Effective use of data in waste strategy planning in the UK

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EFFECTIVE USE OF DATA IN WASTE STRATEGY PLANNING IN ENGLAND

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ABSTRACT
Effective waste strategy planning for sustainable and integrated waste management is predicated on high-quality information. However a review of recent local authority waste strategies in England, part of a research project into effective use of data and analysis in waste strategy planning carried out by researchers at the Open University, showed little evidence of being based on thorough analysis. Lack of good data on many aspects of performance restricts what can be achieved in planning better integrated, more sustainable waste management provision. This paper draws from the results of that project and illustrates improvements that could be achieved by using better quality data and analysis to inform decision making. The research explored the use of various types of information and analysis including compositional analysis and establishing diversion rates; scenario building; applications of geographical information systems; understanding and measuring public participation; the use of trials to collect relevant data; and understanding of the effects of recycling schemes on residual waste composition. The general principals and methodologies of each approach are illustrated by examples derived from the authors' analysis and interpretation of local authority data provided by case study partners, and show how local data can provide relevant and effective local answers.

INTRODUCTION
The management of municipal waste in the UK is currently going through a period of considerable and rapid change, with EU and UK government initiatives being significant drivers in this changing environment. Alongside these drivers, existing infrastructure and waste management systems, financial constraints, political climate and influences (local but also national and international), social and technical issues, knowledge, contacts and prejudices will all play a part in shaping local authority waste management strategic planning. Balancing these often-conflicting demands, and planning in an integrated way for sustainable waste management, is a major challenge faced by local authorities today. In helping to address these challenges, researchers in the Integrated Waste Systems group undertook a two year research project, which is described fully in the report 'Developing Integrated Waste Management Strategies: Information Needs and the Role of Locally-Based Data'[11]. The report is available from http://technology.open.ac.uk/iws, and this paper is a summary of some of the main points that emerged from that research. It was directed at exploring how recognising and responding to strategy information needs combined with the use of locally-based data could promote effective waste strategy planning. Indeed the importance of generating sound data which are based on local conditions and which are truly relevant to

local needs is a key element in this work. This paper highlights some of the ways in which research can inform the process of developing integrated waste strategies. It illustrates improvements that could be achieved by using better data and analyses to inform decision making.

Integrated waste management (IWM) describes an approach in which decisions on waste management needs to take account of different waste streams, collection, treatment and disposal methods to achieve a balance between collection and treatment methods that strives for environmental sustainability, cost effectiveness and social acceptability. This integration is beginning to be taken a step further in considering waste management as a part of a wider resource management system, and moving more towards identifying wastes as potential resources[1]. Planning and delivering IWM is a key objective of UK national and local waste strategies[4], [9], [10], [13]. In order to do this effectively, this research argues that a range of information and analyses can or should be included in assessing future options to determine strategies for IWM. It gives examples of analytical tools to assist strategic planning, including scenario building, geographical information systems, compositional analysis and establishing diversion rates, understanding and measuring public participation, and understanding of the effects of recycling schemes on residual waste composition, combined with the importance of relevant local data and how it might be gathered, so that local data provides local answers. The general principals and methodologies of each approach are illustrated in the research by case study examples derived from analysis and interpretation of data provided by case study partners, Project Integra. Project Integra is the partnership in Hampshire, in southern England, between the eleven district councils, Portsmouth and Southampton unitary authorities, Hampshire County Council, and the private waste contractor Hampshire Waste Services.

REVIEW OF STRATEGY PLANNING

Strategy planning by English waste authorities was reviewed in 2002, by examining a selection of plans from 20 areas across the country, in order to identify how these local authorities used data in their planning and decision-making[11]. This review showed that whilst the term *integrated* was used repeatedly by all authorities, it was not necessarily reflected in an integrated approach, either to the planning process, or the systems proposed to provide the future basis for waste management in their area. In selecting particular waste management options, most plans mentioned consideration of a number of factors including not only cost, but ability to meet Best Value targets, to satisfy political or social considerations, the overall environmental impacts, and seeking the Best Practicable Environmental Option (BPEO). However none of authorities studied considered all these aspects or attempted to integrate these multiple criteria in its decision making process. Although many strategies referred to identifying the waste management system that is the BPEO, it was rarely assessed, and where it was this was limited to using Life Cycle Analysis to compare treatment options.

Only half of the authorities evaluated referred to local studies of waste composition involving sampled surveys of collected household waste; of these only two included analyses of Civic Amenity (CA) site wastes in the analysis. Little attempt was made by the authorities to integrate collected waste data with that on waste and recyclable materials collected through CA and bring sites, even though such a picture is critically important in planning collection methods and infrastructure to provide an integrated approach to meeting targets. Very few strategies considered public participation (either in terms of how many participate or how effectively they capture targeted materials) in their planning documents, or acknowledged the need to use data on participation and capture rates, with locally-based compositional data for

the whole household or municipal waste stream, to identify where improvements could be made, and to plan more effectively. Less than a quarter of authorities included data on capture rates for recycling, and overall few strategies included any specific analysis of how their proposals would achieve the proposed improved recycling rates or meet their targets. Overall the review concluded that there was little evidence that understanding of the waste stream and waste composition determined the direction of strategy planning.

USE OF COMPOSITIONAL DATA TO IMPROVE STRATEGY PLANNING

Having reviewed strategy planning approaches and identified a number of failings related to developing integrated waste management strategies, a unique methodological approach was developed. This aimed to integrate operational data with sampled composition analysis, and allow data collected from different household waste streams to be integrated to give a profile of the total municipal waste stream[11]. Data integrated in this way is contended to give a more accurate basis for evaluation of performance and planning to achieve recycling and other targets. At present local waste management strategies often fail to take into account all household waste arisings, including those taken to Civic Amenity sites and 'bring' facilities. Most studies that sample household waste arisings, even recent ones, focus on analysing collected residual and kerbside recycled waste[6]. Some authorities have undertaken compositional studies at CA sites, usually sampling and analysing materials brought in per site visit[2], [3], [8]. However data on this waste stream is limited, and although weight data is combined to give total waste arisings, compositional analysis of CA site waste is rarely integrated with that from collected wastes (i.e. 'dustbin' waste). Collected household or 'dustbin' waste accounts for around 60% of total household waste, with CA sites wastes comprising another 15%. It is unrealistic to assume that the total household waste stream will conform to the characteristics of one part of the picture, albeit a major component. The research concluded that analysis that deals with one aspect of the household waste stream in isolation can build a misleading picture of the amount and type of waste produced by households in any particular area. This can prove a serious weakness in the development of realistic waste management scenarios, and lead to unrealistic choices for future strategy. This point is addressed in a paper for the UK Government Cabinet Office's Strategy Unit on the analysis of household waste composition which is introduced with the sentence:
"*There is much confusion over the meaning and validity of household waste compositional statistics in the UK*" [5]. It goes on to comment that "*compositional studies in the UK have focused almost exclusively on establishing the composition of residual 'dustbin' waste" and consequently that 'dustbin' or collected refuse data is often misconstrued as representing the composition of all municipal waste arisings. And as a result "the lack of credible national estimates (for waste composition) has important implications for the development of waste policies*" [5].

It is essential therefore to integrate as far as possible the findings for the different outlets for households waste, particularly for CA sites and collected wastes through kerbside recycling and 'dustbin' residual waste collections, in relation to the different methods of waste containment and different 'waste catchment' characteristics. This should enable variations in compositional samples to be explained more clearly, both in terms of socio-economic and infrastructure differences between areas.

The methodology describes how sampled data can be classified by 'cluster analysis' which groups together areas with similar waste characteristics to create a generalised composition for each of the main groups or clusters obtained. When this was applied to the Hampshire case study data it resulted in individual districts or boroughs becoming part of a group or cluster. The mean compositional profile of each cluster can be taken to be a more accurate

reflection of each area's waste composition than would be produced by a simple mean of a limited set of data from that area. This approach has merit where there are only a few data points in each district or borough. This reduces the overall influence of those individual data points (and in particular any erroneous data) in producing district or borough level compositional estimates. It can also be applied to other groupings of authorities or areas within authorities.

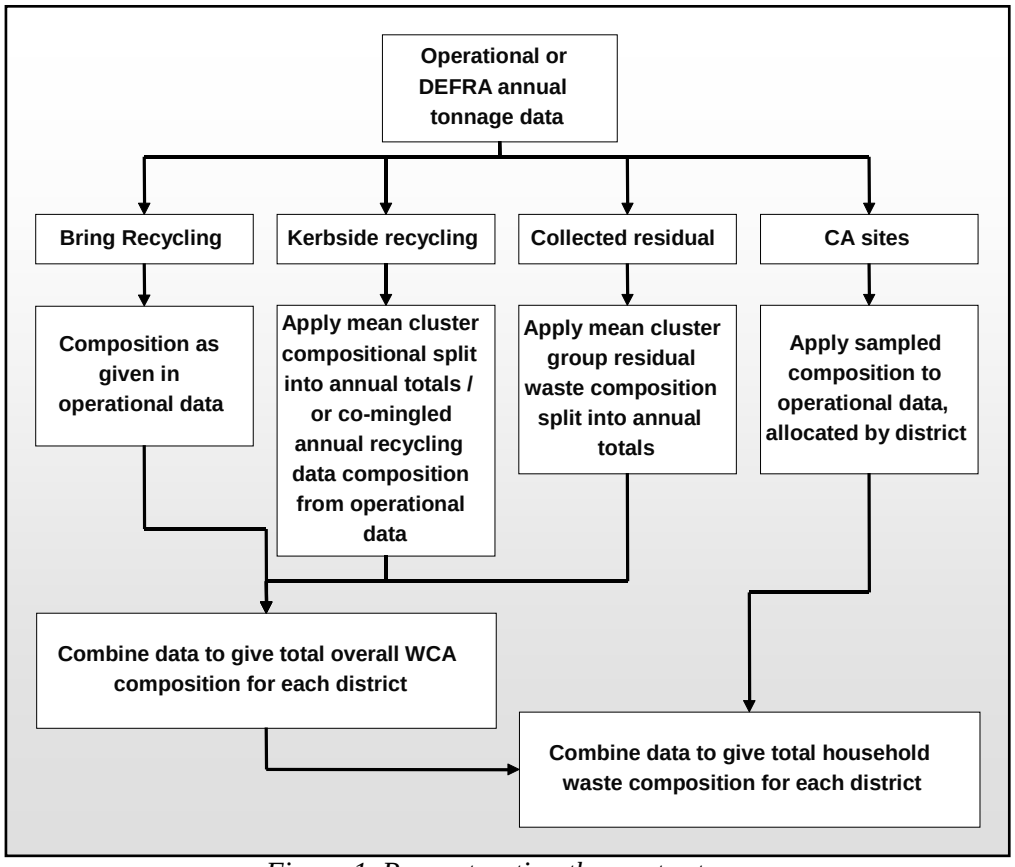

Figure 1. Reconstructing the waste stream

The method developed for building an integrated compositional analysis is shown diagrammatically in figure 1. The approach taken was first to apply the clustered group compositional analysis to the annual collected residual waste data. After similarly applying average compositional analyses to each of the annual kerbside recycling totals, CA and 'bring' site statistics, the four waste streams were recombined to a better indication of total household waste composition for each district. When applied to the compositional and waste data for Hampshire, the compositional profile of the reconstructed waste stream including CA site waste showed a higher proportion of putrescible waste, but significantly lower percentage of paper and card, compared with the composition of collected residual waste and kerbside recyclables only. Looking at differences within the County shows widely varying compositions between Districts which reflect the different mix of collection infrastructure and policies in place. Figure 2 shows a comparison of two Districts, Eastleigh which collects residual waste alternate weekly in wheeled bins and Hart which freely accepts garden waste in their weekly wheeled bin collections.

Eastleigh has only 19% putrescible waste in its collected residual and recyclable waste, compared to Hart's 39%, and a smaller amount of collected waste per household. However Eastleigh has very high CA site use, and when CA site waste is included in the composition

analysis, not only do Eastleigh's households now produce slightly more waste per unit than Hart, but the compositional profile changes.

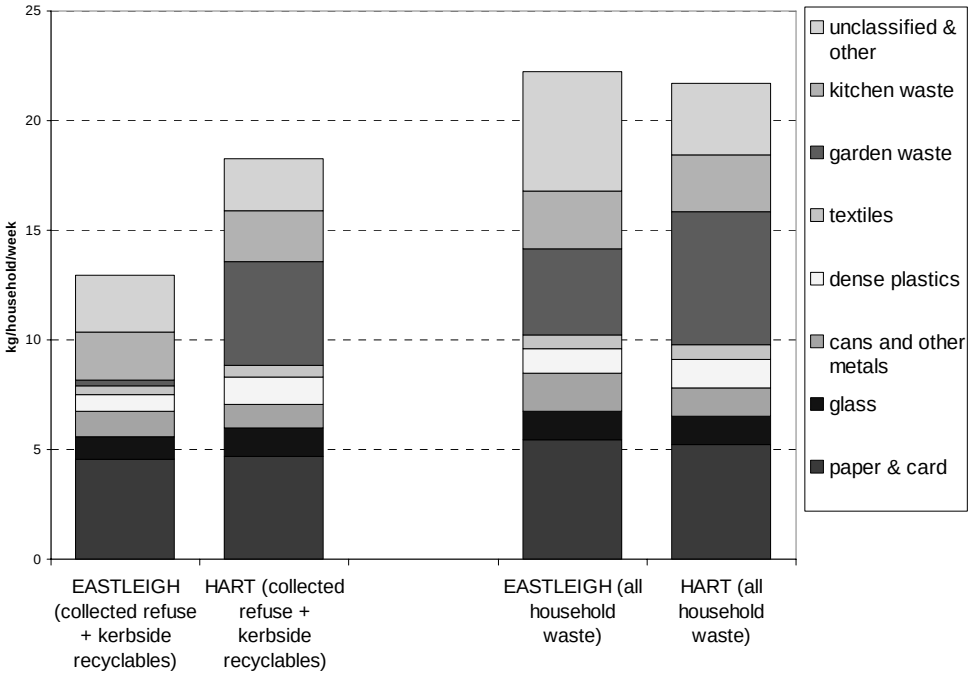

Figure 2. Comparison of the composition of household waste for two Districts in Hampshire

Consequently it is clear that compositional analysis that reflects collected 'bin' waste will give significantly different compositional profile to that based on the total integrated household waste stream. Knowing the composition of the total household waste stream has important applications in exploring strategic planning for waste management in a number of areas, including the potential for meeting the recycling targets and for infrastructure capacity. To evaluate how much material can be captured by different approaches to recycling requires not only realistic data on material diversion and achievable participation rates but also accurate knowledge of what material is potentially available in the waste stream. Knowledge of the whole waste stream is also important as the publics' use of different infrastructure provision is not 'static' and changes in the use of one may effect the type and quantity of materials in other streams.

UNDERSTANDING PUBLIC PARTICIPATION WHEN DEVELOPING STRATEGY PLANS

Understanding public participation has a key role to play in strategic planning, not only in assessing the current performance of recycling schemes but also in identifying where to target improvements and in determining the potential for improvement.

Aspects of participation that are important to measure include:

- numbers participating – both the overall participation rate (of households participating at least once in a four week period) and the set-out rate (the proportion of households putting materials out for collection in any one week);
- how effectively people are participating – measuring the amount of what is collected for recycling, the composition of the separated material, undertaking Material Recycling Facility (MRF) sorts and calculating reject rates, can all tell how well people are

separating their waste and how much of the available recyclables are being captured, but not why they are not participating fully;
- levels of public understanding – to probe why people do or do not effectively participate in particular schemes and how participation might be improved. This can be gained from analysis of public attitude surveys and public involvement strategies.

Knowing how many people participate, and the accurate location of participating households, can inform campaigns to increase participation. Knowing how well people understand how to participate in a scheme and what they choose to do about it is invaluable evidence for local authorities in identifying what and how to target public information campaigns and to effectively improve the quality of participation[12].

An example of research into public participation being used to improve performance in recycling collection schemes involved an analysis of understanding about which materials could be separated for recycling amongst residents in Hampshire[5]. The analysis identified a distinct lack of awareness in certain districts that magazines were collected for recycling. This information, together with data on what was being collected for recycling from different districts, informed a targeted publicity campaign by Hampshire CC to promote magazine recycling to the public in those areas. This targeted campaign was evaluated both for impact of the media and images used, and effect on recycled tonnage. It was found that in the period following the campaign that tonnage of recycled paper collected in the two targeted districts increased at least 12% in comparison with the rest of Hampshire.

The effective monitoring and evaluation of kerbside recycling schemes should involve the close integration of different categories of data, including questionnaire data on public understanding. The research concluded that only when performance data are analysed together with social survey data does a complete picture emerge of how public understanding influences scheme performance. Where this is the case, performance improvements can be better planned and limited resources will be used more effectively as promotional campaigns can be more accurately targeted.

GEOGRAPHICAL INFORMATION SYSTEMS AND THEIR POTENTIAL APPLICATION FOR INFORMING AND DELIVERING WASTE MANAGEMENT STRATEGIES

Geographical Information Systems (GIS) are spatial data processing techniques for the management of information about a particular environment. They are relevant to public service delivery as much of this involves decisions about spatial or location factors. Over the past few years there has been increased use of GIS in decision making for public service provision, with the largest growth in land-use planning, transport and health provision, and to-date there has been limited use of GIS for waste management and recycling. The research explored examples of the potential usefulness and application of GIS techniques for developing waste strategy plans, and in enhancing waste service provision and delivery. A range of applications were examined including data storage, monitoring and analysis at the national, regional and local level.

The most common use of GIS in relation to managing waste is for *site selection*. The first step involves identifying siting factors, which are likely to include geology, transport networks, nature conservation area and demographics. An example is illustrated in figure 3 of an application which used travel times to estimate accessibility to existing civic amenity sites in South Norfolk, and which highlighted areas furthest from the sites in terms of minutes travelled and thus potential locations for additional sites[5]. Bring and CA site data, kerbside collection data, population characteristics and recycling behaviour by area could be mapped

and used to determine correlations between for example recycling behaviour and access to recycling facilities.

GIS has a number of potential applications in relation to *waste collection and transport*. In an integrated approach to the transport of waste, the optimum mode for a given journey may be determined. GIS is a valuable tool for route planning, and is increasingly used to improve waste and recycling collection efficiency. GIS can also be used for a range of *waste monitoring purposes*. For individual landfill site, GIS can be used to outline the void space, to calculate lining requirements, to calculate volumes of individual cells, and identify appropriate leachate and gas monitoring locations. GIS allow spatial patterns of pollutants to be modelled, and data on pollutant concentrations and population distribution to be combined and analysed. GIS can be used to monitor and model pollutant and particle matter from any waste or recycling plant, such as emissions from Energy from Waste plants, and bioaerosols from composting plants.

There are also potential uses for GIS to be used to map public participation information, including public attitude survey data. Possible applications include monitoring and niche marketing, such as to differentiate non-recyclers from medium recyclers for example to allow promotional campaigns to be appropriately designed and targeted.

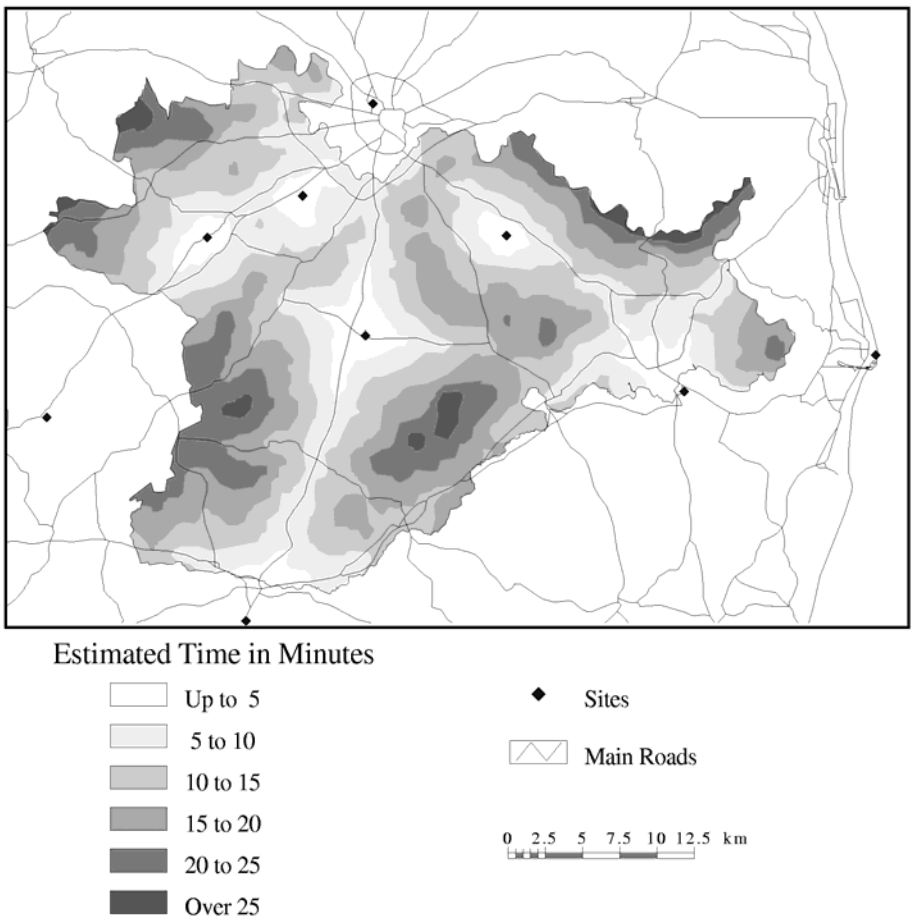

Figure 3. Estimated travel time to nearest CA site[5]

Local authorities' waste strategies need to be based on a detailed understanding of waste arising, composition and flows. GIS could be used to advance this understanding and to provide a framework for developing waste and recycling strategies, and GIS provides a powerful tool for communicating a large amount of data at a glance.

USE OF SCENARIOS IN PREDICTING RECYCLING PERFORMANCE AND MODELLING RESIDUAL WASTE IN STRATEGY PLANNING

Scenarios are often used in strategy planning to explore and compare different options for future waste management, and range widely in detail, with some including only descriptive outlines of the different options suggested, perhaps with estimates as to how these options will perform against the authorities aims and objectives. Others might include full and detailed evaluation of each option's performance against recycling and other waste management targets, as well as evaluating the BPEO including environmental impact with LCI and other techniques, cost factors, risk aspects and their social and political implications. Scenarios are not an end in themselves but a tool for exploring policy decisions, and unless they are designed to illuminate a specific strategic decision then they may not help policy makers identify choices.

In the research project from which this paper is drawn, scenarios were explored to illustrate the consequences of particular choices of recycling policy, and used to predict recycling performance resulting from particular policy choices. The scenarios described were fairly specific in their focus and uses, and explore how enhanced collection provision for bring, kerbside dry recycling and kerbside green waste might perform towards meeting government BVPI recycling targets. In all, nine scenarios, plus a baseline situation, were considered and included increased capture through bring sites for glass and textiles, a number of options for improved capture through kerbside collection of dry recyclables, charged and free kerbside collections of garden waste, and combinations of these approaches. The scenarios focus around predicted capture rates that could be achieved by different developments in recycling provision. These capture rates are then applied to weight and composition data for the complete household waste stream[11].

The research described and used these scenarios to show what might be done but not necessarily how it should be done. Local authorities using scenarios in this way to assess the potential recycling performance of different waste management options available to them – based on local circumstances and local data – will need to decide how and whether the required capture rates can be met. When applied to Hampshire's recycling performance, waste and composition data, the scenarios predicted that bring site recycling alone is unlikely to achieve longer-term national recycling targets, but that effective kerbside collection of dry recyclables, achieving high capture rates, can reach or come close to these targets. It also showed that introducing green waste collections without improved kerbside of dry recyclables is unlikely to reach these targets alone.

These scenarios were developed further to explore not only how recycling targets might be achieved but the effects of different recycling and composting schemes on the characteristics of the residual waste remaining to be processed. Data from a number of sources were combined to model the flow of materials through the waste management system for a number of the scenarios. The flows considered were in both physical terms (paper, glass, garden waste etc) and chemical terms (moisture, ash, carbon thermal content etc). These flows can then be used to characterise any of the material streams and their suitability for the different waste management options such as recycling, composting, combustion etc. It shows how potential conflicts and synergies between different elements of an integrated waste system can be investigated.

Consideration of the physical and chemical composition of the residual waste will give an indication of the suitability of the different recovery and disposal options and whether the upstream recycling scheme allows a system of IWM to be implemented. The treatment options considered are incineration with energy recovery; anaerobic digestion (AD) and mechanical biological treatment (MBT). For the case study example, the modelling exercise

predicted that the proposed intensive recycling schemes would not adversely affect the properties of the residual waste in terms of its suitability for any of the considered residual treatment processes. The different recycling options described in the scenarios were found to influence the *quantity* of residual waste available for processing, but have only a minor impact on the suitability of the material for incineration, AD or MBT. The upstream separations for recycling and composting had no detrimental impact, and in some cases had a positive impact, on the combustion-related properties of the residual waste stream. The research study also demonstrated how the scenarios can be used to predict from the composition of residual waste the amount of biodegradable MSW diverted, and hence how effectively each scenario will be in meeting the Landfill Directive diversion targets.

GENERATING AND USING LOCALLY DERIVED DATA THROUGH PILOT STUDIES

In an attempt to minimise the high risk involved and to introduce kerbside schemes which are tailored to local needs, many local authorities first trial different approaches, equipment and facilities in selected geographical areas. There are many examples of comprehensive and complex kerbside trials being set up where the main aim is to optimise the performance of subsequent full-scale kerbside operations. In such cases, a feature often lacking is the absence of consideration given to alternative or complementary approaches. Very often, the effects of introducing kerbside collection on bring site arisings and home composting activities are not rigorously investigated and the relationship between collection options and recycling rates is also unclear. With kerbside collections of garden waste being cited as an important reason for year-on-year increases in waste arisings, it is vitally important that source segregation systems are introduced within clear integrated waste management frameworks.

The results of the case study data from kerbside collection trials and CA site performance for green or garden waste were modelled using the compositional analysis and scenarios to explore the impact of different policy options[11]. The research concluded that introducing extensive kerbside collection of green waste (not including kitchen waste) could contribute significantly to meeting UK national recycling targets. However, it is important to ensure that additional waste is not created or simply diverted from other recycling routes, and there was some evidence that enhancing existing facilities and/or promoting waste minimisation through home composting might be a cost-effective alternative to the introduction of free kerbside collection schemes. Prohibiting green waste in residual waste collections was found likely to enhance HWRC use, and charged kerbside collections may offer an opportunity of increasing green waste collected whilst minimising green waste diversion from HWRC and home composting.

CONCLUSION

The research into the use of data and analysis in waste management planning described in this paper offers and illustrates a number of tools to assist local decision making, and in developing waste strategies. It identifies some deficiencies in data use in current waste strategy planning and identifies ways of addressing these deficiencies through more effective data collection and analysis.

Lack of good data on many aspects of performance restricts what can be achieved in planning better integrated, more sustainable waste management provision. To make informed decisions strategy planners need to be able to evaluate options, and to do this they need to understand and meet local information, data and analyses needs, as well as assess how realistic the relative options are in meeting their objectives. Much past and current strategy

planning in waste management is not based on thorough analysis. There is a pressing need for good, reliable detailed local information and data on waste arisings for local authorities to be able to plan realistically to meet specific targets.

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REFERENCES

[1] Lisney, B., Riley, K., Banks, C. (2003) 'From Waste to Resource Management: a discussion paper' Hampshire Natural Resources Initiative, Winchester, UK

[2] Milton Keynes Council (2000) *Household Waste Composition Study: April and November 2000.* Report by Network Recycling, Milton Keynes Council, UK

[3] National Assembly for Wales (2002) *Pilot Survey on Municipal Waste Composition in Wales*. National Assembly for Wales , February 2002

[4] ODPM (2002) *Strategic Planning for Sustainable Waste Management: Guidance on Option Development and Appraisal* Office of the Deputy Prime Minister, HMSO, UK

[5] Parfitt, J. (2002) *Analysis of household waste composition and factors driving waste increases*. WRAP for Strategy Unit, Government Cabinet Office, London, UK

[6] Parfitt, J.P. (2000) *A study of the composition of collected household waste in the UK ~ with particular reference to packaging waste*. Final report, prepared under contract No. EPG 7/10/21P1-201, Technical Report P347, Environment Agency ISBN: 1 85705 267 6

[7] Parfitt, J., Lovett, A.A. and Sunnenberg, G. (2002) Reconstructing the Municipal Waste Stream at a Local Scale: Implications for Waste Recycling Strategies. In: Lencioni, E. and Dhanda, R. *Waste 2002. Integrated Waste Management and Pollution Control: Research, Policy and Practice.* Conference Proceedings, Stratford-upon-Avon, UK

[8] Project Integra (1999) *Project Integra Kerbside and Household Waste Recycling Centre Waste Analysis and Questionnaire Survey Results.* Report from MEL Research Ltd for the Project Integra Household Waste Research Programme, Hampshire County Council, UK

[9] SEPA (2003) *The National Waste Plan 2003: Scotland.* Scottish Environmental Protection Agency, Scotland (available at www.sepa.org.uk)

[10] Strategy Unit (2002) *Waste not, Want not: A strategy for tackling the waste problem in England.* Strategy Unit, Cabinet Office, London UK

[11] Thomas, C., Frederickson, J., Burnley, S., Slater, R. (2003) 'Developing Integrated Waste Management Strategies: Information Needs and the Role of Locally-Based Data' Integrated Waste Systems, The Open University, Milton Keynes, UK

[12] Thomas, C. (2001) Public understanding and its effect on recycling performance in Hampshire and Milton Keynes. *Resources, Conservation and Recycling*, 32, 259-274.

[13] Welsh Assembly Government (2002) *Wise About Waste: The National Strategy for Wales*. Welsh Assembly Government, Environmental Protection Division, Cardiff, Wales