinson and Read, 2005; EPA, 2006; Chung and Leung, 2007). In fact, feedback is essential to driving and sustaining change in waste management performance (DEFRA, 2006). However, as noted by Arnstein (1969) in describing the extent to which the public may be genuinely involved in public decisions, the type of “consultation” mandated by such legislation as the Landfill Directive and the Waste Management Act (1996) is but one form of “tokenism” in the traditional “command and control” approach used by governments; true participatory government requires a genuine partnership between the public and their government. Quaghebeur (2006) refers to participatory government in the context of education, and suggests that participatory government is an alternative to dominating and top-down approaches participation, enabling participants to be included while acquiring knowledge skills to enable them to transform their lives.

## **1.2 Commercial / Business Sector**

Waste minimisation clubs can be a cost effective means of achieving reductions in solid waste generation (Phillips *et al.*, 2001). The waste minimisation club is a concept that was first developed in the Netherlands in the early 1990’s, and involves a small number of companies, working together to exchange ideas and information on waste minimisation (Barclay *et al.*, 2000). The commercial sector in the Dublin region, and indeed many other regions, would benefit from waste minimisation clubs locally, to help

discuss ideas and share experiences. This was expressed in survey interviews carried out for the commercial sector (Purcell, 2009), where respondents suggested sharing ideas or having workshops would help them manage their waste in a more environmentally friendly manner when expanding on their ideas. Industrial ecology or a more sustainable system in the commercial sector is becoming more and more important as business investigate material flows and interactions with ecological systems.

The Greening Irish Hotels programme (Irish Hospitality Institute, 2006) introduced by the EPA in 2005 offers to participants audits, opportunities and assistance with the development of cleaner production, and is designed to increase standards and benchmarking for the sector to improve compliance with environmental objectives, including waste reductions. In return, participants achieve improved reputations and visibility among the public while increasing awareness about environmental behaviour in the commercial sector. The Green Hospitality Programme has now evolved for the larger hospitality areas including contract caterers and restaurants and more recently the pub sector.

The Local Government (Business Improvement Districts) Act 2006 (Oireachtas, 2006) and the subsequent Local Government (Business Improvement Districts Ratepayer Plebiscite) Regulations 2007 (Roche, 2007) were passed by the Irish government to allow local authorities to establish districts having specific developmental objectives and to assess rates in order to finance achieving the objectives. The first Business improvement district in Ireland, Dublin City Business Improvement District, was established in the

capital, and businesses in the city have pledged €3 million per year to make the city cleaner, greener and safer (The Sunday Business Post, 2008).

### **1.3 Logic Modelling**

Logic modelling (as applied to activity planning) was developed as a business management tool in the 1970s, and embraced and adapted by the US Department of Agriculture's Cooperative Extension System as a means by which to develop educational programmes and evaluate their impact; the technique has subsequently been adopted by the private and public sectors to plan, implement, evaluate, and communicate their activities more effectively (Taylor-Powell and Henert, 2008). In its simplest form, a logic model links resources to activities, which enable output and the achievement of outcomes (Anonymous, 2005), or said differently, the logic model connects planned work with intended outcomes (Anonymous, 2004). Thus, a logic model can be used to examine what is essential in order to achieve a particular goal.

Logic models are a technique for identifying how to accomplish an objective using the "If → Then" logic to link essential events of outcomes. Beginning with the desired outcome, through deeper analysis to identify fundamental needs and devise strategies to address the needs (*i.e.* intervention strategies). Logic modelling is a powerful (yet simple) way to identify essential 'events' that are necessary to achieve a desired outcome (*i.e.* optimal waste behaviour). Logic modelling is useful for qualitative descriptions of programmes (Kimbrough and Lee, 1988), however rigorous evaluation techniques are usually

employed to assess the effectiveness of such programmes (Taylor-Powell and Henert, 2008; Anonymous, 2005).

#### **1.4 KASA**

“KASA” is an acronym for knowledge, attitudes, skills, and aspirations (Bennett, 1975). The KASA model developed by Bennett (1975) postulated that these four human characteristics both determine an individual’s behaviour and the ability to change that behaviour; Bennett further asserted that a change in KASA was a fundamental step towards achieving changes in practice (for example a different way of managing wastes). “Knowledge” encompasses awareness and understanding. Knowledge increases before changes in behaviour occur. “Attitudes” comprise the outlooks or opinions that a person possesses; these are closely allied with the person’s cultural background and developmental environment. “Skills” refer to a variety of capabilities a person might possess, and may or may not be related to a person’s level of education.

Environmental benefits depend on the adoption of a strategy, and not just technical feasibility (Lockeretz, 1990). Often, knowledge gain can be assessed as part of an educational activity. Attitudes generally change slowly and require lengthy time frames to assess changes; however, opinions contribute to attitude change (Bennett, 1975) and tend to shift prior to attitude change. While skills can be practiced during an educational programme for some immediate observations, the evaluation of skills is more meaningful after they have been applied in real life situations. Assessing aspirations immediately after a program implementation helps anticipate possible outcomes at the practice level.

The needs of a community can be assessed to identify baseline KASA's (for example, through surveys) and also the type and extent of programming needed to produce changes. Once these targets are established, appropriate intervention strategies can be devised.

## **2.0 Methods**

The objective of this research was to generate targeted solutions to real-world, practical waste problems at the small scale of the local authority in order to achieve optimal waste behaviour for the region as a whole.

The detailed analysis (Purcell, 2009; Purcell and Magette, 2010) of opinions and attitudes regarding waste management that were expressed by members of the residential and commercial sectors served as the starting point for this research. As noted in the research, selection of specific areas in the region for inclusion in the opinion / attitudes survey followed from the prediction of BMW generation (Purcell and Magette 2009), which were subsequently validated against measured data (Purcell, 2009), albeit in a cursory manner due to the spatial resolution of the measured data. The survey responses allowed the identification of specific issues that needed to be addressed at a local scale.

Logic modelling was then used to conceptualise a strategy that would address the issues identified by survey respondents, acknowledging that a KASA change would be fundamental to the success of the strategies. A statistical description of socio-economic variables, such as was employed in making predictions about waste generation (Purcell

and Magette 2009), was used to understand the socio-economic context of each area for which a strategy was developed. Lastly, each of the strategies was critically analysed for appropriateness for the local authority and for realistic implementation of the strategy in the region. Strategies were generated for each local authority (Purcell, 2009) and three of these strategies are detailed in this paper.

### **3.0 Results and Discussion**

Local authorities employ one or more Environmental Officers to assist with a variety of environmentally related functions. Involving the environmental officers in each local authority at the smaller scale of an electoral district, or identified community, or an estate would be a useful first step in any waste management strategy. Armed with their knowledge of waste generation, waste issues, and waste targets, these officers would act as a liaison between residents and the local authorities and engage people in local waste management. These officers would be essential to converting regional waste management targets into local targets, with which residents and businesses can relate, and provide important feedback on progress.

Setting local targets for diversion with feedback from local environmental officers should prove beneficial in waste management for the region by improving individual's and business's motivation towards this activity. As noted in much research on waste management, motivation is fundamental to the success of waste management initiatives, as indicated by the KASA model. Local targets can be set and waste strategies based on local monitoring. When householders and individual businesses are given coherent

targets which they themselves can monitor through feedback, residents can identify with local waste management policies rather than country wide targets which are difficult to relate to weekly waste management activity. Currently, there is little or no communication at the local level back to residents on waste management progress (Singleton, 2008).

The main strategies devised include (a) roll out of the Brown Bin (Organics) Collection and Community Workshops in Dún Laoghaire Rathdown, (b) initiation of a Community Composting Project in Dublin City (c) implementation of a Waste Promotion and Motivation Scheme in South Dublin (d) development and distribution of a Waste Booklet to promote waste reduction activities in Fingal (e) region wide distribution of a Waste Booklet to the commercial sector and (f) Greening Irish pubs Initiative. Each of these strategies was devised after interviews with both the residential and commercial sectors to help make optimal waste management the norm for both sectors. Strategy (b), (e) and (f) are detailed in this paper.

### **3.1 Residential Strategies**

Residential strategy (b) is presented in this research. Strategies were devised for each local authority areas with full details of the strategies available in Purcell (2009).

#### **3.1.1 Dublin City Local Authority**

According to the attitudinal survey for the region (Purcell, 2009; Purcell and Magette, 2010), the vast majority of Dublin City respondents are “very satisfied” or “satisfied” with their waste service (23% and 65%, respectively). Only 20% of respondents in the

Dublin City local authority reported any composting activity, with the majority of respondents disposing of organic waste in the residual bin, rather than in a brown bin (or by backyard composting i.e composting on ones garden). Increasing / improving recycling facilities was regarded by respondents as an important future issue (Purcell, 2009; Purcell and Magette 2010), but the most important issue was regarded as reducing the amount of waste generated. Dublin City is predominately made up of smaller households, but all sizes of households are distributed throughout this local authority (CSO, 2008).

### **Proposed Strategy: Community Composting Project**

Following the recent success of the Ballymun Community Composting Project (Rediscovery Centre, 2008) and the finding that there is little backyard composting activity by Dublin City local authority respondents (Purcell, 2009), it is logical to presume that the establishment of one or more community-based (community scaled for example, apartment complex) composting ventures in the city would help divert organic waste from disposal in the residual bin (and therefore divert organic waste form landfill). A community project would also offer skills training and motivation in order for this initiative to be successful. A community-based composting initiative would also be a step towards increasing / improving recycling facilities in the city, which was one of the future issues cited by Dublin City respondents (Purcell, 2009). Admittedly, lack of space / garden can be an issue for many Dublin City local authority residents, particularly those in flats/apartment type accommodation, but a community composting project would help address these constraints. The success of the Ballymun Community Composting Project



highlights the need for and the success in community involvement in effective urban waste management. This project composts kitchen waste and distributes the compost to gardens in the area (Miller, 2006). Figure 1 details the logic model generated for the Community Composting Project.

## **3.2 Commercial / Business Strategies**

Two strategies (e) and (f) are detailed below. Further details are available in Purcell (2009).

### **3.2.1 Region-Wide**

The majority (60%) of private businesses reported that they believe it is their responsibility to pay for waste services (Purcell and Magette, 2010; Lavagnoto, 2010). In this research onsite composting was practiced by 58% of businesses located in rural areas, and by 18% of city located businesses. Business image was reported as an influence in waste management practices for the majority of Dublin City businesses (50%), but was less an influence for businesses in South Dublin (40%) and Fingal (20%). Only 7% of Dún Laoghaire Rathdown commercial respondents reported this as an influence.

### **Proposed Strategy: Waste Information Booklet**

City wide strategies may not be appropriate in particular areas. However, a waste information booklet covering aspects of waste, such as the amount of waste generated by commercial activity and the options available for waste collection and contact numbers for businesses on waste management issues would prove beneficial. Information is important in waste management. The booklet should contain information on how to inform staff of waste management issues and options for dealing with multi-lingual

training in waste matters, for example, to order stickers/signs in different languages for bins from local authorities. Figure 2 illustrates the logic model for the implementation of the waste information booklet for the region.

### **3.2.2 Dublin City Local Authority**

In Dublin City 28% of businesses reported experiencing difficulty in managing waste (mostly large / heavy items) (Purcell, 2009). The majority of commercial respondents to the survey from Dublin City businesses were restaurants followed by pubs.

#### **Proposed Strategy: Greening Irish Pubs Initiative**

The implementation of a ‘Greening Irish Pubs’ initiative, similar to the EPA Greening Irish Hotels Project (Irish Hospitality Institute, 2006) would prove beneficial in terms of increasing information, education and awareness within the public house sector. Dublin City local authority has large numbers of pubs located throughout the region, generating large quantities of waste. Following the success of the Greening Irish Hotels Project and the recently introduced Greening Irish Hospitality Project (EPA, 2008a) and publications such as Calling Time On Waste (Monaghan County Council, 2009) a similar initiative for public houses should also be successful, as pubs generate similar waste to the hotel/restaurant sector and the targeted information and assistance in waste matters for the sector would help divert waste from landfill. Setting local targets for the sector would help motivate establishments to manage their waste optimally. Figure 3 illustrates the logic model for the Greening Irish Pubs Initiative.

### **3.3 Application, Advantages and Limitations**

The impact of each strategy would be determined by the individual household's or business's reaction to the initiative. The advantages of each strategy include improvements in waste practices in the home or at work, and ultimately the diversion of waste from landfill, as stipulated by the Landfill Directive. The limitations of each strategy involve the intrinsic desire of a household or business to partake in the strategy, along with the motivation to continue to do so. Situational characteristics have been taken into consideration where possible, along with the information gathered by means of survey/interview (Purcell, 2009; Purcell and Magette, 2010) for the region. As with all waste initiatives, these strategies rely on the individual to enact the optimal practice. This is easier to achieve if the actions are not time consuming or require too much effort or create inconvenience (Perrin and Barton, 2001; Bach *et al.*, 2004). Behavioural changes will be required in each strategy; however, both residents and businesses showed enthusiasm and desire to improve their waste practices, and the required behavioural changes are not onerous. Recently, since this research was conducted the Green Hospitality Programme has evolved to include restaurants, guest houses and pubs under the same programme. It may be beneficial to have a separate set of information available for this sector. This also shows the need for such a programme to be implemented as identified by this research.

Setting targets and analysing waste procedures at the small scale of the local authority or indeed the smaller scale of the electoral district means that waste matters are more relevant to the individual, whether it be a business or householder. Such targets would be

set at a relevant scale to suit the characteristics of the region so that residents and commercial enterprises alike can comprehend what the requirements of them are, and therefore act effectively to achieve the requirements, while monitoring their own progress. According to the Council Directive 1999/31/EC on the landfill of waste (EU, 1999), Ireland must progressively reduce the quantities of BMW going to landfill. The quantities and schedule of BMW requiring diversion for the country, using 1995 (1289911 t of waste) as the baseline year, are.

- 2010 not more than 75% (967433 t);
- 2013 not more than 50% (644956 t);
- 2016 not more than 35% (451469 t).

Unfortunately, the quantity of BMW landfilled in Ireland is increasing (up to 2008), not decreasing, as shown by the following reported data. BMW landfilled in 2008 decreased but is still short of the target:

- 2004 - 1304426 t;
- 2005 – 1307570 t;
- 2006 – 1412581 t;

Since the research was carried out the figures for 2008 have been published in the National Waste Report (EPA, 2009) indicating 1196044 t of BMW was sent to landfill (more than 200,000 t short of the 2010 target).

The Dublin region (figure 4), which makes up 28% of the population of Ireland is required to reduce the amount of biodegradable waste going to landfill as a region by an average of 53% (or  $4.37 \text{ kg cap}^{-1} \text{ wk}^{-1}$ ) to fulfil the 2010 deadline (Purcell, 2009) and a

further reduction of  $2.9 \text{ kg cap}^{-1} \text{ wk}^{-1}$  to fulfil the 2013 deadline according to the predicted BMW generation from the region for 2006 (Purcell, 2009) (on a household size basis for 2006 BMW estimations considering Dublin is responsible for 28% of Ireland's population, Purcell, 2009). A further reduction of  $1.79 \text{ kg cap}^{-1} \text{ wk}^{-1}$  is required to reach the 2016 deadline (Purcell, 2009). Figure 5 illustrates the percentage ( $\text{kg wk}^{-1} \text{ cap}^{-1}$ ) diversion required in each electoral district to meet the Landfill Directive 2010 targets based on predicted 2006 waste generation using the household size estimation technique. Similarly, Figure 6 illustrates the percentage ( $\text{kg wk}^{-1} \text{ cap}^{-1}$ ) diversion required in each electoral district to meet the Landfill Directive 2013, and Figure 7 illustrates the percentage ( $\text{kg wk}^{-1} \text{ cap}^{-1}$ ) diversion required in each electoral district to meet the Landfill Directive 2016 targets (Purcell, 2009).

It can be seen in Figures 5 to 7 that the electoral districts bordering the city centre are required to divert larger and larger quantities of waste from landfill each week in order to meet the progressively stringent requirements of the landfill directive, based on the waste generation predictions developed in Purcell and Magette (2009). It is notable that for each target year, some electoral districts must divert more waste than is actually predicted to have been generated in 2006. Therefore waste prevention will be an important element of waste management for the area.

Landfill Directive targets translated to the small scale of each electoral district are more relevant to residents and better illustrate what is required of them. Landfill directive targets expressed on this basis also allow for local authorities and policy makers to make

more knowledgeable decisions regarding waste strategies and legislation for the region. Also monitoring at the small scale of the electoral district or local authority will facilitate an evaluation of the effectiveness of waste strategies in terms of BMW reduction.

Table 1 describes the percentage reduction frequencies (the number of electoral districts which need to reduce their BMW generation) required for electoral districts according to 2006 BMW household size estimation technique (Purcell and Magette, 2009) to reach the 2010 diversion targets. The vast majority of electoral districts need to divert 51 – 54% of the waste they generate, based on predictions for 2006 (Purcell and Magette, 2009). Electoral District “Beaumont D” is required to reduce the least amount (41.87%) while “Mansion House B” is required to reduce the most (112.23%) to reach the 2010 targets (i.e. Mansion House B must reduce overall waste generation rates by more than is being produced).

#### **4.0 Summary Discussion**

A “one size fits all” approach to waste management in a region such as Dublin has many deficiencies, yet this is what is included in all of Ireland’s regional waste management plans (including Dublin’s). The same-for-everyone approach results in some residents (including commercial establishments) not having the knowledge or skills to implement a strategy, and ignores the needs or wants of specific areas. Targeting waste strategies to particular unique areas means that sectors are not left out or ignored. Targeting strategies to particular areas can also help to identify unique problem areas, which may require different strategies to others. Setting informal targets on waste diversion for a region

depending on the area's characteristics and subsequently involving residents and businesses in self-monitoring would prove beneficial in terms of identifying comprehensible measures, and motivating communities to achieve optimal waste management.

Binding landfill diversion targets present a genuine challenge for Ireland. Generating unique, targeted intervention strategies for the Dublin region will be a major step towards optimising the potential of both recycling and diversion rates for the region as a whole, while filling gaps in waste services identified in on-the-ground interviews regarding the strengths / weakness of the waste sector in the region. With increasing waste generation in Ireland, and in particular increased quantities going to landfill (8% increase in municipal waste landfilled in 2006), new policy intervention is recommended to divert waste and biodegradable waste in particular, according the EPA (2008b) report. Appropriate waste management solutions vary from one locality to another (Diem Trang *et al.*, 2007; Woodard *et al.*, 2005). The reductions in BMW sent to landfill in 2008 (EPA, 2009) is a positive trend for Ireland which is moving in the right direction towards achieving the diversion targets. But it must be noted that overall 2008 municipal waste generation was down 5% towards 2007 figures which is reflected in a reduction in Gross Domestic Product (GDP) as well (Bond, 2009).

Traditional methods of promoting waste initiatives, including media campaigns, newsletters *etc.*, can only achieve a limited level of success in shifting public perception, behaviour and attitude (Hopper and McCarl, 1991). Although 34% of survey respondents

in research (Purcell, 2009) stated that providing increased advertisements/information regarding waste issues was important, many respondents said they do not wish to get increased levels of 'junk mail' through their door. This dichotomy in opinion shows that advertisements and promotions for waste initiatives need to be cleverly thought out and publicised using means that are not regarded as "junk mail", yet are interesting and actively promote awareness and information. Lack of information has been reported as a barrier to recycling (Environment Agency, 2000; Perrin and Barton, 2001), and overcoming such barriers would ultimately help householders and businesses participate in optimal waste management practices. Chan (1998) discussed the importance of mass media to bringing about social pressure on individual environmental behaviour. Ostman and Parker (1988) found use of newspapers for environmental information to be useful in predicting attention, awareness, concerns, and the subsequent behaviours.

Environmental education, rather than imposing more facts and figures on people, will result in positive waste activities that are more meaningful to the individual, as through education, individuals will gain an understanding of why they are pursuing some action, rather than viewing it as a task imposed on them by legislation or local authorities. As noted by Bennett (1975), changing attitudes (through education and other means) is fundamental to motivating people and achieving a change in practice. Consumer ignorance, misunderstanding and confusion can be a barrier (Hornik *et al.*, 1995) to optimal waste management. Hornik *et al.* (1995) found knowledge to have the highest correlation with tendency to recycle.



It is imperative that local authorities try to establish tailored, locally-relevant approaches towards sustainable waste management rather than a prescriptive approach to meet nationally set targets (Price, 2001). A long-term educational approach to a more sustainable lifestyle at the consumer level should be considered (Price, 2001). The ability to identify any socio-economic and demographic factors associated with non-recyclers is important (Martin *et al.*, 2006) as this can be linked to awareness (Coggins, 1994) and targeted for intervention.

The needs of the community should inform the design of a waste management strategy (Williams and Kelly, 2003). Martin *et al.* (2006) stated that '*Apart from the publicity and promotion of specific recycling schemes, more general education and information about the broader issues underlying waste management are required in order to apprise the public of the necessity for, and the benefits from the acceptance of a wider responsibility towards waste disposal.*' This sentiment is echoed by those that participated in this research of the Dublin region (Purcell, 2009; Purcell and Magette, 2010); 24% of respondents said better education / information would encourage them to manage their waste in a more environmentally sound way. Educational programmes and advertisements (TV, radio, newspapers *etc.*) were chosen by the majority of respondents (63%) as influencing their waste management practices, and these results were used as a foundation for devising the appropriate targeted intervention strategies described previously. Information and education at a local level is an important aspect of waste minimisation strategies (Price, 2001).

Solid waste management is a complex problem involving several components, among which social elements and community participation are key factors (Srivastava *et al.*, 2005; Hung *et al.*, 2007). Waste management must integrate different issues (economic, technical, social *etc.*) (Minciardi *et al.*, 2008). Approaches based on the possibility of taking into account these different aspects are important (Costi *et al.*, 2004).

Up to recently (2008), municipal solid waste management services have been provided by local authorities (Massoud *et al.*, 2003), but over time, the participation of the private sector has grown. Public-private partnerships for waste management have experienced increased interest (Massoud *et al.*, 2003). However, in the Dublin region, competition has developed between the local authorities and the private sector for waste services. The private sector offers services to single households, as well as apartment complexes and the commercial sector; some local authorities are determined to retain these services in their remit. Regardless of who provides waste services, it is important that all waste service providers (and waste promotion campaigns) have common objectives in implementing the waste hierarchy and diversion of waste from landfill. Commercial waste is primarily collected by the private sector in the Dublin region (RPS, 2008). This new environment of private competition with the public sector for the collection of household waste may have significant effects on collection rates and service quality within the region.

Delegating targeted responsibility to environmental officers for particular areas within the local authorities is important, so that continual contributions from them help keep

households and business up to date and motivated with waste management issues, would also help keep local authorities up to date with the needs and wants of the communities in particular areas.

## **5.0 Conclusions**

Surveys of public opinion are a valid means of identifying site-specific waste management needs in a diverse region such as Dublin. Differences in waste issues, as evident in the analysis of the survey illustrate the importance of public consultation (participatory government) before changes/alterations or new waste schemes are introduced. Taking into account the situational characteristics of local regions is important in achieving optimal waste behaviour through any waste activity. As noted by Kotra and Leslie (2003), the importance of engaging the public and listening to concerns and providing clear responses, is fundamental to building public confidence and trust.

By combining the results of public opinion surveys with documented waste management elements, waste management initiatives can be tailored to the specific needs of areas. Theoretically, the derived strategies to enhance the waste awareness and waste practices for the region to ultimately achieve increased diversion from landfill are dependent on the individual to react to the strategy to improve or enhance waste practice. However, even though the survey interviews revealed a population who genuinely want to improve waste practice as a whole, all too often these intentions may not be acted upon, bringing to the fore the attitude and action gap. Targeting these strategies to the local authority area may directly achieve what the people are need and so may have a better chance of achieving

improved waste practice than region wide, or indeed country wide strategies, which may not be appropriate to all areas.

Although the initiatives developed in this research were not tested in practice, evidence from the literature would suggest that these strategies would be more effective in leading to the optimum diversion of waste from landfill, as set down in the EU Landfill Directive, than the current one-size-fits all strategy based on national targets that is characteristic of Ireland's regional waste management plans.

### **Acknowledgements**

This research was supported by the Environmental Protection Agency ERTDI Programme and the National Development Plan under project 2005-PHD5-GIS-8.

### **6.0 References**

- Anonymous, 2004. Logic Model Development Guide. W. K. Kellogg Foundation, Battle Creek, Michigan.
- Anonymous, 2005. Logic Model Workbook. Innovation Network, Inc., Washington, DC.
- Arnstein, S.R., 1969. A ladder of citizen participation. *Journal of American Institute of Planners* 35(4):216-224.
- Bach, H., Mild, A., Natter, M. and Weber, A., 2004. Combining socio-demographic and logistic factors to explain the generation and collection of waste paper. *Resources Conservation and Recycling* 41(1):65-73.

- Barclay, S.J., Buckley, C.A. and Mercer, D.G., 2000. Waste minimisation clubs – managing them for success. Wastecon 2000, Cape Town 5<sup>th</sup> -7<sup>th</sup> September.
- Bennett, C., 1975. Up the hierarchy. *Journal of Extension*, March/April p 7 – 12.
- Bolaane, B., 2006. Constraints to promoting people centred approaches in recycling. *Habitat International* 30(4):731 – 740.
- Bond, S. (2009) Economic slow down helps Ireland meet waste targets, *Edie newsroom*, Available at [http://www.edie.net/news/news\\_story.asp?src=nl&id=17353](http://www.edie.net/news/news_story.asp?src=nl&id=17353) Accessed 27 October 2010.
- Chan, K., 1998. Mass communication and pro-environmental behaviour: waste recycling in Hong Kong. *Journal of Environmental Management* 52(4):317 – 325.
- Chung, S.S. and Leung, M., 2007. The value-action gap in waste recycling: the case of undergraduates in Hong Kong. *Environmental Management* 40(4):603-612.
- Coggins, C., 1994. Who is the recycler? *Journal of Waste Management Resource and Recovery* 1(2):69-75.
- Costi, P, Minciardi, R., Robba, M, Ravatti, M and Sacile, R., 2004. An environmentally sustainable decision model for urban solid waste mnaagement. *Waste Management* 24(3):277 – 295.
- CSO, 2008. Small Area Population Statistics, 2006. Central Statistics Office Cork, Ireland.
- Davies, A.R., Taylor, D.M., Fahy, F., Meade, H., O’Callaghan-Platt, A., 2005. Environmental attitudes and behaviour: values, actions and waste management. Final research report to the Environmental Protection Agency, Dublin.

DEFRA, 2006. Tackling the waste challenge, Department of Environment, Food and Rural Affairs, London, UK.

Diem Trang, N.T., Parayno, P.P., Karagiannidid, A. and Bilitewski, B., 2007. The effects of local cultural and socio-economic features on the structure of solid waste management in developing countries: the case of the Philippines and Vietnam. In: Proceedings Sardinia 2007, Eleventh International Waste Management and Landfill Symposium, 1<sup>st</sup> – 5<sup>th</sup> October, CISA Publishers, Cagliari, Italy.

Environment Agency, 2000. A study of the composition of collected household waste in the United Kingdom – with particular reference to packaging waste. Research and Development Technical Report.

EPA, 2006. Environmental attitudes and behaviour, values, actions and waste management, Synthesis Report, pp 27. Environmental Protection Agency, Johnstown Castle, Co. Wexford, Ireland.

EPA, 2008a. EPA announces new environmental project for the hotel and hospitality sector. Press Release, April 23, 2008.

<http://www.epa.ie/news/pr/2008/name.24415.en.html>

EPA, 2008b. National Waste Report 2006. Environmental Protection Agency, Johnstown Castle Estate, Wexford, Ireland.

EPA, 2008c. Ireland's Environment 2008. Environmental Protection Agency, Johnstown Castle Estate, Wexford, Ireland. p. 149.

EPA, 2009. National Waste Report 2008. Environmental Protection Agency, Johnstown Castle Estate, Wexford, Ireland.

EC, 1999. Council Directive 1999/31/EC of 26<sup>th</sup> April 1999 on the Landfill of Waste.

Official Journal, L182. European Community.

Fahy, F., 2005. The right to refuse. *Local Environ* 10(6):551 – 569.

Fahy, F. and Davies, A., 2007. Home improvements: Household waste minimization and action research. *Resources, Conservation and Recycling* 52(1):13-27.

Hopper, J.R. and McCarl, N.J., 1991. Recycling as altruistic behavior. Normative and behavioral strategies to expand participation in a community recycling program *Environment and Behavior* 23(2):195 – 220.

Hornik, J., Cherian, J., Madansky, M. and Narayana, C., 1995. Determinants of recycling behavior: a synthesis of research results. *The Journal of Socio-Economics* 24(1):105 – 127.

Hung, M.L., Ma, H.W. and Young, W.F., 2007. A novel sustainable decision making model or municipal solid waste management. *Waste Management* 27(2):209 – 219.

Irish Hospitality Institute, 2006. Greening Irish Hotels, a Cleaner Greener Production Programme for the Irish Hotel Industry. Available at [www.greeningirishhotels.ie](http://www.greeningirishhotels.ie) (Accessed August 2006).

Kimbrough, S.O. and Lee, R.M., 1988. Logic modeling: a tool for management science. *Decision Support Systems* 4(1):3-16.

Kotra, J.P. and Leslie, B.W., 2003. Talking with the public about regulating high-level waste disposal: recent progress. WM'03 Conference February 23 – 27 2003, Tuscon, Arizona, USA. <http://www.wmsym.org/abstracts/2003/pdfs/554.pdf>

- Lavagnoto, M.C., (2010) (editor) Attitudes and behaviour towards non-household waste management in the Dublin, Ireland region. In: A Glance at the World, Waste Management 30(12): 2664 – 2667). Authors: Purcell, M. and Magette, W.L.
- Lockeretz, W., 1990. What have we learned about who conserves soil. Journal of soil and water conservation 45(5):517-523.
- Martin, M., William, I.D. and Clarke, M., 2006. Social, cultural and structural influences on household waste recycling. Resources, Conservation and Recycling 48(4):357-395.
- Massoud, M.A., El-Fadel, M. and Malak, A.A., 2003. Assessment of public v private MSW management: a case study. Journal of Environmental Management 69(1):15 – 24.
- Mee, N., Clewes, D., Phillips, P.S. and Read, A.D., 2004. Effective implementation of a marketing communications strategy for kerbside recycling, a case study from Rushcliffe UK. Resources, Conservation and Recycling 42(1):1-26.
- Miller, S., 2006. Ballymun Community Composting Project, Centre Rediscovery. Information Bulletin pp 1. Available at <http://d2549.n41.webtradehost.com/fileupload/Image/ERTDIDCompostingProject.pdf>
- Minciardai, R., Paolucci, M., Robba, M. And Sacile, R., 2008. Multi-objective optimisation of solid waste flows: environmentally sustainable strategies for municipalities. Waste Management 28(11):2202 – 2212.
- Monaghan County Council, 2009. Calling Time On Waste. A publican's handbook to a leaner, greener cost base, pp36. National Waste Prevention Programme, Ireland.



Mosler, H.J., Drescher, S., Zurbrügg, C., Rodríguez, T. C. and Miranda, O.G., 2006.

Formulating waste management strategies based on waste management practices of households in Santiago de Cuba, Cuba. *Habitat International* 30(4):849-862.

Oireachtas, 2006. Local Government (Business Improvement Districts) Act 2006, No. 42 of 2006. The Stationary Office, Molesworth Street, Dublin.

Oskamp, S., Harrington, M.J., Edwards, T.C. and Sherwood, D.L., 1991. Factors influencing household recycling behaviour. *Environment and Behaviour* 23(4):494-519.

Ostman, R.E. and Parker, J.L., 1988. Impact of education, age, newspapers, and television on environmental knowledge, concerns, and behaviors. *Journal of Environmental Education* 19(1):3 – 9.

Parizeau, K., Maclaren, V. and Chanthy, L., 2006. Waste characterization as an element of waste management planning: lessons learned from a study in Siem Reap Cambodia. *Resources, Conservation and Recycling* 49(2):110 – 128.

Perrin, D., and Barton, J., 2001. Issues associated with transforming household attitudes and opinions into materials recovery: a review of two kerbside recycling schemes. *Resources Conservation and Recycling* 33(1):61 – 74.

Phillips, P.S., Pratt, R.M. and Pike, K., 2001. Waste minimisation clubs in the UK: key factors for cost effectiveness future developments. *Waste Management* 21(4):389-404.

Plöchl, C., Dobson, G., and Buell, U., 2003. Factors influencing municipal waste arising and composition. Proceedings of the 8<sup>th</sup> International Conference on Environmental Science and Technology, Lemnos Island 8-10 September Vol. B: 682 – 689.

- Price, J.L., 2001. The landfill directive and the challenge ahead: demands and pressures on the UK householder. *Resources Conservation and Recycling* 32(3-4):333 – 348.
- Purcell, M., 2009. A New Approach to the Design of Waste Management Systems for Biodegradable Municipal Waste (BMW). PhD Dissertation, School of Architecture, Landscape and Civil Engineering, University College Dublin, Belfield, Dublin, Ireland.
- Purcell, M. and Magette, W.L., 2009. Prediction of household and commercial BMW generation according to socio-economic and other factors for the Dublin region. *Waste Management* 29(4):1237 – 1250.
- Purcell, M. and Magette, W.L., 2010. Attitudes and behaviours towards waste management in the Dublin, Ireland region. *Waste Management* 30(10):2003 – 2012.
- Quaghebeur, K., 2006. Participation for free. Exploring (limits of) participatory government. *Education Philosophy and Theory* 38(4):497 – 511.
- Read, A., 2000. Public education and recycling performance – how to convince the public to participate in recycling. In *Waste 2000 Conference Proceedings*. 2nd – 4th October 2000. Stratford-Upon-Avon, UK.
- Read, M., Gregory, M.K. and Phillips, P.S., 2008. Driving the waste prevention agenda - an evaluation of weighing kerbside household waste arisings methodology, in Dorset, UK. *The Journal of solid Waste Technology and Management* 34(3):161 – 176.
- Rediscovery Centre, 2008. Ballymun Community Compostin Project. Ballymun regenreation limited and the national botanic gardens partnership project. Available at: <http://www.rediscoverycentre.ie/fileupload/Image/ERTDICompostingProject.pdf>

- Roche, D., 2007. Local Government (Business Improvement Districts Ratepayer Plebiscite) Regulations 2007, Statutory Instrument 166 of 2007. The Stationary Office, Molesworth Street, Dublin.
- Robinson, G.M. and Read, A.D., 2005. Recycling behaviour in a London Borough: results from large-scale household surveys. *Resources, Conservation and Recycling* 45(1):70-83.
- RPS, 2008. Waste Management Plan for the Dublin Region. 2005 – 2010. Annual Progress Report 2007, pp 78. RPS Consulting Engineers, Dublin Ireland. Available at [http://www.dublinwaste.ie/files/MDR0560RP0001F02\\_Provisional%20For%20Website.pdf](http://www.dublinwaste.ie/files/MDR0560RP0001F02_Provisional%20For%20Website.pdf) (Accessed April 2008).
- Schneider, F. and Obersteiner, G., 2007. User-friendliness of waste bins – a case study. Proceedings Sardinia 2007, 11<sup>th</sup> International Waste Management and Landfill Symposium, S. Margherita di Pula, Italy; 1<sup>st</sup> – 5<sup>th</sup> October, CISA, Italy.
- Singleton, J. 2008. Personal communication. Dublin City Council Waste Management Services Division, 68/70 Marrowbone Lane Dublin 8, Ireland.
- Srivastava, P.K., Kulsmeshtha, K., Mohanly, C.S., Pushpangadan, P. and Singh, A., 2005. Stakeholder – based SWOT analysis for successful municipal solid waste management in Lucknow, India. *Waste Management* 25(5):531 – 537.
- Steel, B., 1995. Thinking globally and acting locally. Environmental attitudes, behaviour and activism. *Journal of Environmental Management* 47(1):27-36.

- Sujauddin, M., Huda, S.M.S. and Rafiqul Hogue, A.T.M., 2008. Household solid waste characterization and management in Chittagong, Bangladesh. *Waste Management* 28(9):1688 – 1695.
- The Sunday Business Post, 2008. Businesses in bid to clean up Dublin city. Sunday 31 August 2008. The Sunday Business Post Online. Thomas Crosbie Media. TCH.  
Available at: <http://archives.tcm.ie/businesspost/2008/08/31/story35517.asp>
- Taylor-Powell, E. and Henert, E., 2008. Developing a Logic Model: Teaching and Training Guide. Board of Regents of the University of Wisconsin System, Madison, Wisconsin.
- Tonglet, M., Phillips, P. and Bates, M.P., 2004. Determining the drivers for householder pro-environmental behaviour: waste minimization compared to recycling. *Resources Conservation and Recycling* 42(1):27-48.
- Williams, I.D. and Gunton, H.B., 2007. Sustainable lifestyles for young people: a case study for university students. Proceedings Sardinia 2007, 11<sup>th</sup> International Landfill Symposium, CISA Publishers, Cagliari, Sardinia, Italy.
- Williams, I.D. and Kelly, J., 2003. Green waste collections and public recycling behaviour in the Borough of Wyre, England. *Resources, Conservation and Recycling* 38(2):139-159.
- Wilson, C.D.H. and Williams, I.D., 2007. Kerbside collection: A case study from the north-west of England. *Resources Conservation and Recycling* 52(2):381-394.
- Woodard, R., Bench, M. and Harder, M.K., 2005. The development of a UK kerbside scheme using known practice. *Journal of Environmental Management* 75(2):115 – 127.