

# **Developing Sustainable Household Waste Management - A Local Authority Approach to Zero Waste**

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**DEVELOPING SUSTAINABLE HOUSEHOLD WASTE  
MANAGEMENT:  
A LOCAL AUTHORITY APPROACH TO ZERO WASTE**

By  
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A dissertation thesis submitted in partial fulfilment of the requirements for the award of the degree Doctor of Engineering (EngD), at Loughborough University

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I would like to thank my family and friends for their support and encouragement, my husband and children for giving me the time to write up. Finally, I owe my friends Lynne Tripp and Charlie Devine special thanks. Lynne for providing me with many motivational chats, and Charlie who was always willing to offer help, support and encouragement.

## **ABSTRACT**

This project was a case study with a Local Authority (Charnwood Borough Council, Leicestershire) to research the options in response to the challenges of managing household waste. This research focused on establishing and analysing methods of improving the sustainability of household waste management operation within a Waste Collection Authority, where the interaction with a variety of external and internal stakeholders meant a holistic approach was needed.

Waste management practices and performances in Charnwood were evaluated and benchmarked against national standards and the demography of a semi-rural Borough. Waste management practices nationally were also reviewed. The performance of the LA was quantitatively compared with other UK LAs where higher recycling performances are achieved. Differences were separate food waste collection and treatment; a larger proportion of urban housing and the university with a transient population. Other differences included strategy and operational practices for garden waste, the storage, collection, transportation and treatment of waste.

A time series statistical model was modified and applied to investigate long term waste generation trends from the Boroughs official waste data returns to Defra. These were used to assess the success of interventions undertaken. This statistical model was able to differentiate interventions that were able to achieve lasting improvements in either waste minimisation or recycling.

The declaration of a Zero Waste Strategy was to capture the public imagination. A series of focus groups and public consultations were held to judge public reaction and develop and refine the strategy. These were used to adapt the Zero Waste idea to suit the local conditions. A major conclusion was that householder involvement would be crucial for successful implementation of the further separation of waste that would be required.

The findings of this research are presented in five peer-reviewed papers.

## **KEY WORDS**

Household waste management; Zero Waste; Local Authority, Recycling.

## **PREFACE**

The research presented by this thesis was conducted to fulfill the requirements of an Engineering Doctorate (EngD) at the Centre of Innovative Construction Engineering (CICE), Loughborough University. The research programme was supervised by CICE at Loughborough University and funded by the Engineering Physical Sciences Research Council, with Charnwood Borough Council as sponsors.

The core aim of the EngD is to solve one or more significant and challenging engineering problems with an industrial context. As such the EngD is a radical alternative to the traditional PhD, requiring the researcher to be located within a sponsoring organisation guided by an industrial supervisor, while academic support is provided by regular contact with academic research supervisors.

The EngD is examined on the basis of a thesis supported by publications or technical reports. This thesis is supported by two journal papers and three conference papers.

The papers have been numbered 1-5 for ease of reference and are located in Appendices A to E. While references are made throughout the thesis to the papers there are key reference points in section 4 where the reader is directed to these papers, this is intended to help the reader to refer to the accompanying papers while reading the thesis.

## **USED ACRONYMS / ABBREVIATIONS**

AHP	Absorbent hygiene products
APSE	Association for Public Service Excellence
BVPIs	Best Value Performance Indicators
CBC	Charnwood Borough Council
CICE	Centre for Innovative Collaborative Engineering
DCLG	Department for Communities and Local Government
Defra	Department of Environment, Food and Rural Affairs
DoENI	Department of the Environment – Northern Ireland
EngD	Engineering Doctorate
EA	Environment Agency
EPSRC	Engineering and Physical Sciences Research Council
HMSO	Her Majesty’s Stationery Office
ICE	Institution of Civil Engineers
IMD	Index of Multiple Deprivations
LA	Local Authority
LATs	Landfill Allowance Trading Scheme
LCA	Life cycle assessment
LGA	Local Government Association
NBC	Newcastle-under-Lyme Borough Council
NIs	National Indicators
UK	United Kingdom
UA	Unitary Authority
UNCED	United Nations Conference on Environment and Development

UNEP	United Nations Environment Programme
UNSD	United Nations Statistics Division
WCA	Waste Collection Authority
WCED	World Commission on Environment and Development
WDA	Waste Disposal Authority
WEEE	Waste Electrical and Electronic Equipment
WRAP	Waste Resources Action Programme
ZWS	Zero Waste Strategy

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## **LIST OF PAPERS**

The following papers, included in the appendices, have been produced in partial fulfilment of the award requirements of the Engineering Doctorate during the course of the research.

### **PAPER 1 (APPENDIX A)**

Cole, C., Osmani, M., Quddus, M.A., Wheatley, A.D., (2012) Household Waste Management Practices in Charnwood Borough. In Seventh Annual International Conference on Environment, Athens, Greece, pp. 5-16.

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### **PAPER 2 (APPENDIX B)**

Cole, C., Osmani, M., Wheatley, A., Quddus, M. (2013) Bulky Household Waste Management in a UK Local Authority Area: Current Practice, Challenges and Improvement Opportunities, Proceedings Sardinia 2013, Fourteenth International Waste Management and Landfill Symposium, S. Margherita Di Pula, Cagliari, Italy; 30 September – 4 October 2013 © 2013 By CISA Publisher, Italy, pp 424.

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### **PAPER 3 (APPENDIX C)**

Cole, C., Osmani, M., Quddus, M.A., Wheatley, A.D. (2014) Moving towards Zero Waste in a UK Local Authority area: Challenges to the Introduction of Separate Food Waste Collections. In: Proceedings of ICEWM 2014: International Conference on Environment and Waste Management, Copenhagen, Denmark, 12-13 June 2014.

### **PAPER 4 (APPENDIX D)**

Cole, C., Quddus, M., Wheatley, A., Osmani, M., (2014) The impact of a Local Authorities' interventions on household waste collection: a case study approach using time series modelling. *Waste Management*, 34 (2) 266-272.

**DOI - 10.1016/j.wasman.2013.10.018**

### **PAPER 5 (APPENDIX E)**

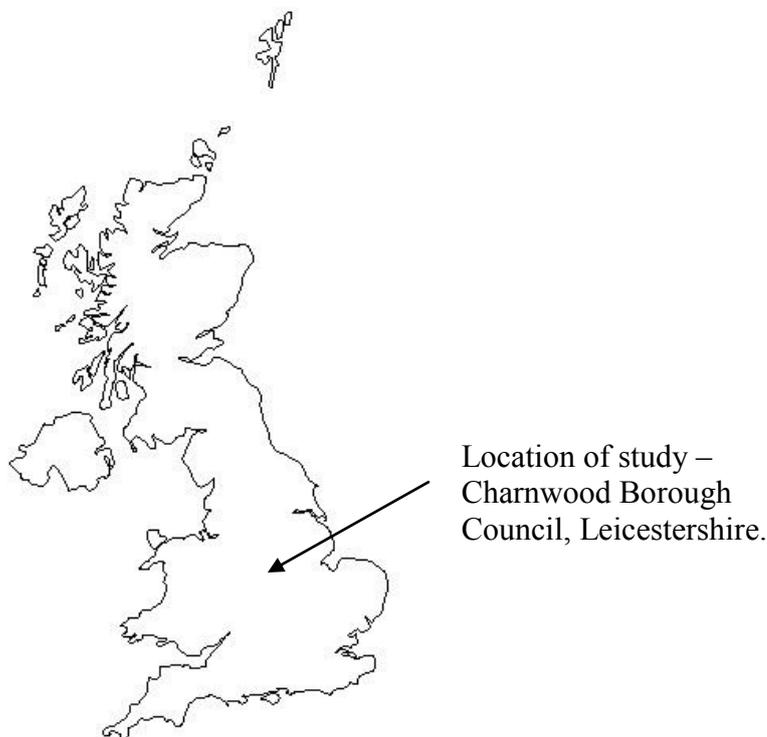
Cole, C., Osmani, M., Quddus, M., Wheatley, A., Kay, K., (2014). Towards a Zero Waste Strategy for an English Local Authority. *Resources, Conservation and Recycling*, 89 (2014) 64-75

**DOI – 10.1016/j.resconrec.2014.05.005**

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## 1 CHAPTER 1 - BACKGROUND

This thesis presents the research undertaken as part of a four year Engineering Doctorate (EngD) programme on sustainable responses to improve household waste management. It is based on a case study of a Local Authority, Charnwood Borough Council (CBC), a semi-rural Borough in Leicestershire, England (Figure 1.1); with two main urban centres, Loughborough and Shepshed, and a number of rural villages.



**Figure 1.1 - Map showing location of Charnwood Borough, England**

This chapter sets out the key issues and topics relevant to the subject domain, an outline of the research context, the scope and summarises the aims and objectives of the research within an industrial context

The chapter concludes with a summary of each paper published during the course of the study and it is intended that these papers form part of the thesis (Appendices A-E).

## **1.1 BACKGROUND TO THE RESEARCH**

Ever since the Brundtland Report “Our Common Future” (WCED, 1987) brought the concept of sustainability and environmental issues into the mainstream of the business and political agenda, most sectors of society have been affected. This is particularly relevant to the waste management industry, with legislation at EU and national levels introduced with the aim of improving environmental performance within the sector.

The majority of environmental regulatory measures in the UK have originated in Europe in the form of EU Directives (Davoudi, 2009). These have targeted: reducing emissions, controlling waste shipments and preventing illegal dumping or export (Williams, 2005). More recently issues of material flow, waste prevention and the recovery of materials and resources have been addressed (Massarutto, 2007). Volumes of waste generated, resource depletion, climate change and rising consumer awareness are all providing challenges for more sustainable waste management practices. The Waste Framework Directive, 1975 (75/442/EEC) and later revisions in 1991 (91/156/EEC) and 2008 (2008/98/EC) alongside other Directives including the Landfill Directive (1991/31/EC) has enabled Member States to approach a uniform set of objectives in different ways to develop policies and legislation to meet sustainability goals (Costa et al, 2010).

The long term dependence on landfill as the primary waste disposal route in the UK was challenged by the Landfill Directive, which outlined operating and permitting regulations for landfill sites, restricted certain types of waste being landfilled, introduced pre-treatment for some waste streams and set targets to reduce the amount of municipal biodegradable waste going to landfill (Williams, 2005). The main financial drivers to reduce landfill disposal are Landfill Tax, an escalating tax charged in addition to the landfill operator’s disposal costs (£80

per tonne for the year 2014/15), and Landfill Allowance Trading Scheme (LATs). LATs, introduced in the Waste and Emissions Trading (WET) Act 2003 operated between 2005 and 2013 and imposed limits on Local Authorities (LAs) disposal at landfill sites in addition to fines of £150 per tonne if the limits were exceeded. Together, these financial measures shaped local waste management policy, with the success of landfill tax being strongly influenced by the tax level (Braathen, 2007). As the tax level increased, recycling and reuse schemes became more economically viable options (Costa et al, 2010). By encouraging householders to separate recyclates and organic waste for recycling and composting LAs have avoided additional tax payments charged for landfill disposal, this acted as a financial incentive to provide household recycling collections (Muhle et al, 2010; Watson and Bulkeley, 2005).

### **1.1.1 HOUSEHOLD WASTE MANAGEMENT**

Household waste management is a complex system, involving the sorting, collection, treatment and disposal of waste. It interfaces with public health and environmental quality and is an inherently urban problem (Gandy, 1994). The Environmental Protection Act (1990) defined the roles of UK LAs in handling, transportation, treatment and disposal of household waste, dividing the responsibility between Waste Collection Authorities (WCA), the District and Borough Councils and Waste Disposal Authorities (WDA), the larger County Councils. Unitary Authorities (UA) have both waste collection and waste disposal duties. This two tier local government structure did not incentivise recycling and recovery solutions, limiting the power of some local government to control and guide the development of waste management infrastructure (Bulkeley et al, 2005). CBC, the case study in this research, is a WCA responsible only for the collection of household waste from 69,000 households. The disposal and treatment of the household waste collected by CBC is the responsibility of Leicestershire County Council as the WDA.

Waste Strategy for England, 2007 (Defra, 2007) presents a framework for waste management in England, setting out the benefits of sustainable waste management. The Waste Strategy lists actions, targets and timescales and how progress will be measured. It includes reference to the Waste Hierarchy, the potential role of recycling in future, resource availability and introduction of National Indicators to monitor performance (Watson & Bulkeley, 2005). Waste is a devolved responsibility; therefore there are separate waste strategies for Wales (Welsh Assembly Govt., 2010); Scotland (Scottish Government, 2010); Northern Ireland (DoENI, 2006); and England (Defra, 2007).

For many years, the focus in the UK has been on increasing the amount of household waste that is collected for recycling and reducing landfill disposal (Defra, 2007). Source separated kerbside collections for recyclates and organic waste have been implemented, recycling targets set and education programmes for householders to encourage recycling have been undertaken (WRAP, 2009a). Through these actions, annual amounts of recycled household waste in the UK increased from 3.2 to 9.8 million tonnes between 2001/02 and 2012/13 and 73 of the 352 LAs now recycle above 50% of the household waste they collect (Defra, 2013a). This recycling figure includes organic waste processed by bio-treatment (composting and anaerobic digestion). The design of a household waste kerbside collection service is often industry led, shaped by population density at the source of the waste and the location of disposal or treatment points (Rogge and De Jaegar, 2013). However, waste management, and particularly household waste management depends significantly on the involvement of householders and local communities to act as active participants, particularly those systems which rely on the sorting of waste in households (Uyarra and Gee, 2013).

Historically, the role of a WCA has been collecting and transporting waste to a landfill site or incinerator to protect public health and the environment. The emphasis has moved towards a “whole system” approach including reuse, recycling and waste reduction initiatives (Uyarra and Gee, 2013).

CBC has been performing well in recent years with respect to the recovery of recyclable and compostable materials from household waste. Between 2002 and 2010 there was a steady improvement in the proportion of household waste collected that has been reused, recycled or composted. However, further improvement is required if CBC is to meet future targets and make progress towards the aspirational goal of becoming a Zero Waste Borough.

## **1.2 CONTEXT OF THE RESEARCH**

### **1.2.1 THE INDUSTRIAL SPONSORS**

CBC is the WCA responsible for the collection of household waste and recycles from 69,000 domestic properties in the Charnwood Borough of Leicestershire. Deregulation, Competitive Tendering and changes to public service provision have enabled CBC to contract out the service provision of the household waste collections, a service the LA has a statutory duty to provide. A public – private partnership such as this combines the custodianship of the public sector with the flexibility of the private sector (Massarutto, 2007), offers the opportunity for quality services at a lower cost with a degree of customer satisfaction (Bel and Warner, 2005; Chettiparamb et al, 2011). The operational delivery of the household waste and recycling collection service has been placed with an external contractor, Serco®, through a tendering process which took place in 2009. Serco® is a FTSE 100 listed company, carrying out a diverse range of services both nationally and internationally and is currently operating waste management contracts for 16 LAs (LAs) in England, including CBC. The

Environmental Services contract awarded by CBC to Serco® covers all aspects of the household waste and recycling collections and street cleansing in CBC.

The contract between the CBC and Serco® allows changes to be made to operational procedures of the household waste collection service to align with LA policies which seek to minimize the need for landfill disposal for any of the household waste collected in the Borough. The research examines the interrelated areas of household waste collection, sustainable treatment options and explores areas of best practice. The development of a Zero Waste Strategy (ZWS), informed by the research, will assist the Council with its aspirations to be a Zero Waste Borough. The resulting ZWS and associated targets are time specific and unique to CBC, its own response in advance of regulatory and policy pressures. It was shaped by existing infrastructure, local networks and political objectives.

### **1.2.2. JUSTIFICATION FOR THE RESEARCH**

The best performing LAs were achieving a recycling performance in excess of 60% at the start of this research (2010), compared to CBC's 42% (WasteDataFlow, 2010). The major areas covered by the investigation were to seek and provide the best system for waste collection, to engage with householders to ensure the system of collection gave them the best possible experience and to understand the impact of the availability of recycling facilities. CBC would also need to operate more effectively and efficiently in delivering the statutory environmental and support services within a limited budget.

The research offered the opportunity to address the needs of the CBC as a Waste Collection Authority (WCA), within the regulatory constraints for the collection of household waste in the area. It was set up to investigate household waste management practices, performances and different approaches taken to the handling, storage, collection, movement, treatment and

recycling. Past recycling performance and existing household waste management practices could then be benchmarked against alternative approaches in the industry. There has been innovation in the mechanised facilities used for sorting recyclable materials and also in waste treatment processes (energy from waste, composting and anaerobic digestion) which could all have been relevant to CBC.

### **1.3 AIM AND OBJECTIVES**

The overall aim of the research project was to develop waste management practices at CBC to-:

**“Improve household waste management performance within Charnwood Borough and assist the Council with its aspirations to be a Zero Waste Borough.”**

This was a long term vision and the research project is part of a national cultural change that will see CBC and others change working practices and services to ensure more sustainable methods of waste management in the future.

The following objectives were developed to achieve the research aim and the needs of the sponsoring organisation. In addition, together with the research design, they allowed the academic course and training requirements of the EngD to also be fulfilled over the four year period.

1. Examine current household waste management practices.
2. Assess sustainable options for recycling household waste streams.

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- 3. Evaluate current household waste management performance in Charnwood Borough Council.
- 4. Develop and validate a Zero Waste Strategy for Charnwood Borough Council.

These Objectives have been met through undertaking a series of inter-related research activities which are shown in Table 1.1, together with the resulting outputs from the research programme.

**Table 1-1: Objectives aligned with research methods and outputs.**

Research Objectives	Research method	Research output
1. Examine current household waste management practices.	Literature review Questionnaire Survey *	Chapter 2 Paper 1
2. Assess sustainable options for recycling household waste streams.	Literature review	Paper 2 Paper 3
3. Evaluate current household waste management performance in Charnwood Borough.	Archival analysis Statistical analysis Questionnaire Survey *	Paper 4
4. Develop and validate a ZWS for CBC.	Focus groups Public consultation questionnaire survey	Paper 5 The ZWS for CBC (2012-2024), adopted by CBC Chapters 3,4 & 5

\* Questionnaire Survey – Industry survey exploring household waste collection practices and policy issues of 30 English LAs.

Objective 1 provided an in-depth understanding of household waste management, generation and composition, collection methods and drivers for change with respect to current literature and research. Findings are presented in Chapter 2 and Paper 1.

Objective 2 continues the literature review to explore available sustainable options for recycling household waste streams. It was essential to understand the current provision in order to identify problems that need to be overcome and changes that can be made. Findings are presented in Papers 2 and 3.

Objective 3 takes a case study approach informed by findings from Objectives 1 and 2 to evaluate the current household waste management performance. Using archival analysis and statistical analysis of household waste data, the findings are presented in Paper 4.

Objective 4 covers the development and validation processes for the ZWS. The outcome is a strategy around which to base further improvements to household waste management practices in an attempt to move towards Zero Waste. Using focus groups as a starting point for the draft strategy, the development process is outlined in Paper 5. Public consultation was undertaken to validate the ZWS through a questionnaire survey, this formed the basis for amendments to the draft strategy before the formal Local Government approval process. Findings are presented in Chapters 3, 4 and 5.

## **1.4 STRUCTURE OF THIS THESIS**

The thesis is organised into five chapters and a series of supporting appendices which are structured as follows:

**Chapter 1: Introduction** - provides an introduction and the background to this EngD project and sets out the aim, objectives and scope of the research. The structure of the thesis and a synopsis of each of the published papers is also presented.

**Chapter 2: Related Work** - provides the findings of a literature review on the subject of household waste management and acknowledges previous research undertaken in the field. The main subject domain of the research was household waste management practices in the UK, but it was apparent that the supporting areas of waste disposal, treatment and technologies, together with the concept of Zero Waste would also have an influence. They have also been reported on in the literature review.

**Chapter 3: Research Methodology** - reviews the range of research methodologies available. Chapter 3 then outlines and justifies the adopted methodological approach.

**Chapter 4: Research Undertaken** - presents a detailed description of the research undertaken to address the research objectives. This chapter presents the overall interlinks between the methodological processes used in the research, the results and discussion of the research are presented Chapter 5.

**Chapter 5: Findings and Implications** - presents the key findings of the research and discusses them within the context of literature. It highlights the originality and contribution to existing theory and practice, identifies the impact on the sponsor and the wider industry. It critically evaluates the research and makes recommendations for areas of further research. A final overall summary and conclusions are also included.

Five of the papers presented and published during this research are included in the appendices. These papers were the key outputs of the EngD during the four year research project and are summarised in Table 1.2. These papers are also an integral part of the thesis output.

Table 1-2: Synopsis of published papers.

<b>Paper ID</b>	<b>Title</b>	<b>Journal / Conference</b>	<b>Status</b>	<b>Description</b>
Paper 1	<b><i>“Household Waste Management Practices in Charnwood Borough, England”</i></b>	7th Annual International Symposium on Environment, Athens, Greece. May 2012  (Appendix A)	Published	Summarizing case study on household waste & recycling collections operated in Charnwood Borough, setting out the local context, performance data and comparing operational procedures and the performance with other Local Authorities.
Paper 2	<b><i>“Bulky Household Waste Management in a UK Local Authority Area: Current Practice, Challenges and Improvement Opportunities”</i></b>	Fourteenth International Waste Management And Landfill Symposium, S.Margherita Di Pula, Cagliari, Italy. September 2013  (Appendix B)	Published	Summarising current collection practices for bulky household waste in Charnwood Borough area. Details quantity of items in this waste stream and makes recommendations for improving reuse and recycling opportunities for this waste stream.
Paper 3	<b><i>“Moving towards Zero Waste in a UK Local Authority area: Challenges to the Introduction of Separate Food Waste Collections”</i></b>	ICEWM 2014: International Conference on Environment and Waste Management Copenhagen, Denmark. June 2014  (Appendix C)	Published	Charnwood Borough Council has adopted the aspirational strategy of becoming a Zero Waste Borough to lead the drive for public participation. This work researches how the separate collection of food waste would assist CBC to reach this goal using the example of a neighbouring Authority (Newcastle-under-Lyme Borough Council (NBC), a similar size local authority that has a successful weekly food waste collection service.
Paper 4	<b><i>“The Impact of Local Authorities’ Interventions on Household Waste Collection: A Case Study Approach Using Time Series Modelling”</i></b>	Waste Management, 34, 2, (2014) 266–272  (Appendix D)	Published	Using statistical analysis of data tracking quantities of household waste generated in Charnwood Borough (2004 – 2012) to establish responses to various operational and policy changes to household waste and recycling collections.
Paper 5	<b><i>“Towards a Zero Waste Strategy for an English Local Authority”</i></b>	Resources, Conservation and Recycling Journal, 89 (2014) 64–75  (Appendix E)	Published	The process of development of the strategy, series of consultation processes undertaken and the development of the framework forming the Zero Waste Strategy.

## **2 CHAPTER 2 – LITERATURE REVIEW**

### **2.1 INTRODUCTION**

This chapter describes the findings of the literature review carried out on the existing knowledge in the subject area. The main subject domain was research on household waste management in the UK. The supporting areas of waste disposal, treatment, technologies and the concept of Zero Waste has led to links in the literature review between management, reuse and recycling.

The literature review informed the background to the research, developing an understanding of the gaps and barriers to household waste management in the UK. This comprised of an exploration of current approaches, practices, drivers for change and barriers to change which impede effective household waste management. Householder behaviour patterns and the householder/collection interface was found to be critical because of its impact on the recycling performance of a Local Authority (LA) and ultimately the progress towards Zero Waste. The literature review has therefore enabled this research work to be placed in context with previous work, ensuring this was built on, rather than duplicated.

### **2.2 LITERATURE REVIEW**

Increasing economic activity, industrialisation, urbanisation, improving living standards and population growth has led to an increase in the quantity of waste generated in our society. Waste is generated in all stages of production and consumption (UNEP, 2008). However, this research concentrates on improving household waste management performance in the UK at a LA level.

The reviewed literature examined the drivers for change, namely household waste generation and composition, household waste management responsibilities, household waste management practices, household waste recycling behaviour, household waste reduction and the concept of Zero Waste.

### **2.2.1 DRIVERS FOR CHANGE**

Concerns about volumes of waste generated, long term resource depletion and the environmental impact of waste has seen many drivers for change encouraging a movement towards more sustainable household waste management practices including waste prevention and increased recycling. These include political and legislative drivers (Rahimifard *et al.*, 2009); economic drivers (Rahimifard *et al.*, 2009; Costa *et al.*, 2010; Cela and Kaneko, 2011); social drivers (Luckin and Sharp, 2004), technological drivers (Energy & Utility Skills, 2010; Tunesi, 2011) and environmental drivers (Energy & Utility Skills, 2010; Larsen and Astrup, 2011; Luckin and Sharp, 2004; Tabata, 2013; Allwood *et al.*, 2011; Achillas *et al.*, 2011).

#### **2.2.1.1 Political and legislative drivers**

The Brundtland Report “Our Common Future” (WCED, 1987) brought the concept of sustainable development into the main-stream of business and political thought. As a response to this report the United Nations “Earth Summit” in Rio de Janeiro, 1992 adopted Agenda 21 (UNSD, 1992) which addressed environmentally sound management of waste, recognising that this went beyond safe disposal or treatment of waste. Agenda 21 also challenged production and consumption patterns, proposed developing public awareness and education to promote waste reduction and recycling programmes. In 1994 the UK Government published “Sustainable Development: The UK Strategy” (HMSO, 1994) in response to the Earth summit, with the complicated concept of sustainable development divided into three major themes, economy, environment and society (Giddings *et al.*, 2002).

This separation disconnects the design and production phase of a product from the use and waste phase of its life cycle. Since then, legislation has been introduced at European and National levels with the aim of improving environmental performance, including better waste management practices. On a local level, this has led to strategies and operational practices including the introduction of separate household collections for organic (compostable) waste and recyclable materials.

The key legislative drivers to improve waste management within the UK are the EU Directives including the revised Waste Framework Directive 2008/98/EC, which covers regulation, handling and movement of waste. This Directive also defines “waste” as: “...any substance or object which the holder discards or intends or is required to discard...” This definition serves a regulatory purpose and allows for treatment and disposal processes to effectively prevent pollution and protect the environment. The Landfill Directive 1999/31/EC (European Parliament and Council Directive, 1999) introduced phased targets for reducing landfilling of biodegradable municipal waste ultimately to less than 35% of the bio degradable waste landfilled in 1995 by 2020, which has achieved some success in changing waste management practices (Fischer, 2011). The Waste Incineration Directive 2000/76/EC, covers particular types of waste treatment and disposal and other Directives, for example Waste Electrical and Electronic Equipment Directive 2002/96/EC; Waste Batteries and Accumulators Directive 2006/66/EC; and the End of Life Vehicles Directive 2000/53/EC have focused on single waste streams (Williams, 2005).

The Waste Duty of Care Regulation requires all waste transfers in the UK to be recorded from its origin to final disposal point, providing an auditable trail for waste movements. This data records the weight of waste, its origin and ultimate disposal or treatment routes. LAs

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report waste movements on a quarterly basis to Department for Environment, Food and Rural Affairs (Defra) via a web based spread sheet (WasteDataFlow), enabling Defra to report progress trends in waste generation, treatment and disposal. Recycling performance over time is also reported, with an annual “league table” issued showing the performance of individual LAs (Defra, 2013a). Data on waste generation trends is useful for design and operation of collection services, identifying recycling and composting opportunities, the point of waste generation and enabling comparisons between performances in different geographical areas.

### **National Waste Policy**

UK waste policy has for several years focussed primarily on increasing the amount of household waste collected for recycling and composting to ensure a reduction in landfill disposal. This led LAs to introduce separate collections for some recyclable household materials. The devolved Governments of Scotland, Wales and Northern Ireland have in recent years introduced far more ambitious waste policies than those set for England. Evolving waste policy in England recognises the importance of the Waste Hierarchy, highlighting the prevention of waste as well as reuse and recycling as key parts to achieving a zero waste economy, notably through Waste Prevention Programme for England (2013) (Defra, 2013) responding to The Roadmap to a Resource-Efficient Europe (European Commission, 2011). Waste policy also seeks to meet the targets set in the Landfill Directive 1991/31/EC and to improve the quality of recyclates collected from households and to improve market conditions for high quality recyclates. This change in emphasis to improve the quality of recovered materials follows the EU revised Waste Framework Directive 2008/98/EC, which made it compulsory to recycle four recyclable materials separately from household waste. The Waste (England and Wales) (Amendment) Regulations 2012 required waste collection authorities to collect waste paper, metal, plastic and glass separately. This

applies where separate collection is necessary to facilitate or improve recovery; and where it is technically, environmentally and economically practicable (“TEEP”). Alongside this, The Environmental Permitting (England and Wales) (Amendment) Regulations, 2014 introduces a requirement on material sorting facilities to carry out mandatory sampling of feedstock, aimed at improving the quality of recovered recyclable materials.

### **National Waste Strategies**

Waste management is a devolved responsibility in the UK; the devolved governments of Wales, Scotland and Northern Ireland have different strategies with progressively higher targets than the UK as a whole (which is to reuse, or recycle 50% of household waste by 2020, to meet the EU revised Waste Framework Directive (European Commission, 2008). However, all take account of the Waste Framework Directive’s Waste Hierarchy (Figure 2.2), with waste reduction, recovery of resources and potential energy in preference to using disposal at landfill sites.

### **English Waste Strategy**

The Waste Strategy for England, 2007 (Defra, 2007) increased targets set in previous strategies for English LAs to recycle and compost at least 50% of household waste. These targets and the increasing cost of landfill disposal due to the escalating Landfill Tax encouraged LAs to collect household materials separately for recycling and bio-treatment. Separate kerbside collections of common, easily recyclable materials (glass, metals, plastics, cardboard and paper) enabled UK LAs to achieve an average of 43% recycling in 2012/13 (Defra, 2013a). Annual amounts recycled since 2001/02 increased from 3.2 to 10.7 million tonnes in 2011/12. The additional separate collection of organic waste, garden and/or food waste by some LAs has achieved reductions in household waste disposal up to 69%, with 73 of the 352 English LAs recycling above 50% of the household waste they collect (Defra, 2013a).

### **Household Waste Management Performance in the UK**

In response to European waste and environmental legislation, the UK Government imposed recycling and composting targets on individual LAs, with Performance Indicators to monitor their performance. Best Value Performance Indicators (BVPIs) were introduced in 1999. These were replaced by National Indicators (NIs) between 2008 and 2011 (Audit Commission, 2011) with data collated in the same way by Defra (Dept for Communities & Government, 2011). The introduction of performance indicators improved dissemination of best waste management practices, contributing to a reduction in landfilled waste (Tebbutt Adams *et al.*, 2000) and introduced a competitive nature among some LAs whilst performance was target driven (Mee *et al.*, 2004).

Although National Indicators are no longer in use and LAs in England are not currently subject to individual recycling targets imposed by Central Government, the reporting mechanism remains unchanged, with LAs reporting waste weights through WasteDataFlow to Defra. This enables recycling performance over time to be tracked and comparisons are possible between current performance and previous years.

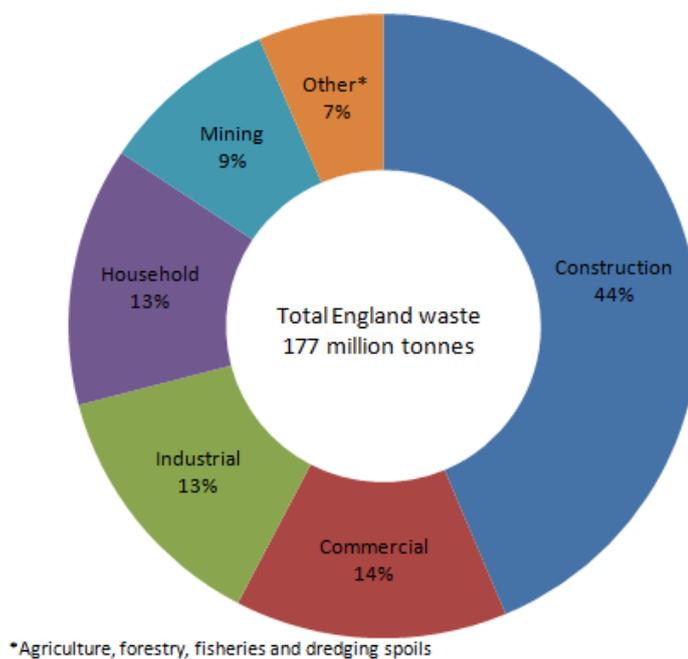
#### **2.2.1.2 Economic drivers**

Financial drivers such as Landfill Tax payments, an escalating tax (£80 per tonne for the year 2014/15), charged in addition to landfill operator's disposal fees, estimated on average to be a further £50/tonne. LATs, which were withdrawn in 2013, exposed LAs exceeding landfill disposal allowances to fines of £150 per tonne and resulted in accelerated waste reduction programmes and an increase in recycling performance among UK LAs (Mirata, 2004; Calaforn *et al.*, 2014). The application of these taxes provided incentives for LAs to encourage the separation of materials for recycling and composting (Costa *et al.*, 2010). The

improvement however, suggests costs rather than environmental reasons may provide the stronger incentive (Jamash and Nepal, 2010).

### 2.2.1.3 Social drivers

In England household waste makes up approximately 13% of all waste collected and treated in the UK each year, Figure 2.1 (Defra, 2013b). Whilst this is a small proportion of the waste generated, it is the fraction of the waste stream that is most visible to the majority of people (Barr, 2005; Martin *et al.*, 2006).



**Figure 2.1: The distribution of waste arising in England by the key sectors (Defra, 2013b).**

Public awareness and concern about environmental issues is reflected in the objectives of community waste projects, such as furniture reuse network, which serves social and environmental functions in the delivery of reuse and recycling projects (Curran and Williams, 2010, Ongondo *et al.*, 2013). This is in contrast to private sector companies where an increased commercial focus on environmental issues is used as a promotional or marketing tool (Luckin and Sharp, 2004) to meet consumer's demands for sustainable production and behaviours (Allwood *et al.*, 2011).

### 2.2.1.4 Environmental drivers

Concerns about energy and resource efficiency and the movement to reduce carbon emissions have influenced waste management practices (Allwood *et al.*, 2011). The Waste Hierarchy, introduced in the Waste Framework Directive, sets out the preferred order for treatment and disposal of waste, prioritising those that cause least environmental damage (Figure 2.2).



**Figure 2.2: The Waste Hierarchy (EU revised Waste Framework Directive, 2008).**

Managing waste treatment processes properly can lead to potential environmental improvements (Gentil *et al.*, 2011).

### 2.2.1.5 Technological drivers

Advances in household waste management methods and technologies and an awareness in climate change and carbon emissions have led to many changes in the management of household waste (Larsen and Astrup, 2011). This includes changes to collection methods, processing and treatment facilities where technologies are key to influencing waste management performance (Gentil *et al.*, 2011; Achillas *et al.*, 2011; Tunesi, 2011).

## 2.2.2 HOUSEHOLD WASTE GENERATION AND COMPOSITION

In 2009/10 English LAs collected 23.7 million tonnes of household waste, almost 40% of this was recycled or composted with landfill disposal was used for 12.5 million tonnes of the

remaining waste (Defra, 2010a). Waste arisings decreased to 22.9 million tonnes in 2011/12, a reduction of 3% since 2009/10, this trend is predicted to continue (Defra, 2013c) suggesting success from the waste reduction strategy, but equally could be a result of a decline in economic activity. The amount of household waste landfilled and the quantity of resources lost is still an issue (York *et al.*, 2004).

Waste composition analysis can establish variations in type and quantity of materials present in waste. This enables collections and waste treatment technologies to be tailored to suit waste arisings (Dangi *et al.*, 2011; Demirbas, 2011; Burnley, 2007) and allows recycling potential to be gauged (Dahlen and Lagerkvist, 2010).

Household waste composition studies in various parts of the UK found consistency in the proportion of materials present in waste analysed (Table 2.1). However, it should be noted that many of these studies were carried out before the widespread introduction of kerbside collections of recyclable materials. The organic fraction present is food and garden waste, paper and card; the non-organic fraction is mostly glass, metals and plastics (Burnley, 2007).

**Table 2-1: Household waste composition (Burnley, 2007).**

<b>Material</b>	<b>% present</b>
Kitchen and garden	35-38 %
Paper and cardboard	23-25 %
Plastics	8-10 %
Glass	6-7 %
Metals	3-5 %

Factors that affect the composition include seasonal variations, recycling levels, affluence, and the type of household, urban, rural area etc.

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### 2.2.3 HOUSEHOLD WASTE MANAGEMENT RESPONSIBILITIES

LAs have a statutory duty under The Environmental Protection Act, 1990 to collect and dispose of household waste. This responsibility is divided at a local level between Waste Collection Authorities (WCA), the District and Borough Councils and Waste Disposal Authorities (WDA), the County Councils. Unitary Authorities have the responsibility for both collection and disposal of household waste. In England there are 354 WCAs and 121 WDAs (of these, 81 are Unitary Authorities, responsible for both waste collection and disposal) (Defra, 2005).

Separating responsibility and costs for waste collection and disposal prevents holistic approaches to household waste management. Bulkeley *et al.* (2005) suggest this division is unhelpful and makes policy and operational functions separate with differing incentives. Waste Disposal Authorities procure disposal, treatment and recycling facilities for waste collections in which they have limited input (Harder and Woodward, 2007) however, some authorities work together on strategy and service to successfully deliver efficiencies and meet targets (Slater *et al.*, 2007).

A similar division of responsibility occurs at a national level between Defra, the Government Department responsible for waste policy, strategy and monitoring, whilst the Environment Agency (EA) is the UK Government Agency responsible for licensing and regulating waste collection and disposal (Table 2.2).

**Table 2-2: UK waste management responsibilities (Energy & Utility Skills, 2010).**

<b>Organisational responsibilities</b>	<b>Activities and jurisdiction</b>	<b>Role</b>	<b>Legislative Framework / Driver</b>
Department for Environment, Food & Rural Affairs (Defra)	Sets general waste policy and has monitoring and reporting role	Policy maker	Waste Framework Directive (revised 2008)
Environment Agency (EA)	Licences waste collection companies, waste carriers and waste disposal and treatment sites	General regulator	Environmental Protection Act (1990)
District / Borough Council	Responsible for collecting municipal solid waste and recycling	Waste Collection Authority	Environmental Protection Act (1990) sections 45,46-7, 49
County Council	Responsible for disposal of municipal solid waste collected by Waste Collection Authorities	Waste Disposal Authority	Environmental Protection Act (1990) section 51, Waste & Emissions Trading Act, 2003
Unitary / Metropolitan Borough Council	Responsible for collection and disposal of Municipal Solid Waste	Waste Collection & Disposal Authority	Environmental Protection Act (1990) sections 45,46-7, 49 & 51, Waste & Emissions Trading Act, 2003

## **2.2.4 HOUSEHOLD WASTE MANAGEMENT PRACTICES**

Household waste management practices vary widely across the country, and even between neighbouring LAs. Different approaches have been taken by LAs to the separation of recyclable materials, collection methods adopted and frequency of collection. This has resulted in varying levels of success in recovering recyclable materials from household waste (Defra, 2013a).

### **2.2.4.1 Waste Management system design**

A variety of different tools and methods have been researched and developed for designing the optimum household waste management system, including life cycle assessments (LCA) (den Boer *et al.*, 2007); adopting a systems approach (Seadon, 2010); environmental and economic modelling (Emery *et al.*, 2007); and measuring carbon impacts (Muhle *et al.*, 2010). Approaching the interlinked operations of waste generation, collection and disposal to

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achieve a balanced approach requires planning, cooperation between the different organisations responsible for the activities (Slater *et al.*, 2007).

#### **2.2.4.2 Source separation of recyclable materials**

There is a consensus in the literature that source separation is critical to meet the target of 50% recycling of household waste by 2020 (Barr and Gilg, 2005; Dahlén and Lagerkvist, 2010). It is generally easy to obtain the involvement of the aware and informed householders but even in the best performing areas about 20% of households do not use the recycling collection service (Harder and Woodward, 2007). One generally reported factor is collection complexity, simpler and more convenient collection systems get better householder participation (Woodward *et al.*, 2005; Read, 1999; Barr and Gilg, 2005). For example, Barr and Gilg (2005) found that householders were confused when asked to separate materials into different containers and consequently produced more residual waste. Similarly, Oom do Valle *et al.* (2004) argued that collection services with many different containers had lower participation rates. Martin *et al.* (2006) reported collection schemes limited to two containers, one for recyclates and one for waste, were more popular with residents than those with multiple containers.

The 10 LAs in England with the highest recycling rates in 2007 used fortnightly rather than weekly collections and achieved 30% more separation (LGA, 2007). This was corroborated in data from McLeod and Cherrett (2008) who measured a 20% shift from residual waste into recycling following a change to fortnightly collections with separated garden waste. Availability of centralised separation, treatment methods and appropriate vehicles, influences the type of householder separation used (ICE, 2011; Eriksson *et al.*, 2005). Additionally, housing types (Muhle *et al.*, 2010), population density (Emery *et al.*, 2007), and available waste infrastructure can all affect the design of waste collections.

Traditional weekly collections of household waste for landfill disposal have changed to several collection rounds for different materials; sometimes on different timescales. The most common practice is alternate weekly collection of recyclables and residual waste (Watson and Bulkeley, 2005). Waste Collection Authorities are required to collect separately at least two materials for recycling unless “costs are unreasonably high or comparable alternative arrangements are available” to comply with the Household Waste Recycling Act, 2003. This allows LAs to choose between low technology solutions (source separation by householders) or high tech solutions (mechanical separation of mixed materials) (Shaw *et al.*, 2006). All English LAs now offer some form of kerbside collection for dry recycling (WRAP, 2009b), with the door to door collection system delivering higher recovery rates than other methods, such as bring banks and centralised communal recycling points (Iriarte *et al.*, 2009). The frequency and container size, for recycling can vary; however, reliability, convenience, and cost are determinant factors (Woodward *et al.*, 2005).

#### **2.2.4.3 Collection methods**

Environmental, social, governmental and fiscal pressures have led to a range of measures being introduced that have impacted on the way LAs collect household waste. These include recycling targets, the introduction of separate kerbside collections for recyclable materials, and organic waste for composting or anaerobic digestion alongside collections of residual waste for treatment or landfill disposal together with education programmes for householders to encourage recycling (WRAP, 2009a; LGA, 2013).

The move towards more sustainable household waste management, with waste increasingly seen as a resource has seen widespread changes in household waste collection methods with significant variations in collection systems now existing across the UK (Muhle *et al.*, 2010;

Emery *et al.*, 2007). Some LAs simply comply with legislation and offer separate collections of four types recyclable materials; while others collect waste from up to nine containers.

Many different studies have been carried out comparing the variety of different household waste collection schemes including system cost, frequency of collection, different materials collected for recycling, container type, the amount of source separation the householder is asked to carry out and the yield and quality of recyclates collected (Tanskanen, 2001; Tucker *et al.*, 2001; Wilson and Williams, 2007; WRAP, 2010a; WYG Environment, 2010).

Noehammer and Byer (1997) noted nine design variables for household waste collection schemes (Table 2.3), these impact on cost, participation and performance to varying degrees. Collection services with complex sorting processes had lower participation rates (Oom de Valle, 2004); binary sorting, simply separating recyclable materials from residual waste has been found to be consistently more popular than multiple sorting (Martin *et al.*, 2006).

**Table 2-3: Design variables for kerbside recycling collection schemes (Adapted from Noehammer and Byer, 1997 and expanded).**

Design variable	Notes and implications
Status : mandatory or voluntary	With mandatory schemes fines may be imposed as an incentive to recycle. Status may be constrained or defined in legislation (1)
Materials collected	May be prescribed by legislation, e.g. in England and Wales at least two material types must be collected at the kerbside (2)
Number of segregations	The requirement of householders to segregate materials into type or segregated from non-targeted materials and mixed in a container separate from residual waste
Provision of collection container	May include a financial factor through charges for provision of specified container
Collection frequency	Increases in frequency of collection may increase costs
Collection day	Collection of recyclable and residual materials on the same day may reduce collection costs (mainly if the same collection vehicle is used for both waste streams, with delivery to separate treatment/disposal sites) (3)
Collection vehicle type	Vehicle type may be limited by container or vice versa
Education programme	Provision or non-provision – mode of delivery is a key factor.
Financial incentives	Incentives may be rewards or penalties.

(1) Environmental Protection Act, 1990; Price, 2001

(2) Household Waste and Recycling Act, 2003

(3) Lyas *et al.*, 2004, Lyas *et al.*, 2005; Shaw and Maynard, 2008.

The majority of UK LAs operate separate collections of recyclates and residual waste (APSE, 2013). However, this increases the complexity of waste collection from one container to several collections of multiple materials; often working to different timescales (i.e. alternate weeks). The success of these separations is increasingly dependent on co-operation from householders (Watson and Bulkeley, 2005). Jenkins *et al.*, (2003) found LAs that provided households with a kerbside collection rather than relying on householders to take recyclable materials to a specified collection point achieved twice as much recycling (by weight), whilst Dahlen and Lagerkvist (2010) found that fewer recyclable items were left in residual waste in areas where households received kerbside recycling collections.

### **2.2.5 HOUSEHOLD WASTE RECYCLING BEHAVIOUR**

A well operated household waste collection system can have a considerable impact on increasing recycling levels (Barr and Gilg, 2005), but for this to be successful householders need to engage in the process (Shaw *et al.*, 2007). The collection and segregation of household waste has two main parties, the householder and the LA and the success, or otherwise, of a kerbside collection service can be dependent on this householder / collection interface, where there is a complex mix of situational and personal behaviour patterns.

It is also important to take into account the socio-economic conditions of any group expected to participate (Matsumoto, 2011). More affluent areas often see higher levels of environmental awareness and are therefore more willing to engage in recycling activities (Dresner and Ekins, 2010; Martin *et al.*, 2006) this is evidenced by lower yields of recycling associated with areas of higher deprivation (WRAP, 2010b). Around 25% of the variation on LA recycling performance is due to the socio-demographic characteristics of the local area and population such as population density and deprivation levels (WRAP, 2009a). Additionally, self-declared participation rates for recycling show the 25-44 years age group

are the least likely to engage in recycling activities, probably because of lack of time (Williams and Kelly, 2003).

Separating waste for recycling is a step which some householders are not prepared to undertake, yet their behaviour and resulting performance are necessary to reach challenging targets (Bulkeley *et al.*, 2005). This is a problem, without incentives for householders to take part in recycling schemes. There is no legislative mechanism currently in place to charge householders variable amounts depending on how much waste they generate (Dresner and Ekins, 2010). Penalties for non-participation have also been suggested (Wilson and Williams, 2007).

Establishing certain behaviour patterns in transient populations such as military and student groups can also be challenging (Zhang *et al.*, 2011). Targeted strategies which are aimed at specific areas and groups, primarily focusing on providing instructions on how, what, and where to recycle can result in greater success rates (Purcell and Magette, 2010; Smyth *et al.*, 2010; Best and Kneip, 2011).

Changing behaviour to more sustainable patterns remains one of the biggest waste management challenges (Price, 2001). This requires raising awareness in waste prevention and reuse and providing information on a wider range of sustainable actions rather than concentrating on recycling. However, funding for awareness schemes is now under significant threat due to the continued reductions in Local Government spending and because the impact of these activities is very difficult to monitor (Read *et al.*, 2009).

### **2.2.6 HOUSEHOLDER RECYCLING INITIATIVES**

Participation and interest in recycling schemes can be impacted by a variety of factors, situational factors, behavioural intentions and psychological variables (Schultz *et al.*, 1995; Barr, 2004). These include demographic differences, access to facilities, convenience of collection, adequate knowledge and expertise to carry out what is being asked, environmental concerns, understanding the consequences or benefits of actions (Tonglet *et al.*, 2004a; Davis *et al.*, 2006; Hansmann *et al.*, 2006;).

Collection services designed to suit property types produced higher levels of recycling (Wilson and Williams, 2007). For example, available space might preclude large multiple containers for some households (Tucker *et al.*, 2001; Barr and Gilg, 2005), therefore, the use of smaller containers (bags or boxes) for those with limited storage space increased participation in apartment blocks (Barr and Gilg, 2005; den Boer *et al.*, 2007).

The types and number of materials collected by particular schemes was also found to have an influence on participation levels (Woodward *et al.*, 2006). Previous work also noted an influence from frequency of collections, LAs reducing collections of residual waste to fortnightly from weekly achieved more recycling (WRAP, 2009b). This study suggested that the reduced collection frequency forced householders to manage their waste by recycling.

Raising awareness of recycling schemes was found to have a positive impact on performance. Several methods have been used to change behaviour and improve participation (Timlett and Williams, 2008). Woodward *et al.*, 2001 found that interaction with householders through a public consultation exercise and education activities provided by the LA resulted in a more successful recycling scheme. Likewise, a variety of marketing strategies in addition to the commonly used leaflet drops and newspaper adverts prompted

some increase in participation levels (Read, 1999) and it is suggested that standard communications strategies are adopted (Mee *et al.*, 2004), with recycling messages repeated on a regular basis to reinforce messages and prevent a decline in participation levels (Woodward *et al.*, 2005). A similar strategy was suggested by Sidique *et al.* (2010) to increase recycling via drop-off recycling points.

It is possible to achieve some short-term success in altering behaviour by introducing incentive based schemes, offering rewards for participation (Timlett and Williams, 2008). However, behaviour changes established using these methods is not maintained long-term if the reward is removed (Kaplowitz *et al.*, 2009). With administrative and financial costs to such schemes it has been suggested that the priority for enhancing recycling should therefore be to improve infrastructure and support for kerbside schemes (Shaw and Maynard, 2007).

### **2.2.7 HOUSEHOLD WASTE REDUCTION**

There are several elements to waste reduction from an LA perspective, these are: preventing and/or reducing the generation of waste at source and encouraging re-use, recycling and recovery (Singh *et al.*, 2014). Waste management should focus on limiting the impact of waste on the environment and reducing waste arisings (Demirbas, 2011).

It is a challenge at LA level to realise the priority position that waste reduction has in the EU Waste Framework Directive, with local waste policies often biased towards recycling and disposal (Mazzanti and Zoboli 2008; Tudor *et al.*, 2011). Reducing household waste at source involves a greater behaviour change than participation in recycling activities. It is not one behaviour, but many different behaviours (Cox *et al.*, 2010), requiring different

strategies and messages at two different events, the point of purchase and the point of discarding to encourage reuse or repair (Tonglet *et al.*, 2004b).

Various initiatives operate nationally, which target either particular waste streams, either by material, by product or at source, or target different groups such as retailers or householders, with examples of both high technology and low technology. Low cost waste reduction activities that can result in a reduction in the weight of waste entering the waste management system (Sharp *et al.*, 2010). These include targeting a reduction in the use of advertising material (junk mail), packaging materials, nappies, food waste, either through changing purchasing habits or consumer's use patterns (Cox *et al.*, 2010). Each initiative requires a different approach, with consumers unwilling to reduce personal consumption as they are often unable to see links between waste and their purchasing habits (Salhofer *et al.*, 2008). One example of a waste reduction initiative is a national education programme; "Love Food Hate Waste". This was initiated by Waste Resource Action Programme (WRAP). With 35-38% of household residual waste being organic waste, the prevention of food waste offers important environmental benefits (Gentil *et al.*, 2011), this programme aims to reduce food waste by educating the public about the correct storage of food, menu planning and using left-over ingredients (WRAP, 2013). However, there is little quantitative data available regarding performance (Salhofer *et al.*, 2008). It is also difficult to monitor the success of waste reduction activities (Read *et al.*, 2009) "how do you measure something that isn't there?" (Zorpas and Lasaridi, 2013), since measuring the change against a moving trend is difficult.

### **2.3 ZERO WASTE CONCEPT**

Zero Waste was a visionary concept for addressing waste problems, involving many different strategies developed for sustainable management of waste; these include waste reduction, repair, reuse and recycling (Welsh Assembly Govt., 2010). Zero waste focuses on production and distribution systems to reduce waste (Young *et al.*, 2010), recognising the distinction between waste and resource as being crucial in identifying the most appropriate options for treating and disposing of waste. A Zero Waste philosophy is an aspirational goal providing guiding principles to work towards the elimination of waste (Snow and Dickinson, 2001; Zaman and Lehmann, 2011).

Many developed countries including USA, Canada, Australia, Lebanon, Taiwan and China are using a Zero Waste concept to change current waste management practices to more sustainable methods of managing waste, including household waste (Greyson, 2007). The concept includes waste prevention; high levels of recycling and recovery of all resources from waste; and behavioural change (Townend, 2010).

The devolved Governments of Scotland, Wales and Northern Ireland are leading the movement towards Zero Waste in the UK, with published strategies targeting Zero Waste and improved resource management (Scottish Government, 2010; Welsh Assembly Government, 2010; DoENI, 2006). Moving towards Zero Waste will require industry and Government involvement, with industry controls on product and packaging design, manufacturing processes, and material selection (Townend, 2010) and Governments assistance in the development of waste management strategies which seek to eliminate waste rather than manage it (Snow and Dickinson, 2001).

## 2.4 GAP ANALYSIS

Previous research assessing LA household waste management has largely focused on:

- Household waste collection methods (Erikson *et al.*, 2005; Emery *et al.*, 2007; Muhle *et al.*, 2010).
- Waste Management system design (Noehammer and Byer, 1997; den Boer *et al.*, 2007; Emery *et al.*, 2007; Seadon, 2010).
- Recycling performance (Tebbatt Adams *et al.*, 2000; Mee *et al.*, 2004)
- Waste generation and waste composition (Burnley, 2007; Dahlen and Lagerkvist, 2010; Dangi *et al.*, 2011; Demirbas, 2011).
- Segregation of waste (Tanskanen, 2001; Tucker *et al.*, 2001; Wilson and Williams, 2007).
- Participation in recycling collections (Schulz *et al.*, 1995; Barr, 2004; WRAP, 2009a).
- Awareness and recycling behaviour of householders (Martin *et al.*, 2006; Dresner and Ekins, 2010; Matsumoto, 2011).

Examining these areas reveals that there are both challenges and opportunities for LAs that seek to improve household waste management performance. Adopting a Zero Waste approach is an aspirational target in this process. However, to date, little research has been conducted in this area. There is a significant lack of case study material and only limited material that providing guidance as to how to adopt this approach in England without the legislative framework that is being developed by the devolved Governments of Scotland and Wales.

This research has used a single case study approach to address the lack of knowledge outlined above. The work has focused on a broad range of areas to have impact and to meet

the sponsoring organisation's needs. The aim was to identify suitable processes and address the human factors that govern user acceptance. Various research methods were adopted which included questionnaire surveys, archival analysis and focus groups.

## **2.5 SUMMARY**

The literature review has demonstrated the complicated interactions that exist within the waste management process by providing an overview of relevant research that has been conducted primarily researching household waste management practices in the UK. This has provided an understanding of drivers for change, waste generation and composition, waste management system design, collection methods, recycling performance, recycling awareness and participation and challenges and barriers to improving the sustainability of household waste management.

It appears difficult to reduce household waste generation completely in the current economic and political climate. It is, therefore, important to decide how household waste should be treated in the least costly ways, both financially and environmentally. The Waste Hierarchy provides guidance, setting out treatment and disposal methods in order of environmental impact. Despite progress in household waste management practices, waste policy remains a challenge, with the individual UK Governments all taking differing approaches. The most sustainable solutions require a combination of regulatory interventions and social norms.

To further increase recycling rates LAs must ensure some progress towards full recovery of all recyclable materials by changing behaviour patterns, engaging non-recyclers and improving the quantity of waste recycled by people already participating. Additionally, the difficult area of waste prevention needs addressing. With various target groups, target waste

streams and different messages this requires specialist communications involving a wide group of stakeholders. It is difficult to see how this will happen without legislation, individually imposed targets or funding opportunities that encourage innovation and improved environmental performance. The development of a ZWS for CBC will see these areas being addressed, with the benefit of local context and stakeholder input from this research project.

The next chapter reviews a range of research methodologies and outlines the adopted methodological approach for this research along with justification for this selection.

### **3 CHAPTER 3 – RESEARCH METHODOLOGY**

#### **3.1 INTRODUCTION**

This Chapter reviews a range of research methodologies available to address the research objectives and outlines the adopted methodology and provides justification for their selection.

#### **3.2 RESEARCH STRATEGY**

A successful outcome from research is critically dependant on the appropriate selection of research methods (Fellows and Lui, 2008). A typical research strategy has to take into account theory and previous work to provide a research framework for the collection and analysis of new data, with the choice of methods varying according to the nature of the research problem. This section explains the difference between quantitative, qualitative and mixed methods approaches.

##### **3.2.1 QUANTITATIVE RESEARCH METHOD**

Quantitative research follows a deductive approach, starting with a theory and testing its implications with data, moving from a general level to a specific level. Using data in the form of numerical information and analysing it to investigate relationships between and how these sit with respect to previously published research (Fellows and Lui, 2008).

Often statistical methods are used to find relationships between variables in the process of testing a hypothesis. This statistical analysis can be used in two ways; reliability summarising data, averages, totals, ranges, deviation etc. and inferential statistics which suggest the extent of the correlation, association significance, probability etc. (Gillham, 2000). Quantitative research can also be used to assess behaviour by using questionnaires and surveys to produce a numerical description of trends, attitudes or opinions by studying a

sample of a population (Creswell, 2009). The three main approaches to gathering quantitative data are questionnaires and surveys, conducting experiments or desktop research using existing archived data (Cresswell, 2009). Questionnaires can be either self-administered or researcher administered, the latter generally having a higher response rate and having the advantage of a researcher present to clarify questions for respondents (Mitchell and Jolley, 2001).

Quantitative research relies on the quality of data collected (Teddlie & Tashakkori 2009); ideally data collection can be repeatable and include a control to assess the reliability of measurements. The main disadvantage of quantitative methods is that whilst they can highlight patterns in data, they may not be able to explain them. For example, it may be difficult to derive a causal relationship among variables using a classical statistical model.

### **3.2.2 QUALITATIVE RESEARCH METHODS**

Qualitative methods gather data investigating beliefs, understanding, opinions and actions (Gillham, 2000) and forms an interpretation of narrative information (Teddlie & Tashakkori, 2009); attempting to understand people's perceptions of the world (Fellows and Lui, 2008). Analysis of qualitative data may involve transcribing interviews, or analysing the content of conversations and many variables exist (Fellows and Lui, 2008). Qualitative data collection methods include document analysis, archival analysis interviews, observations and audio-visual material analysis.

Using qualitative methods provides rich data with deeper insight, but produces results of a subjective nature, using small sample sizes. Qualitative data can be unstructured and analysis may be difficult (Fellows & Lui, 2008).

### 3.2.3 COMBINED / TRIANGULATION METHODS

Qualitative and quantitative research are quite different approaches to research, but McQueen and Knussen (2002) suggest they are different ends of the same dimension with numerical data at one extreme and qualitative descriptive data at the other end (Figure 3.1).

Qualitative research      Mixed methods research      Quantitative research



**Figure 3.1: Representation of qualitative, quantitative and mixed methods research.**

In many areas of social science there is no clear predominance of qualitative or quantitative methods, the two strategies are often combined, referred to as “triangulation”, to form a mixed methods approach (Blumberg *et al*, 2005). The differences between quantitative, qualitative and mixed methods approaches are presented in Table 3.1.

**Table 3-1: Differences between the three research methodologies, quantitative, qualitative and mixed methods research (Adapted from Teddlie and Tashakkori, 2009).**

	<b>Qualitative research</b>	<b>Quantitative research</b>	<b>Mixed methods research</b>
<b>Research questions</b>	Qualitative research questions	Quantitative research questions, research hypotheses	Mixed method research questions (quantitative & qualitative)
<b>Form of data</b>	Typically narrative	Typically numeric	Narrative & numeric
<b>Purpose of research</b>	(Often) exploratory plus confirmatory	(Often) confirmatory plus exploratory	Confirmatory plus exploratory
<b>Data analysis</b>	Thematic strategies: categorical and contextualising	Statistical analyses: descriptive and inferential	Integration of thematic and statistical; data conversion
<b>Validity / trustworthiness issues</b>	Trustworthiness; credibility; transferability	Internal validity; external validity	Inference quality; inference transferability

A mixed methods approach uses the most suitable methodological tool to answer a research question, whether this is a quantitative or qualitative method. Findings are presented in both numerical and narrative formats; integrating, linking and connecting the research rather than reporting two distinct strands of research (Teddlie and Tashakkori, 2009).

### **3.3 METHODOLOGICAL CONSIDERATIONS**

This section explains how the research methodology was selected. Chapter 1 sets out the aim of the research and the four objectives set to meet that aim. Research methods were chosen that were best suited for data collection and analysis to meet those objectives. Figure 3.2 maps the objectives, adopted research methods and the outputs generated.

In the process of addressing each objective the most appropriate method for that task was chosen. Quantitative methods were used, for example evaluating the performance of the case study from historic data relating to patterns of waste generation and recycling yield. Statistical analysis of this data produces a track record of performance. Qualitative methods were adopted, for example using focus groups for the development of a ZWS and questionnaires to establish current household waste management practices.

On the basis that both quantitative and qualitative approaches were suited to some parts of the research a mixed methods approach was adopted (Fellows and Lui, 2008). It was at this stage that other research methods such as controlled experimental research (treatment laboratory analysis) were excluded from the methods.

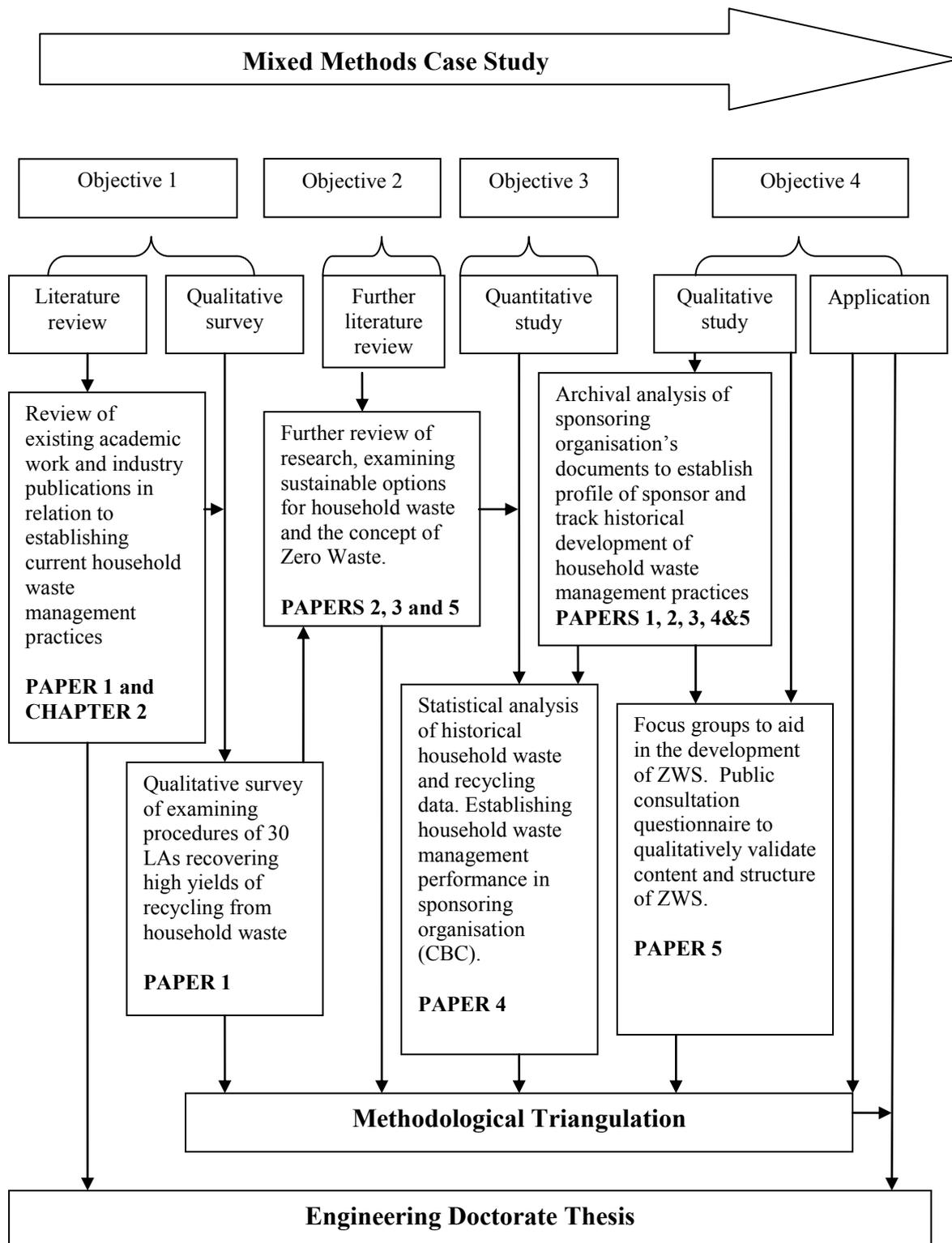


Figure 3.2: Research methods adopted and links to published papers.

### **3.4 ADOPTED RESEARCH METHODS**

This research takes a single case study approach using archival analysis, questionnaire surveys, and focus groups. A single case study is appropriate methodology when an in-depth holistic investigation is required (Feagin, Orum and Sjoberg, 1991) offering the opportunity to obtain information from multiple sources of data. One criticism is that a single case study then lacks generality (Flyvbjerg, 2006); and wider application. However, Yin (2009) suggests that there are also advantages from the use of a mixed methods approach from providing the opportunity for greater insights into the underpinning principles as opposed to sample size dependant statistics. A single case study allows in-depth data collection from multiple sources that can be analysed with other data from the same study. The best aspects of data collection can be replicated with other cases and used as a basis for later comparison. It was therefore concluded that a detailed single case study approach was more appropriate for academic study where the goal was to expand and consolidate theories (analytic generalisation).

The single case study approach enabled in depth study of the sponsoring organisation, using data that would not have been accessible outside the arrangement offered by the EngD. Collecting and analysing data relating to the sponsor offered the opportunity to demonstrate evidence of causal relations between interventions and behaviour change (Appendix D, Paper 4). This offered the opportunity to modify and trial more innovative tailored to suit the sponsor and its own particular circumstances (Appendix E, Paper 5) this may not have been possible in a multiple case study using a larger sample size.

Table 3.2 summarises the decision making process used in selecting the mixture of methods used.

**Table 3-2: Analysis of different research methods available (Adapted from Yin, 2009; Mitchell & Jolley, 2001; Teddlie & Tashakkori, 2009).**

<b>Research techniques</b>	<b>Strengths</b>	<b>Weaknesses</b>	<b>Reason chosen</b>
<b>Single case study</b>	<p>Holistic approach to one “subject”</p> <p>Evidence gathered from multiple sources</p> <p>Allows in depth examination of the organisation</p> <p>Source of rich information</p> <p>Offer insights that cannot be obtained with other research methods</p> <p>Offers the possibility of comparison with a similar “case”</p> <p>Combination of data collection methods used</p>	<p>Analysis of data sometimes difficult</p> <p>Interpretation of data in a replicable way</p> <p>Loss of impartiality</p> <p>Data difficult and time consuming to analyse</p>	<p>Sponsoring company willing and “captive” group</p> <p>Access to multiple types of data regarding subject organisation, including some which is not in the public domain</p> <p>Ability to explore other local authorities working practices in a similar way in order to compare and contrast methods.</p>
<b>Archival analysis</b>	<p>Data has already been collected</p> <p>Possible to study subject over a long time span</p> <p>Comparative studies with past and present possible</p> <p>Access to previously closed information held by the sponsoring company</p> <p>Inform if there are differences between policy and practice in the organisation</p>	<p>Historical data – may not be fully up to date or may use different measuring / testing systems</p> <p>Secondary data sets which may not be in an easy to use format having been gathered for a different purpose originally</p> <p>May not have asked the question you want answering</p>	<p>EngD research in an industrial context – allowing project to be set in context for the sponsor</p>

DEVELOPING SUSTAINABLE HOUSEHOLD WASTE MANAGEMENT – A LOCAL AUTHORITY APPROACH TO ZERO WASTE

<b>Research techniques</b>	<b>Strengths</b>	<b>Weaknesses</b>	<b>Reason chosen</b>
<p><b>Questionnaire Survey</b></p> <p><b>(Public consultation exercise)</b></p>	<p>Low cost</p> <p>Minimal Resources</p> <p>Allows larger sample group to be studied</p> <p>Allows lots of questions to be asked</p> <p>Can be used in combination with other methods</p> <p>Can be distributed in a variety of ways to increase participation (post, online, in person)</p>	<p>Limited in amount of detail provided</p> <p>Potential for bias in self reporting behaviour studies</p> <p>Misunderstanding the wording of questions</p> <p>Fixed in one point in time</p>	<p>Established practice within the sponsoring organisation</p> <p>Low cost – easy to deliver to target group</p> <p>Allowed questions to be put to LAs in locations across England</p> <p>Allowed access to questions regarding the draft Zero Waste Strategy by a wide range of stakeholders</p>
<p><b>Focus Groups</b></p>	<p>Adaptable - Stand-alone method or used to supplement other research methods</p> <p>Produce lots of data if managed successfully</p>	<p>Recruitment of participants to produce representative body</p> <p>Transcription and analysis of data may be time consuming</p> <p>Participants can withhold or provide information that is “expected”</p>	<p>Sponsoring company using workshop/focus group as part of established practice</p>

Table 1.1 (Chapter 1) shows the research objectives aligned with research methods and outputs and is reproduced here as Table 3.3.

**Table 3-3: Research objectives aligned with methods and outputs.**

<b>Research Objectives</b>	<b>Research method</b>	<b>Research output</b>
1. Examine current household waste management practices.	Literature review	Chapter 2
	Questionnaire Survey*	Paper 1
2. Assess sustainable options for household waste streams.	Literature review	Paper 2
		Paper 3
3. Evaluate current household waste management performance in Charnwood Borough.	Archival analysis	Paper 4
	Statistical analysis	
	Questionnaire Survey*	
4. Develop and validate a ZWS for CBC.	Focus groups	Paper 5
	Public consultation questionnaire survey	The ZWS for CBC (2012-2024) adopted by CBC Chapters 3,4 & 5

\* Questionnaire Survey – Industry survey exploring household waste collection practices and policy issues of 30 English LAs.

### **3.4.1 CASE STUDY RESEARCH**

Case study research uses a representative “case” to demonstrate generalised findings in a topic, often using multiple methods to gather evidence such as interviews and observations (Yin 2009, Fellows and Liu 2008, Brewton and Millward 2001). The Engineering doctorate programme enables the researcher to become embedded in the sponsoring organisation. The researcher then has access to case and field data not normally available in an academic or public environment, making case study research particularly applicable. The aim in this case was to improve household waste management performance in Charnwood Borough and assist the Council with its aspirations to be a Zero Waste Borough.

Case study research has previously used both quantitative and qualitative methods, this is also sometimes termed “triangulation” (Fellows & Lui, 2008; Teddlie and Tashakkori, 2009) and uses multiple sources of evidence (Yin, 2009). The data collection for this case study research involved a variety of both quantitative and qualitative methodologies and was typical of the standard procedures for case studies (Yin 2009). These included archived LA documents and data, focus groups and questionnaires.

The main advantage of case study research is its rich documentation. It was also possible with the case study to compare CBC performance in recycling with other LAs using the same indicators, again accessing information not in the public domain. The disadvantage of a case study is the amount of information and complex analysis required (Berg and Latin, 2008).

### **3.4.2 LITERATURE REVIEW**

The purpose of the literature review was to establish what was already known in the subject area (Cresswell, 2009). In addition, it informed how data has been collected and analysed (Bryman and Bell, 2007).

The initial literature review was largely conducted from previous academic journal and Government publications and is presented in Chapter 2; the wider literature review examined sustainable options for household waste, identifying examples of Best Practice, which may be adopted by the sponsor and also to understand what had been done to support the concept of Zero Waste. In addition to academic publications this used industry and non-academic sources. This work is presented in the introductory sections of the published papers, particularly papers 2, 3 and 5 (Appendices B, C and E).

The literature review examined drivers for change, household waste generation and composition, household waste management responsibilities, household waste management practices, household waste recycling behaviour, household waste reduction and the concept of Zero Waste. This gave the opportunity to review previous academic research relevant to this EngD. Comparing approaches taken by other academics made it possible to identify the gap in knowledge, refine the research and identify suitable research methods, whilst also acknowledging there are numerous other methodologies that could be adopted.

### **3.4.3 QUESTIONNAIRE SURVEY**

Surveys are a method of statistical sampling (Fellows and Lui, 2008) which produce a numerical description of trends, attitudes or opinions of a population by studying a population sample (Creswell, 2009). The term survey covers a number of different research methods, for the purpose of this research a Questionnaire Survey was prepared, this is included as Appendix F.

The sponsoring LA, CBC was placed 121<sup>st</sup> out of 325 LAs in the Defra league table for the overall percentage of household waste that is reused, recycled or composted at the start of the research period (2009/10) (Defra, 2010b). However, when the performance is concentrated on the element of household waste that is reused or recycled only, excluding the organic household waste fraction that is collected for bio-treatment, then CBC appears at 28<sup>th</sup> place in the league table. The survey was therefore limited to the top 30 performing recycling LAs. This concentrates only on the LAs that were outperforming, or matching the performance of CBC, when the known influence of organic waste is excluded. These comparative LAs were identified using Defra's national WasteDataFlow data set for 2009/2010 and are listed in Table 3.4.

**Table 3-4 - Top 30 performing recycling Local Authorities 2009/10 (WasteDataFlow, 2010).**

<b>Local Authority</b>	<b>% of household waste collected for recycling</b>
Leicester City Council	38.26
South Oxfordshire District Council	35.51
Bournemouth Borough Council	35.38
Newcastle-upon-Tyne City Council MBC	34.29
Mid Sussex District Council	34.16
City of London	33.89
Uttlesford District Council	33.80
Blackburn with Darwen Borough Council	33.17
South Kesteven District Council (Lincolnshire)	33.12
Swindon Borough Council	33.01
Waverley Borough Council (Godalming - Surrey)	32.54
Worcester City Council	32.54
Mole Valley District Council (Dorking - Surrey)	32.20
Wychavon District Council (Persore Wores)	32.08
Surrey Heath Borough Council (Camberley, Surrey)	32.01
Adur District Council	31.95
Woking Borough Council (Surrey)	31.92
South Holland District Council (Spalding)	31.88
Chichester District Council (West Sussex)	31.85
East Hampshire District Council - Petersfield Hants	31.74
Rutland County Council	31.40
Walsall MBC	31.36
Guildford Borough Council	31.02
Richmond upon Thames	30.27
Central Bedfordshire	30.10
Royal Borough of Kingston upon Thames	30.06
Mid Suffolk District Council	29.96
Charnwood Borough Council	29.94
Milton Keynes Council	29.89
Eastleigh Borough Council	29.87

The questionnaire (Appendix F) specifically investigated operational aspects of household waste and recycling collections, to identify any common approaches, such as the frequency of collections, types and number of materials collected for recycling, the number of

containers issued to households and the degree of separation LAs required from householders. In addition to this, charging policies for the collection of organic and bulky waste were investigated. The questionnaire used both open and closed questions. The open questions enabled respondents to provide detail and their own thoughts without undue influence.

The survey was conducted by email and a high response rate was achieved, with all surveys completed and returned. Data analysis was undertaken using Excel and its standard statistical functions, the results were reported in Paper 1 (Appendix A). The results provided comparisons similarities and differences, and identified areas for further research, along with changes to the methodology.

### **3.4.4 ARCHIVAL ANALYSIS**

Archival analysis took place at various stages of the research. This provided essential information regarding the research topic and also informed the planning of further research.

#### **3.4.4.1 Examine current household waste management practices**

Alongside the survey of the top performing recycling LAs, geographical and demographic information for each LA area was investigated to establish the following:

- Type of LA and its waste responsibilities (WCA, WDA or Unitary).
- Geographical location.
- Deprivation levels found on the Index of Multiple Deprivations (IMD).
- Type of LA according to the Defra classification (urban/rural).
- Size of population and population density.
- Whether a major university was located in the area.

This investigation was carried out to establish if any patterns or relationships existed that explain why these areas achieved higher yields of dry recyclates from their household waste collections.

#### **3.4.4.2 Evaluate current household waste management performance in Charnwood Borough**

Based on this UK survey it was then possible to investigate the working practices at CBC. The key data for this investigation were historical waste collection figures available from the National data base, WasteDataFlow. Seven years information was reviewed and a timeline showing the changes to household waste and recycling collection service produced. CBC archived documents including the minutes of Council Committee Meetings, internal and external council reports, performance indicators were used to identify the dates of the changes. Reviewing the wide range of archived documents available enabled corroboration of the dates and the strategies, policies and thinking promoting the change. Secondary data was also reviewed including Census information, WasteDataFlow, Defra Local Authority Classifications and Index of Multiple Deprivation (IMD). This was used to augment and corroborate data examined from other sources in producing the case study, which is presented in Paper 1 (Appendix A), but also forms a starting point for the work reported in Papers 2 and 3 (Appendices B and C).

Statistical analysis of CBC's household waste data was undertaken using a time series model to investigate trends in waste generation. This novel application of the model was used to assess the impact of a series of amendments made to the way waste was segregated and sorted by householders. These were then identified on the timeline previously mentioned. This level of statistical analysis enabled both the reliability of the data (descriptive statistics) and the uncertainty in the conclusions, referred to as inferential statistics (Fellow and Liu,

2008). Statistical analysis in this study was undertaken using SPSS (statistical software package) and a time series model as outlined in Paper 4 (Appendix D).

Additionally, archival analysis was undertaken investigating the household waste management practices of Newcastle-under-Lyme Borough Council (NBC), a similarly sized LA in the West Midlands of England with comparable demographics to CBC. This focused in particular on the separate collection for food waste. The research explored how a similar separate food waste collection could improve the sustainability of CBC's waste collections by using the past performance of the food waste service in NBC to project the possible impact onto CBC's recycling performance Paper 3 (Appendix C).

### **3.4.5 FOCUS GROUP**

Focus Groups are described as “a group discussion organised for research purposes, guided, monitored and recorded by the facilitator” (Gill et al., 2008). They consist of a planned series of discussions with the aim of getting closer to the participants' understanding and perspectives on a defined area of interest (Calder, 1997; Brewerton and Millward, 2001; Massey, 2011). This research method was used to obtain stakeholder's views on the Zero Waste concept and to provide direction during the development stages of a ZWS for the sponsoring LA.

Following procedures outlining the LA's decision making, consultation, overview and scrutiny processes set out in CBC's Constitution (Charnwood Borough Council, 2008), two focus groups were held (Paper 5 – Appendix E). One Focus group was established to seek the opinions and experience of representative residents of the Borough, from a variety of demographic and geographical backgrounds. The second focus group was made up of elected

members from the LA; the makeup of this focus group was broadly representative of the political make-up of the council and arguably influenced by the economics of change.

The purpose of the focus groups was to identify and prioritise policy and operational issues early in the development process of the ZWS. The Focus Groups began with facilitated discussions on UK waste legislation, targets and LAs compliance issues. The discussion was widened to identify possible policy options available to the LA and identified two ways of moving towards Zero Waste as “recycle and reuse” and “reduce waste produced in households”. Within these two categories, the group considered how adopting a variety of policy options would impact on waste management across the following factors:

- Climate change mitigation.
- Customer satisfaction.
- Impact on targets.
- Economic factors.
- Resource Efficiency.

The focus groups were used as a platform to identify and prioritise environmental, operational and social options available to the LA. Data was collected using a combination of qualitative and quantitative methods. Analysis was carried out using standard statistical functions in Excel software, to produce a ranked order for policy instruments. The outcomes from the focus groups were used to inform actions and targets within the draft ZWS and supporting policies and these are reported in Paper 5 (Appendix E).

### **3.4.6 ZERO WASTE STRATEGY VALIDATION AND REVIEW PROCESS**

Two procedures were used for the validation of the ZWS. One was to use a public consultation exercise, this provided access to a larger sample of stakeholders than it was possible to accommodate in the focus groups and is reported in Paper 5 (Appendix E).

The consultation was undertaken using a questionnaire available online and in paper format and was promoted using a series of public meetings, leaflets, posters, text alerts, the LA website and LA Twitter account. Making the questionnaire available in this way in a variety of formats and locations enabled wider circulation. The questionnaire consisted of 10 questions, two were demographic questions, seven were multiple choice and a further question offered the opportunity for free text comments on the current waste and recycling collections, or related issues.

Comments and inputs received were analysed using Excel and its basic statistical functions. In line with the LAs procedures (Charnwood Borough Council, 2008) the main points from the consultation were reported to elected members for review and amendments were made to the draft strategy. This ZWS was then formally adopted by CBC in January 2013.

The second validation process was the Local Government Strategy approval process followed by the LA for the implementation of all strategy and policy documents. This saw it open to scrutiny by a committee of elected members of the council, where the process undertaken during the initial focus groups, the draft writing of the strategy and the wider public consultation process were questioned. Scrutiny of the consultation results and amendments made to the draft strategy were explored.

### **3.5 SUMMARY**

This chapter has explained how and why a single case study approach, with a mix of qualitative and quantitative research methods was used. These research, methods and outcomes are summarised in the research map (Figure 3.1). Methods included the academic critical literature review combined with statistical analysis of a seven year archive of raw waste data, questionnaire surveys and focus groups to gather the opinion of experts and users. A brief overview of the adopted research methods has been presented.

The next chapter presents the results of the research undertaken.

## **4 CHAPTER 4 – RESULTS**

### **4.1 INTRODUCTION**

This chapter presents the research results from the four years of the EngD to meet the aim and objectives stated in Chapter 1. The research activities were conducted as described in Chapter 3. One of the requirements of the EngD is the publication of research papers in appropriate journals and conference proceedings. Three conference papers and two journal papers are accordingly presented in the Appendices to give more detailed information and references are made throughout this chapter.

### **4.2 RESEARCH UNDERTAKEN**

The research followed the methodology outlined in Chapter 3 and illustrated in Figure 3.2.

#### **4.2.1 HOUSEHOLD WASTE MANAGEMENT PRACTICES**

In order to examine current household waste management practices (Objective 1) and establish an understanding of the research topic two different research methods were adopted. These were a literature review and a questionnaire survey of 30 Local Authorities (LAs) with a track record showing high performance in recycling household waste.

##### **4.2.1.1 Literature review**

An initial general literature review was undertaken to assess available knowledge and develop the research area, it is reported in Chapter 2, as well as Papers 1, 2 and 3 (Appendices A, B & C). This also informed and guided decisions made later about the research methodology. A number of inter-connecting, but also quite distinct areas were investigated by undertaking the critical literature review. The issues listed below were established from the literature review undertaken and are explained in more detail in the appended papers:-

- EU, UK Government and the devolved Governments of Scotland and Wales have all attempted, to varying degrees, to address sustainability and the environmental performance of household waste management. (Chapter 2 and Paper 5 - Appendix E).
- The division of responsibility for household waste management between different tiers of Local Government may create a barrier to holistic approaches to household waste management (Chapter 2). However, partnership working between LA can produce innovative working practices to provide efficiency gains and improve performance and sustainability of waste management practices (Paper 1).
- Sustainable improvements to the treatment of household waste would make an important contribution in the movement towards Zero Waste in the UK (Papers 2, 3 and 5 - Appendices B, C and E).
- LAs have achieved progress with recycling and bio-waste treatment of household waste. This progress is very diverse, with a wide variety of issues effecting collection services, treatment methods and differing levels of performance are shown in the results (Papers 1, 2 and 3 - Appendices A, B and C).
- Householder participation, whilst a vital part of the success of any sustainable waste management process, is a complicated area involving behaviour patterns relating to values, beliefs, situations, knowledge and understanding (Chapter 2 and Papers 3 and 5 – Appendices C and F).

#### **4.2.1.2 Questionnaire Survey**

Following the findings from the literature review, it was decided to undertake a survey of LAs with a record of recovering high yields of recyclable materials from household waste.

Results from the questionnaire survey reveal that:

- A diverse range of LAs achieve high yields of recyclates, showing high performance is not restricted by population size, location or collection method.
- Of the 30 Local Authorities in the sample, 19 are Waste Collection Authorities; responsible only for the collection of household waste and 11 are Unitary Authorities, responsible for the collection and disposal of household waste.
- A variety of different collection methods are used within the sample group, with no collection methods common to, or exclusive to, the group of LAs surveyed.
- Two thirds (20 of the 30 LAs surveyed) contract-out the household waste collection services.
- There are widely differing policies regarding charging for bulky waste collections and organic waste collections among the surveyed LAs. 18 Authorities charge for the collection of garden waste, nine Authorities operate a free of charge collection service and three Authorities do not operate a garden waste collection service. Separate charges for the collection of materials in these waste streams may impact on the performance of a recycling scheme.

#### **4.2.1.3 Archival analysis**

Alongside the questionnaire survey, archival analysis investigating geographical and demographic aspects of the 30 LAs surveyed revealed:

- A variety of urban, rural, metropolitan and inner city LAs, with varying population sizes were represented within the sample LAs. The distribution pattern reflected that of all English Local Authorities (Figure 4.1).

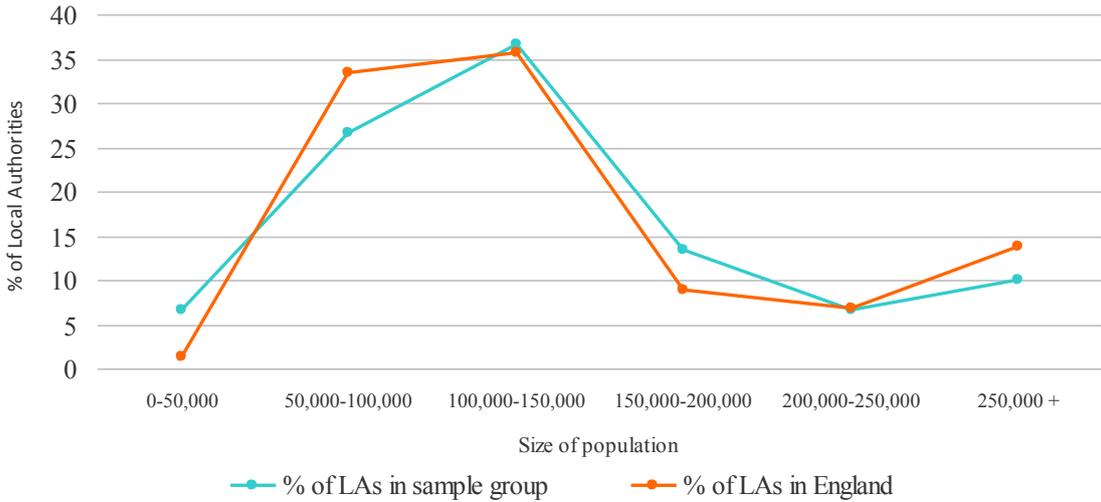
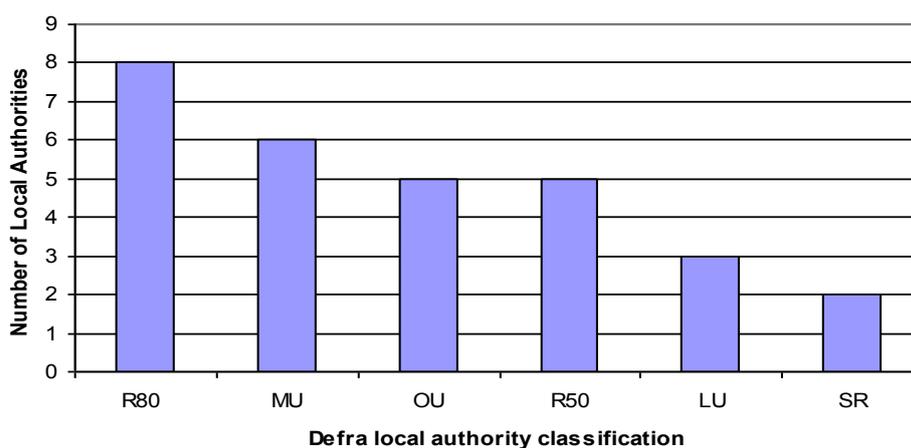


Figure 4.1: Population figures of LAs in the sample group compared to all English LAs.

- There appears to be no common or exclusive socio-economic or other demographic factors. For example Stratford-upon-Avon and Rochford are relatively affluent, rural areas and the Metropolitan Boroughs of Newcastle-upon-Tyne and Walsall are densely populated, less affluent urban areas.
- Defra classifies Local Authorities according to the urban/rural mix of the area. The six categories are major urban (MU) – area with more than 750,000 population, large urban (LU) – area with between 250,000 and 750,000 population, other urban (OU) – LAs with less than 26% of population in rural settlements and larger market towns, significant rural (SR) - LAs with more than 26% but less than 50% of the population in rural settlements or larger market towns, rural 50 (R50) – 50% of the population in rural areas and rural 80 (R80) - 80% of the population in rural areas. Each category is represented in the top 30 performing councils, but the dominant category is Rural 80 districts. The distribution of the sample Local Authorities across these categories is shown in Figure 4.2.



### Key

MU - Major Urban- area with more than 750,000 population

LU -Large Urban – area with population between 250,000 and 750,000

OU - Other Urban – LAs with less than 26% of population in rural settlements and larger market towns

SR- Significant Rural- LAs with between 26% & 50% population in rural settlements/larger market towns

R50 - Rural 50 - 50% of the population in rural areas

R80 - Rural 80 - 80% of the population in rural areas

**Figure 4.2: Distribution of LAs within the sample across the Defra classification groups (Defra, 2012).**

- This group of 30 high performing recycling LAs contained a spread of LAs across the Index of Multiple Deprivation (IMD) spectrum. The IMD assesses LA areas across a range of economic, social and housing data sets, ranking LAs between 1 and 326, with 1 the most deprived and 326 the least deprived. However, whilst there were some LAs from the lower IMD bandings (with higher levels of deprivation) there were higher numbers of LAs in the more affluent IMD groupings with high performing recycling collection schemes (Figure 4.3). It was concluded that the population, rather than the collection system had the biggest impact on yield of recyclates.

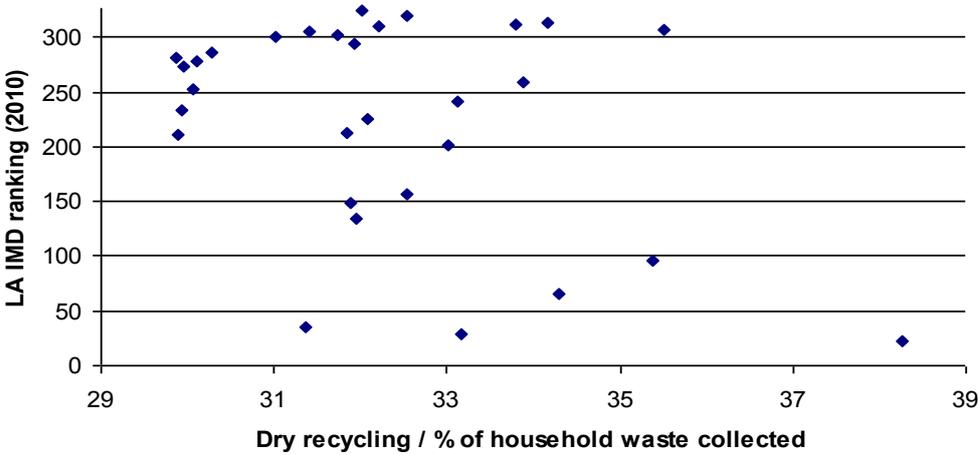


Figure 4.3: LA IMD rankings (2010) of the 30 LAs in the survey sample plotted against percentage of household waste recycled in 2009/10.

**4.2.1.4 Review and next steps**

The industry questionnaire survey confirmed the results of the literature review that there are many different successful recycling collection methods. Whilst there are some commonly used systems, there are none unique to this group of high performing LAs. Local decision making and the ability to tailor services to suit different geographic and demographic areas is recognised as a contributing factor to high performance in these cases.

More detailed results from this stage of the research are presented in Paper 1 (Appendix A). As well as establishing current household waste management practices, this exercise enabled comparison with CBC performance, operations and policies as part of a benchmarking process.

**4.2.2 SUSTAINABLE OPTIONS FOR RECYCLING HOUSEHOLD WASTE STREAMS**

Whilst there is no common household waste collection scheme offering high performance in respect of the yield of materials recovered for recycling, there are areas of Best Practice which may be duplicated with elements of success. Objective 2 was completed by carrying out a further review of academic literature and non-academic industry papers to assess sustainable

options for the recyclable elements of household waste. Previous waste composition analysis work carried out for CBC (WasteWorks, 2009) was used as a starting point. Findings are reported in the published papers 2, 3 and 5 (Appendices B, C and E) and cover the treatment options for various waste streams, including the reuse of bulky waste items and separate collection of food waste.

#### **4.2.2.1 Sustainable household waste management - Bulky waste**

Sustainable solutions for household bulky management were explored. The literature review of academic publications and non-academic industry publications confirms that an established network exists supporting the reuse of bulky waste items. It is estimated that between 20% and 70% of the bulky waste stream has the potential to be reused or recycled (WRAP, 2009). However, with current working practices, as little as 2% of the waste stream is currently reused. Many barriers prevent items being “rescued” from the waste stream and entering the reuse sector, including awareness and current LA collection methods. Similar barriers prevent materials from bulky waste items being sent for recycling. This waste stream is already segregated for collection by householders, for current operational reasons. The research explored how simple changes to the current management of this waste stream would improve the opportunities to reuse items or recycle materials quite easily from this waste stream via already existing routes.

Analysis of CBC’s household waste collection data enabled the bulky waste collected by CBC in a three month period in 2012 to be quantified. Examining current operational practices enabled barriers to increasing reuse and recycling to be identified. Areas for potential improvement in recycling and reuse performance were revealed that could be implemented by amending operational practices to salvage more of this already segregated waste stream for existing reuse and recycling markets. The impact of these suggested

amendments was quantified and the impact on recycling performance was estimated; this is reported in more detail in Paper 2 (Appendix B).

#### **4.2.2.2 Sustainable household waste management - food waste**

Sustainable management options for household food waste were explored using a literature review of academic and non-academic publications. The literature review highlights:

- Food waste is the largest proportion of organic waste present in household residual waste.
- Options are available for treatment of food waste, if segregated and collected separately.
- Benefits include the diversion of organic waste from landfill disposal and potential savings on Landfill Tax.
- Differing approaches to food waste were found to be taken by the devolved Governments of Scotland and Wales.
- The top ten performing recycling LAs in 2012/13 all operate some form of segregated food waste collection.

Additionally, a case study of Newcastle-under-Lyme Borough Council (NBC) was undertaken, particularly focusing on the impact introducing and operating a separate collection for food waste has had on the LA's recycling performance. NBC and CBC have differing historical performance records for recovering recycling from household waste, with CBC achieving higher yields of recycling until 2010. At this point NBC changed their waste and recycling collections significantly and introduced separate food waste collections. Since this change, NBC has out-performed CBC, with some of this being attributed to the food waste collection offered to all households within the area. The research explored how a

similar separate food waste collection could improve the sustainability of CBC's waste collections. Paper 3 (Appendix C) uses the past performance of the food waste service in NBC to project the possible impact onto CBC's recycling performance and an improvement of < 7% if services were introduced in a similar fashion to those in NBC.

### **4.2.3 CURRENT CHARNWOOD BOROUGH COUNCIL WASTE MANAGEMENT PERFORMANCE**

To evaluate the current performance of CBC's household waste management (Objective 3) two research methods were used. These were a review of archive documents and statistical analysis of historic waste collection data.

#### **4.2.3.1 Archival Analysis**

A review was undertaken of archive documents including council reports, council documents, minutes of council meetings and externally audited performance indicators. These, together with a review of existing strategies, policies and operational practices enabled a profile of CBC to be constructed outlining local household waste management service and trends in waste arisings. This profile is reported in Papers 1, 2, 3 and 4 (Appendices A, B, C & D).

A summary timeline showing the evolution of the household waste and recycling collection as the service developed is reported in Paper 4 (Appendix D). Changes include those made as the LA reacted to legislative changes, recycling targets, and the introduction of new technologies which made it possible to recycle additional materials as new sorting facilities became available; this is reported in Paper 4 (Appendix D).

Additionally, data from Defra's WasteDataFlow was used to track household waste generation, and recycling performance of CBC over time. This was used to produce a baseline assessment and to allow comparison to the performance of other English LAs performances.

#### 4.2.3.2 Statistical Analysis

The statutory requirement on the LA to provide Defra with monthly returns for WasteDataFlow provided an archive of data for the quantities of household waste and recycling collected in the Borough.

Quantitative analysis was undertaken using SPSS (a statistical software package). Data was analysed using an ARIMA (Autoregressive Integrated Moving Average) time series model, this is explained in more detail in Paper 4 (Appendix D).

Using the time series model in conjunction with the summary timeline developed through the archival analysis outlined above, the data was analysed to evaluate the impact, if any, of various interventions taken by the LA to improve waste collection performance had on the yield of recyclates in the Borough.

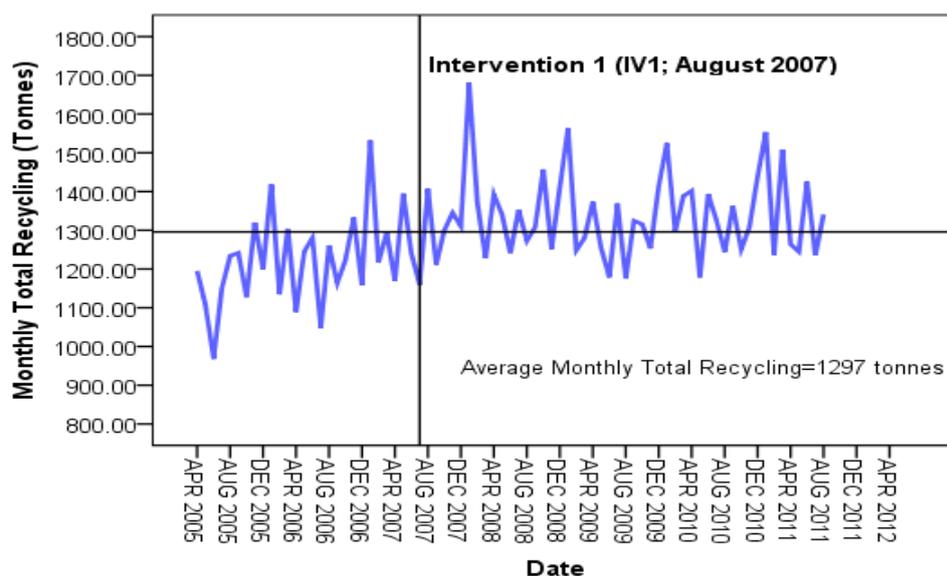
The interventions investigated were:

- Adding mixed plastics and Tetrapak (drinks containers) to the already segregated collections of paper, cardboard, glass and metals. As these were lightweight materials, it was unknown what impact they would have on the yield of recyclable materials.
- Reducing the number of collection containers, simplifying the sorting of recyclable materials for householders. Literature had suggested that simplification would help avoid confusion for householders about which container to place recycling in. An increase in recycling yield and householder participation was expected.

The movement of recyclable materials from the residual waste stream into the recycling stream was also monitored to confirm the correlation with a reduction in the amount of residual household waste collected for landfill disposal.

Analysis of the three waste streams (recycling, organic waste and residual waste) was carried out. The estimation of noise, seasonality, control variables and cross correlation between data were taken into account and adjustments made to the model to account for these prior to analysis of the interventions. The process is explained in more detail in Paper 4. The statistical analysis revealed:

- The interventions taken by CBC were shown to cause step and permanent improvements to the amounts of recyclates recovered from households. The second intervention, simplifying separation of recyclable materials into fewer containers had a bigger impact than the first intervention which just increased the number of materials collected for recycling.
- A long term upward trend in the yield of recyclable materials from household waste collections in Charnwood Borough. This reflected the national pattern in the years studied (Figure 4.4).



**Figure 4.4: Monthly recycling yield in Charnwood Borough (April 2005 to March 2012).**

Cross-correlation shows the correlations are small with both positive and negative lags. A negative lag suggests the first series (monthly residual waste) follows the second series (monthly recycled waste). The value of the cross correlation coefficient is negative at a

positive lag 1 (i.e. -0.252) suggesting that an increase in the values of the leading series (i.e. recycling) will cause a decrease in the values of the second series (residual waste) one month later. This suggests an increase in recycling yield leads to a corresponding decrease in the quantity of residual waste (Figure 4.5).

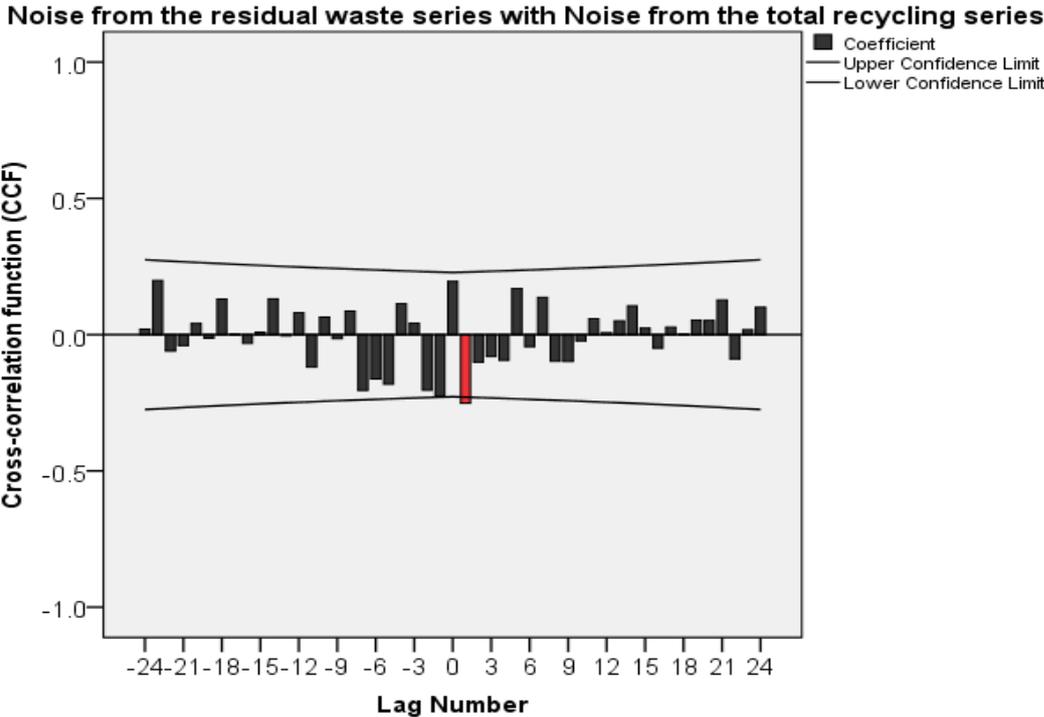


Figure 4.5: Cross-correlation function between noise residuals from the residual waste and total recycling models.

The time series model is reported in more detail in Paper 4 (Appendix D).

#### 4.2.4 TOWARDS A ZERO WASTE STRATEGY FOR CHARNWOOD BOROUGH COUNCIL

The final research steps to fulfil Objective 4 involved five phases. These were:

- Analysis of options using a literature review as a foundation.
- Input from focus groups using elected members from CBC and householders.
- Formulation of a draft ZWS for CBC.
- Further public consultation with a wider group of stakeholders.
- Validation process

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#### 4.2.4.1 Literature review

The key research work undertaken in the development process of the ZWS was a literature review which explored the following areas:

- Concept of Zero Waste.
- Variety of definitions for Zero Waste.
- Zero Waste, International and UK contexts.

The outcomes of this review are covered in Paper 5 (Appendix E). Zero Waste was found to be a multi-faceted and hugely ambitious concept, with numerous definitions. Based on the review, Zero Waste has been defined in this research and in the development of the ZWS for CBC as “an aspirational end process where all waste that is produced is reused or recycled as a resource without the need for any landfill or energy recovery”.

The literature review highlights how reuse, recycling and waste minimisation, with the use of sustainable waste management technologies are essential to aid a progression towards Zero Waste and how these have social, economic and environmental considerations. LAs can raise awareness, promoting positive actions, particularly in waste prevention initiatives by designing education campaigns that seek to influence householder behaviour. Additionally, changes to products within the design and manufacturing processes can contribute to recycling, but these are outside the scope of the LAs influence.

#### 4.2.4.2 Focus Groups

The two focus groups held, one comprising of residents from across Charnwood Borough and one comprising of elected members from the LA, (Section 3.4.5 and Appendix E, Paper 5) revealed each focus group had different priorities for household waste management provision within the ZWS. These are shown in Table 4.1:

**Table 4-1: Policy instruments prioritised by focus group participants**

Policy instruments	Ranking		
	Elected members*	Members of the community*	Aggregated score (Equation 1)
Increase the range of recyclates collected separately	1	2	1.5
Encourage / subsidise home composting	2	6	4
Restrict the size of the landfill bin issued to households	3	4	3.5
Sustainable treatment/disposal of street cleansing waste	4	8	6
Garden waste charging policy	5	7	6
Behaviour change	6	1	3.5
Influencing treatment options	7	3	5
Residual waste (additional capacity) charging policy (introduction of charge)	8	10	9
Introduce a separate food waste collection	9	5	7
Bulky waste charging policy (introduce a charge)	10	9	9.5

\* 1: Highest priority. 10: Lowest priority.

The priority actions are summarised below:

- Increasing the range of recyclates was top priority for the elected members and second priority for the members of the community.
- Behaviour change was top priority for members of the community, but was sixth in the priorities listed by elected members.
- Policies that involved introducing a charge for services were not popular with either focus group.
- Introducing a charge for bulky waste collections ranked tenth by the elected members and ninth by the members of the community.

- Implementing a charge for the collection of residual waste above a predetermined quantity was also unpopular. Elected members placed this in eighth position and members of the community gave this the lowest priority of all options.

When the rankings were aggregated between the two focus groups, the low cost options (increase the number of recyclable materials collected, behavioural change, encourage home composting and restrict the size of landfill bins supplied to households) occupied the highest ranked placings. The policies regarding the collection of organic waste, garden waste, food waste and street sweepings were seen as neither high nor low priority and occupied the mid ranking places. Finally, the policies that proposed introducing or increasing charges for services were unpopular.

Results from the focus group discussions are included in more detail in Paper 5 (Appendix E).

#### **4.2.4.3 Draft Zero Waste Strategy for CBC**

The findings from the focus groups informed the production of a draft ZWS, written by the researcher. Recognising limitations posed on data collection by the small sample size involved in the Focus Groups, and in order to ensure the LA had greater confidence that the draft ZWS was fit for purpose a period of public consultation took place.

#### **4.2.4.4 Validation of developed Zero Waste Strategy**

The validation process was two-fold. An initial public consultation using a questionnaire survey was followed by the Local Government approval procedure.

##### **4.2.4.4.1 Public consultation – questionnaire survey**

The primary purpose of the public consultation was to access a wider section of stakeholders than those accommodated at the focus groups. The consultation exercise received 411 responses. It is difficult to quantify a response rate because the questionnaire was available online through CBC's website with open access. The number of replies was in line with other

consultation exercises undertaken by CBC, such as the public consultation on the Core Strategy in 2012 (Charnwood Borough Council, 2012).

The main points from the public consultation exercise are covered in Paper 5 (Appendix E) and are summarised as:

- Educating householders to change behaviour patterns by providing information and encouraging compliance of those poor or non-recyclers was an area that should be priority.
- The ZWS was welcomed by all respondents to the consultation. However, it was felt strategy focused heavily on recycling and that the reduction of waste and the promotion of reuse activities should be given more emphasis.
- The ambitious recycling target set by CBC as part of this process was accepted as achievable.
- Increasing the provision of litter bins designed with separate spaces to enable the collection of recyclable materials.
- Policy issues that include continued provision of a free bulky waste collection and the removal of the charge for the garden waste collection.
- The provision of an efficient and effective waste and recycling collection to householders was a priority service from CBC.

The most frequently recurring topics were associated with:

- Addressing the levels of packaging on consumer items (18%).
- Increasing education and communication regarding recycling (12%).

- Blaming “other people” (e.g. neighbours) for low levels of recycling (8%).
- Supporting the introduction of separate food waste collection (11%).

The above points were addressed in the amended version of the ZWS, with education and communication aimed at increasing participation levels and achieving behaviour change forming an important part of the strategy.

Whilst the actions of CBC are limited to those of a WCA, there is potential to work with stakeholders in different areas of the waste management cycle to influence waste processes and embrace areas of best practice. This may initially be carrying key messages to promote sustainable actions to target audiences through the ZWS, for example increasing reuse of items and improving recycling performance. Future work should consider the implementation of additional and improved services to also increase the performance of the waste management operation and progress towards Zero Waste.

#### **4.2.4.4.2 Local Government approval process**

The results from the Public Consultation validation exercise in the previous section were reported to elected members at CBC, alongside the amended draft strategy, through a meeting of the full Council at CBC.

The ZWS went through the democratic process followed by an LA for the implementation of all strategy and policy documents. This saw it open to scrutiny by a selected committee of elected members of the council, where the process undertaken during the initial focus groups, the draft writing of the strategy and the wider public consultation process were questioned. Scrutiny of the consultation results and amendments made to the draft strategy were explored.

The amended document was approved and adopted by the full Council. A copy of the ZWS for Charnwood Borough 2012-2024 is included as Appendix G.

### **4.3 SUMMARY**

This chapter has provided a description of the results of research undertaken to meet the aim and objectives set out in Chapter 1, which was also “within the context of the industrial sponsor” to develop and improve household waste management performance.

Part of the recommendation to improve waste management performances was the development of a ZWS. The research documents the development and validation process for the ZWS. This was achieved through a combination of strategic planning exercises that saw a Strategy produced that was time bound, within current legislative obligations and saw progress towards identified steps and technologically driven solutions that would change working practices.

It was possible to conclude that the priority areas would be the separate collection of food waste, the comprehensive reuse and recycling of bulky waste items, an increase in waste reduction and recycling communications material and educational messages and adopting Zero Waste working practices.

Implications of the research undertaken are presented in Chapter 5.

## **5 CHAPTER 5 – FINDINGS AND IMPLICATIONS**

### **5.1 INTRODUCTION**

The engineering doctorate (EngD) was introduced to be more industry focused than a traditional PhD. The aim was to speed up implementation of the research findings and impact on practice. Therefore the research was carried out within the sponsoring organisation CBC with the aim to improve household waste management performance within Charnwood Borough and to assist the Council with its aspirations to be a Zero Waste Borough.

This chapter describes the extent to which the research aim and objectives have been met and discusses the contribution made to overcome the knowledge gaps originally identified. The contribution to existing theory and practice has been highlighted and consequent suggestions for future work. These conclusions and recommendations have been made both from the point of view of the sponsoring LA and the wider industry.

### **5.2 KEY FINDINGS**

During the four year research period six academic papers were published (four conference papers and two journal papers). Five of these papers are included in this thesis and are referred to throughout. Figure 3.2 (Chapter 3) shows the research objectives, methods adopted and outputs. Key findings from the research can be summarised as follows:

#### **5.2.1 HOUSEHOLD WASTE COLLECTION AND RECYCLING GOOD PRACTICE**

The research into current household waste management practices has highlighted several issues which are summarised below:

The early stages of this research into current household waste management practices highlighted different approaches taken by LAs to both the collection and recycling of household

waste to meet the recent EU Directives. Amounts recycled and bio-waste treatment of household waste varies widely between LAs. A wide variety of issues affect collection services, treatment methods and these differing levels of performance (Papers 1, 2 and 3 - Appendices A, B and C). This, to some extent, reflects differing responses to EU Directives from the UK Government and the devolved Governments of Scotland and Wales (Chapter 2 and Paper 5 - Appendix E).

Identifying LAs with the highest yields of recyclable materials from household waste enabled a survey questionnaire to be designed to collect evidence of the many different practices within these Authorities. The LAs were found to be a very diverse sample, from different geographical locations, with varying population sizes and contain differing demographic make-ups. Additionally, there was no common collection method practiced amongst these LAs and they operate their collection schemes with a variety of differing policies. The results from the survey are presented in Paper 1 (Appendix A).

It was concluded that although adapting collection methods to suit local conditions, such as population density and housing types, did improve recycling efficiency, adapting collections for food and bulky waste were common ways to improve performance. These areas of good practice, the separate collection and treatment of two key waste streams, were explored in more detail to improve recycling performance of CBC (Papers 2 and 3 – Appendix B and C).

### **5.2.2 BENCHMARKING CBC HOUSEHOLD WASTE MANAGEMENT PERFORMANCE AGAINST OTHER ENGLISH LAs**

The sponsor's current waste management performance was benchmarked via literature and case studies of other LAs. This identified a number of practices that may be transferable into CBC household waste management processes. Analysis was carried out using data from CBC

to estimate the possible impact on the LAs recycling rates by the implementation of a separate collection for food waste and increased reuse and recycling of bulky waste items. Results are presented in Papers 2 and 3 (Appendix B and C).

Statistical analysis of historic waste data was used to justify the introduction and judge likely impact of changes made to waste management. Successful practices highlighted were simplifying householder separation systems and reviewing the costs to the householder of the collection of bulky items and garden wastes. The findings and conclusions are presented in detail in Paper 4 (Appendix D).

It was apparent that even with a combination of political support for new and stimulating policies such as Zero Waste, cooperative working and comprehensive household recycling collections it is still necessary to engage the householder. The research concluded from the various methods used that householder participation, a vital part of the success of any sustainable waste management process, is a complicated area involving behaviour patterns relating to values and beliefs, knowledge and understanding (Papers 3 and 5 - Appendices C and E and Chapter 2). Without the cooperation of householders no LA recycling scheme will achieve the optimum yield of recyclable materials. Therefore, educational programmes on recycling repeatedly using promotional or positive messages are recommended.

### **5.2.3 TOWARDS A ZERO WASTE STRATEGY FOR CBC**

The development of a ZWS is a departure from the statutory obligations of a Waste Collection Authority such as CBC. It was concluded that the Strategy benefitted from the input of the variety of key stakeholders. These included local community members and politicians in the focus groups, and the wider consultation process giving access to additional community groups, local residents, neighbouring LAs and waste management companies. This project

raised awareness of the concept of Zero Waste within CBC. The ZWS was supported by both experts and public. Differing priorities between the community and elected members were noted, the elected members with budget knowledge were concerned about additional costs. Synergies between an increase in resource recycling and reduction in landfill disposal were demonstrated by the research, with these seen as a progression towards the aspirational goal of Zero Waste. Engaging with stakeholders during the development and production stages of the Strategy allowed different priorities to be identified to strengthen the acceptability of the strategy and improve the likelihood of implementation. The consultation exercises provided several points of amendment to the strategy and following the defined scrutiny and democratic processes it was possible for CBC to approve and adopt a Zero Waste agenda. The details of the development of the ZWS, including the findings from the focus groups are presented in Paper 5 (Appendix E).

The adoption of the ZWS was used as evidence of CBC's commitment towards improving the sustainability as well as the performance of its services. The research has demonstrated that the public declaration of a ZWS is relevant and can be used as a tool to improve recycling; it was accepted by the major stakeholders. The ZWS is included as Appendix G of this thesis for reference.

The strategy developed as part of this research is unique to the LA, but provides points of comparison that enable it to be used in a generic format. This will allow it to be transferable, adapting some of the content to suit other organisations.

### **5.3 CONTRIBUTION TO EXISTING THEORY AND KNOWLEDGE**

During the four year research period six academic papers were published (four conference papers and two journal papers). The five papers selected for inclusion in the appendices present a detailed discourse of each of the research objectives. The research used a case study approach with comparisons and benchmarking to establish procedures to improve the performance of household waste management by CBC, in order to meet new guidelines and EU Directives. It was possible to conclude this methodology worked well with most data easily accessible.

#### **5.3.1 CONTRIBUTION TO EXISTING THEORY**

The analysis of waste management performance of CBC, compared to other LA revealed the differences noted in Papers 1, 2, 3 and 5 (Appendix A, B, C and E). Best practice was identified to adopt more sustainable waste management processes. Two key waste streams were identified to target initially. These were, as noted in 5.2.2, food waste and bulky waste.

There was very little published about the process of developing waste strategies within a LA. A mechanism for engaging with key stakeholders during the strategy development phases was reported.

The research established that there were a variety of different definitions for Zero Waste both nationally and internationally. The research has noted that legislative approaches to introduce Zero Waste have been implemented, with statutory obligations differing across different regions of the UK.

#### **5.3.2 CONTRIBUTION TO EXISTING KNOWLEDGE**

There has been much written in the literature on the various approaches to household waste management including collection, segregation of recyclable materials, participation and

awareness of recycling and recycling behaviour. However, there was little covering the impact changes to waste collection methods have on the yield of recyclable materials simply as a result of raising awareness.

The novel use of the time series model was successfully used to analyse historical waste data and enabled the impact of changes to waste collection methods to be measured. Validation of new policies and amendments to household waste and recycling was also possible. Time series models may also be useful to quantify the impact of communication campaigns, measuring success of these by the level of positive environmental behaviour change that is achieved.

It was concluded that the methodology developed around the case study (statistical data, analysis of interventions, peer and public review) could be applied to other waste management organisations to generate new strategies and policies. The concept and procedures used could be easily reproduced by other LAs and infrastructure management bodies. This research has demonstrated the development of a ZWS that is time specific and relevant to the organisation, and accepted by a variety of stakeholders. The inclusion of challenging recycling targets, beyond those currently imposed by the UK government for English LAs demonstrates the aspirational nature of this document.

## **5.4 INDUSTRIAL IMPLICATION**

The research has been able to develop a strategy for LAs to move towards Zero Waste, demonstrating the input of a variety of stakeholders.

### **5.4.1 IMPACT ON SPONSORS**

The research has identified specific areas for the sponsoring organisation to target to achieve better waste management. These included separate collections of food waste, improved reuse

and recycling of bulky waste items, continuing education and communication programmes that encourage householders to recycle and the intention generated by an aspirational ZWS. It was possible to conclude that improvements are conditional on continuing pressure within the sponsoring organisation with respect to management, communications and involvement.

This research has therefore provided CBC with embedded credible evidence to support and gain backing for operational and budget decisions to improve the sustainability of household waste management validated by local democratic support. The outputs can be summarised as:

- A ZWS to improve the performance of its household waste management with the aspiration to be a Zero Waste Borough.
- Tools to evaluate improvements and basic performance.
- A series of recommendations using a combination of different methods to monitor individual waste streams and available technologies.
- Increased levels of employee awareness of the wider issues surrounding Waste Strategy, for example kerbside recycling collections, reuse of furniture, white goods, textiles and WEEE through charity shops, car boot sales and freecycle. It was also concluded that promoting the realisation that Zero Waste was not just about increasing recycling but a holistic approach to the management of waste and raised awareness was necessary. This was difficult to achieve in this case study as CBC is a Waste Collection Authority with limited influence on the waste management chain. Actions identified to overcome this limitation included working in partnership with a variety of stakeholders, amending existing working practices, carrying out education and communication to raise awareness and change behaviour.

- The benefit of forging close working relationships with the waste treatment sector and local community groups was demonstrated. It is now recognised by all involved in the research project that working in partnership with these groups is essential to improving performance.
- The two priority waste streams that could easily be targeted and would bring about an immediate major improvement were identified as:
  1. Bulky waste, this waste stream is already segregated at the householder / collection interface. Therefore, all that is necessary to improve reuse and recycling outcomes is to introduce different working practices and publicise the new service.
  2. Food waste, this makes up more than 50% of the remaining residual waste and therefore a large impact compared to other waste materials. The research also showed that many other authorities had introduced food waste processing.

#### **5.4.2 IMPACT OF RESEARCH FINDINGS OF LAS**

The major conclusions have already been noted but it is also possible to emphasise them in the context of how to overcome the industry wide barriers to sustainability. The process of engaging with members of the community and elected members through the focus groups was positive and enabled new issues to be identified for inclusion in the ZWS.

Despite the differences between approaches taken by other LAs generic improvements were identified and it was concluded that many of the findings are applicable throughout the public sector and that engagement with householders as waste generators was essential.

It was concluded that the existing diversity of approaches to household waste management was a reflection of the diversity of LAs in the UK, particularly regarding size and demographic makeup. The ZWS generated is one of a few in the UK and was written with the CBC's obligations, practices and potential for improvement in mind. The methods used could be utilised by other LAs seeking similar goals. The process could also be repeated, with adjustments, to suit different demographic and geographic regions throughout the world. The research also shows that it is possible to change practice and policy in the public sector without the usual Central Government guidance or legislation.

## **5.5 RESEARCH LIMITATIONS**

The aim of this research project was to investigate and improve the performance of the household waste management in Charnwood. Impediments to this were the lack of obvious data and the variety of stakeholders involved. The process includes collection, transportation, treatment and disposal of household waste. It should also be noted that the organisation does not generate the waste it is responsible for. Rather, its responsibility is for the collection of household waste, just one part of the waste management chain.

It was not possible to conduct investigations into all the waste materials present in household waste that have sustainable options for treatment. The two waste streams identified in detail in this research are bulky waste, a waste stream already segregated by the householder and food waste, which makes up a large proportion of the household waste stream. WEEE, although smaller in mass terms may be an economically stronger case but is impeded in the case study by the different responsibilities present in the two tier LA system. Recommendations are made to conduct research to examine additional waste streams and the implication of this on the performance of the LA.

Working within the constraints of the sponsoring organisations established practices for the development of the Zero Waste Strategy meant that the size of initial focus groups were limited. It was possible to address the small sample size by the later public consultation process which allowed the survey questionnaire to be circulated to a larger number of potential respondents.

## **5.6 RECOMMENDATIONS FOR INDUSTRY**

It is recommended that a communications plan to assist in the education and behavioural change issues highlighted in this research should involve all stakeholders, including employees, householders, elected members and local community groups. This would ensure the actions within the strategy are implemented and levels of awareness are raised to increase recycling performance at a household level.

The development and implementation of any strategy has to be driven from the top of an organisation. In public bodies policies need to be democratic to include the views of the community and their elected representatives. This is often seen as diluting the chances of success. In this research, organisational management was mobilised to promote sustainable waste management. Monitoring this aspect of the implementation of the strategy could also be an area for further research. The multifaceted value of this project was supported by senior management and there was evidence from the continuation of the project despite restructuring of both the department and the organisation resulting from the austerity measures. CBC has also agreed to fund a second follow on project.

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## 5.7 RECOMMENDATIONS FOR FURTHER RESEARCH

This research has addressed performance of household waste management within an English Local Authority. This has raised a number of questions and areas for further exploration within academia and industry, leading to the following recommendations for further research:

- Focussing on recyclable waste streams contained within residual waste that have not been included in this research. This could include as a starting point waste electrical and electronic equipment (WEEE), household batteries and absorbent hygiene products (AHP) such as nappies, incontinence pads and sanitary products.
- Improve the household waste data collection process and ease of access. Whilst the existing WasteDataFlow captures household waste collection and treatment data it is limited in scope. This offers additional research opportunities to identify how best this can be implemented.
- Examining the culture within LAs to ascertain the best method to gain acceptance for the implementation of improvement measures that are not legislation driven. This research has shown there is often a difference between an organisation's intention to improve the sustainable performance of household waste management and its resources and priorities. Independent monitoring would address the gap between the ambitions and the performance and implementation of actions to improve sustainability. It would be worthwhile to include a variety of stakeholders in this process from across the waste management chain, including householders, elected members, neighbouring LAs, third sector and charity groups and partner waste management companies to identify barriers. The findings of these processes would not be legally binding, but would allow transparency of priorities.
- A conclusion not previously noted was the opportunity for more service partnerships between neighbouring LAs to increase efficiency. This research was conducted in

collaboration with a Waste Collection Authority, making it difficult to predict the impact of an expansion of the findings to the wider industry. Some conclusions concerning engagement and technology have a previous track record and so it is possible to suggest that they may be adapted to other parts of the waste management chain. It would therefore be useful to research these potential benefits by investigating existing unitary LAs by monitoring improvements and examining examples of inter-organisational cooperation.

- The integration of this strategy into the other aspects of the organisations working practices would prevent Zero Waste being treated as an issue in isolation from other services, for example transport, recreation and education. The level of success achieved by the implementation of a ZWS are dependent on adequate organisational arrangements with respect to change management, this aspect of the implementation of the strategy could also be an area for further research.

## **5.8 SUMMARY**

The research presented in this thesis contributes to the strategic process of improving the waste management performance of the sponsoring organisation. It has established current practices, identified areas for improvement and developed a ZWS with input from stakeholders. Findings from this research project add to the academic body of knowledge and demonstrated the potential for sustained improvements in its operational processes.

There is a need for a holistic approach to the management of household waste, which focuses more widely than on the householder/collection service interface. The movement towards sustainability and Zero Waste is a long term aim which involves environmental, social and economic benefits. Integrating them into a non-governmental organisation with resources

recovery included is worth investigating. However, it is recognised that establishing an integrated waste management system is a complicated issue and depends on a whole range of issues. Some of these are very local issues, for example the availability of treatment facilities for specific waste materials and cooperation from householders. Others are infrastructure dependant on the wider regional area.

It is suggested that Zero Waste is used as a key to improving sustainability within all LA processes and actions rather than using it as a stand-alone strategy relevant only to improving performance within the area of the waste management process that a Waste Collection Authority is responsible for. It was also concluded from the research that the variety of responsible authorities (WDA, WCA) did not provide suitable incentives for improved waste management. The partnership between CBC and Loughborough University worked with limited resources to achieve the aims and objectives, and has the potential to be implemented by other organisations.

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## **APPENDIX A PAPER 1: HOUSEHOLD WASTE MANAGEMENT PRACTICES IN CHARNWOOD BOROUGH**

### **Full reference:**

Cole, C., Osmani, M., Quddus, M.A., Wheatley, A.D., (2012) Household Waste Management Practices in Charnwood Borough. In: Proceedings Seventh Annual International Conference on Environment, Athens, Greece, pp.5-16.

### **Abstract**

Household waste recycling rates vary between 20-60% across the UK. Legislative and financial measures introduced to reduce landfill disposal of waste in the UK, have impacted on the way Local Authorities operate their household waste and recycling collection services.

This paper reports on the performance of Charnwood Borough Council (CBC), a Local Authority in England, it is responsible for the collection and recycling of waste from 67,000 households. This service is carried out by a private company, Serco, who operate household waste collections for 15 UK Local Authorities.

To improve recycling performance CBC has changed the collection frequency and increased the number of materials segregated from residual waste for recovery. There have also been actions and campaigns to raise public awareness. Together these have improved recycling and composting rates in the CBC area from 16% in 2002/03 to 46.1% in 2010/11.

This paper is a case study and progress report on the details of how this was achieved. It compares performance with other Local Authorities, explores the impact of local operational and policy issues on the amount of household waste collected for recycling.

The research has concluded that differences in how the household waste services were provided and local policies influenced the amount of recyclates recovered. Local decision making and the ability to tailor services to suit different demographic areas, together with partnerships between neighbouring Authorities supported better sustainable waste management.

**Paper type:** Published conference paper

## **Introduction**

Growing awareness of the importance of sustainability in waste management practices has seen global efforts being made to provide treatment methods that encourage reuse and recycling in preference to landfill disposal. Waste is increasingly seen as a resource rather than a disposal problem.

In England, responsibility for household waste collection and disposal is divided between Waste Collection Authorities (WCA), at the smallest area (the District and Borough Councils) and Waste Disposal Authorities (WDA), the larger County Councils. Traditional weekly collections of household waste for landfill disposal have changed to several collection rounds for different materials; sometimes on different timescales. The most common practice is alternate weekly collection of recyclables and residual waste (Watson and Bulkeley, 2010). Waste Collection Authorities must collect separately at least two materials for recycling unless “costs are unreasonably high or comparable alternative arrangements are available” to comply with the Household Waste Recycling Act, 2003. All English Local Authorities now offer some form of kerbside collection for dry recycling (WRAP, 2009). The frequency and container size, for recycling or bio-treatment can vary, however, reliability, convenience, and cost are determinant factors (Woodward et al, 2005).

In 2009/10 English Local Authorities recycled and composted nearly 40% of household waste collected (Defra, 2010), landfill disposal was 12.5 million tonnes of household waste (Defra, 2010). Waste arisings have decreased in recent years, with 2009/10 down 2.7% from the previous year (Defra, 2010). The amount of waste landfilled and the quantity of resources waste contains is still an issue (York et al., 2004).

The European Union Landfill Directive 1999/31/EC (European Parliament and Council Directive, 1999) introduced phased targets for reducing landfilling of biodegradable municipal waste (BMW), with the ultimate target of landfilling less than 35% of the BMW landfilled in 1995 by 2020. In response, the UK Government imposed recycling and composting targets on individual Local Authorities, with Performance Indicators to monitor their performance and financial drivers, Landfill Tax and Landfill Allowance Trading Scheme (LATs). Landfill Tax, an escalating tax currently £64 per tonne (April 2012), is charged in addition to landfill operator’s disposal fees estimated on average to be a further £50/tonne. LATs expose Local Authorities exceeding landfill disposal allowances to fines of £150 per tonne. These financial measures have provided incentives for Local Authorities to encourage the separation of materials for recycling and composting (Costa et al, 2010).

A case study of the changes in household waste and recycling collections operated by Charnwood Borough Council (CBC) is presented showing the impact of trends in recovery of dry recyclates, organics, bulky waste and waste management practices. This is further developed, comparing CBC’s waste management performance and operational procedures with other English Local Authorities, with an emphasis on those with high performing recycling collections.

### Background / Context

CBC, in the East Midlands of England, is classified as an “Other Urban” area (Defra, 2005), with a population density of 5.5 persons/hectare (Census, 2001). Waste management responsibility for the 67,000 households is split between CBC, the Waste Collection Authority (WCA) responsible for collection of household waste and Leicestershire County Council (LCC), the Waste Disposal Authority (WDA) responsible for waste disposal.

A relatively low proportion of flats and apartments (9.56%) (Census, 2001) means the authority doesn’t face the waste collection challenges associated with properties of this type. However, the presence of Loughborough University, with its large student population living in rented accommodation presents other challenges associated with a transient population.

### Household Waste Collections

CBC’s household waste collection service has evolved over time to increase the proportion of household waste recycled or composted and to reduce the cost of collections. This has included introducing wheeled bins, changing the collection frequency to fortnightly, increasing the number of recyclable materials collected and introducing a charge for a garden waste service.

As shown in Table 1, the standard household waste collection service uses 240 litre wheeled bins to collect fortnightly residual waste and five dry recyclates that comprise paper, cardboard, glass, metal cans and plastics. More than a third (36%) of English Local Authorities collected this range of five materials in kerbside schemes (WRAP, 2009). An “opt-in” fortnightly chargeable garden waste collection is currently used by more than 30% of the 67,000 households. Additionally, schemes operated with local charities enable textiles and some bulky waste items from households to be recycled and reused.

**Table 1:** Refuse and recycling collections operated in Charnwood Borough Council (Charnwood Borough Council, 2012)

Service	Materials	Container	Collection frequency
Recycling	Glass bottles and jars Steel and aluminium cans, plastic bottles, paper and cardboard	Green 240 litre wheeled bin	Fortnightly
Organic waste	Garden waste only Charged for service	Brown 240 litre wheeled bin	Fortnightly
Residual waste	Non-recyclable waste	Black 240 litre wheeled bin	Fortnightly

In 2002/03 CBC recycled and composted 16.81% of household waste, this rose to 42.73% in 2009/10 (Table 2) when the service noted in Table 1 was operating; similar schemes have been adopted by other UK Local Authorities.

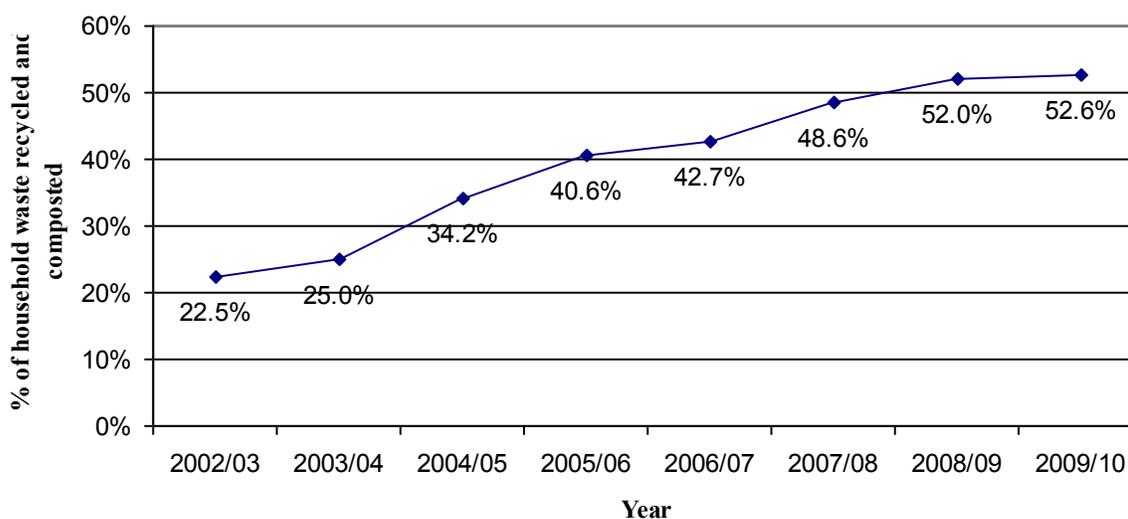
**Table 2:** Percentage of household waste reused, recycled & composted in Charnwood Borough (WasteDataFlow online, 2012).

Year	Dry recycling (%)	Organic waste Composted (%)	Total household waste recycled or composted (%)
2002/03	16.52	0.29	16.81
2003/04	17	0	17
2004/05	21.23	2.75	23.98
2005/06	28.83	6.96	35.79
2006/07	27.95	7.94	35.89
2007/08	30.32	8.92	39.24
2008/09	30.39	11.14	41.53
2009/10	29.94	12.79	42.73
2010/11	26.67	19.43	46.1

**Partnership working - Leicestershire Waste Partnership**

An attempt to further reduce waste to landfill with the aspiration of a Zero Waste Charnwood has encouraged partnership working with other neighbouring local authorities, other organisations and commercial partners.

In the CBC area, the Leicestershire Waste Partnership (LWP) has been formed and collectively they have recycling targets (Figure 1). This is a partnership between the other Waste Collection Authorities (WCAs), the Waste Disposal Authority (WDA), and the largest city in the area, Leicester City Council (a Unitary Authority responsible for both the waste collection and waste disposal). The partnership operates joint waste reduction, recycling and communications projects, but the responsibility for waste collection (and associated budgets) remains with individual partner councils.



**Figure 1.** Leicestershire Waste Partnership joint recycling and composting performance 2002- 2010 (Defra, 2010).

The Partnership’s main effort is to divert waste from landfill rather than pay the default penalties of £150 per tonne imposed if Local Authorities exceed the landfill disposal allowance they have under the LATs scheme. Members of Leicestershire Waste Partnership individual recycling and composting performance figures for 2009/10 are shown in Table 3.

**Table 3:** Recycling and composting performance figures (2009/10) for the member councils of the Leicestershire Waste Partnership (Defra, 2010).

<b>Local Authority</b>	<b>% of household waste reused, recycled or composted, 2009/10</b>
Harborough District Council	53.27
Melton Borough Council	50.05
Hinckley & Bosworth Borough Council	49.78
Blaby District Council	44.77
North West Leicestershire	44.18
Oadby & Wigston Borough Council	44.01
Charnwood Borough Council	42.73
Leicester City Council	39.83

The collection schemes operated by Leicestershire Waste Collection Partners all differ, but generally perform above national recycling and composting targets. The joint strategy (Leicestershire Waste Management Partnership, 2010,) sets a joint target for recycling and composting at least 58% of Leicestershire’s household waste by 2017.

The Leicestershire Partnership was the highest performing two-tier Local Authority waste partnership in England in 2009/10, with 52.6% of household waste sent for recycling and composting (Defra, 2010). This success is attributed to the efficiency benefits from the large partnership.

**Household waste management performance**

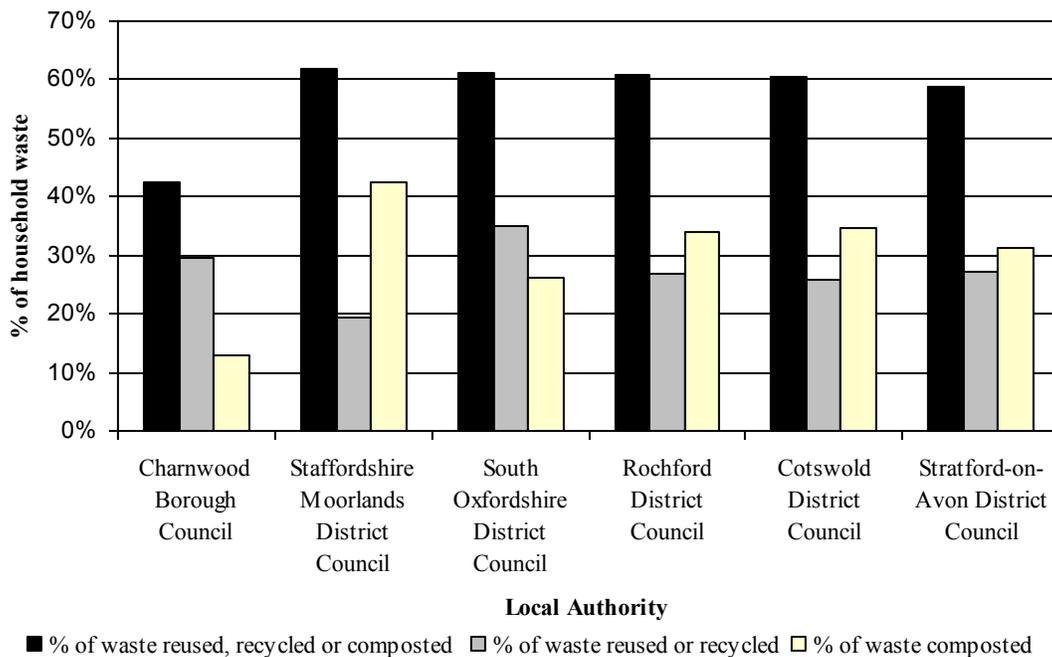
Local Authorities collect a range of data to report their performance against National Indicators. Best Value Performance Indicators (BVPIs) were introduced in 1999, and listed below. The BVPIs use calculated percentages of total weight of material collected.

- BV82a Household waste – percentage recycled
- BV82b Household waste – percentage composted
- BV84 Kg of household waste collected per head
- BV86 Cost of waste collection per household

Between April 2008 & March 2011, National Indicators (NI’s) superseded BVPIs (Audit Commission, 2011). The data is still collated in the same way by Defra (Dept for Communities & Government, 2011). The National Indicators for waste and recycling are:-

- NI 191 - Amount of residual waste per household
- NI 192 - Amount of household waste reused, recycled and composted
- NI 193 - Percentage of municipal waste landfilled

This data is used to calculate recycling performance over time and an annual “league table” is issued by the Department for Environment, Food and Rural Affairs (Defra) showing the performance of individual Local Authorities. The introduction of performance indicators has improved dissemination of best waste management practices, contributing to a reduction in landfilled waste (Tebbutt Adams et al, 2000). Positions at the top of the league table issued annually by Defra are dominated by Local Authorities collecting large amounts of compostable waste, Figure 2.



**Figure 2:** Percentage of household waste recycled and composted by the top five performing Local Authorities 2009/10 and Charnwood Borough Council (Defra, 2010).

Four Local Authorities in England achieved recycling and composting rates in excess of 60% in 2009/10. For CBC, the recycling and composting rate was 42.73%. Only one of the top four performers, South Oxfordshire District Council, collects a higher percentage of dry recyclates than CBC.

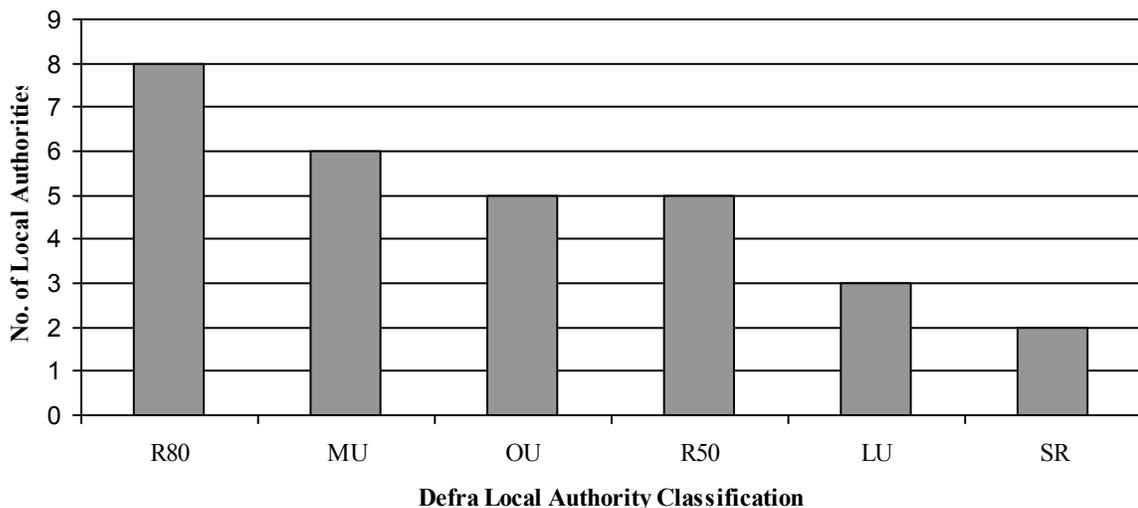
Staffordshire Moorlands District Council headed the 2009/10 “recycling performance league table”, recycling and composting 61.84% of the household waste it collected. The lowest performing council in 2009/10 was Ashford Borough Council, recycling and composting only 15.29% of its household waste. CBC achieved 121<sup>st</sup> place out of 325 English Local Authorities. Figure 2 shows CBC’s 2009/2010 performance for recycling and composting compared to the top five performing Local Authorities, this highlights the influence of organic waste.

The combined total percentage for recycling, reuse and composting of 42.73% in 2009/10 for CBC places them in 121<sup>st</sup> position out of the 325 English Waste Collection Authorities in the “league table”(Defra, 2010). When compared by dry recyclates collected, as expected because of the organics, CBC performs significantly better, being placed in 28<sup>th</sup> position out of 325 Authorities, with 29.94% of the household waste collected being recycled. The highest performing dry recycling collection service is Leicester City Council, recycling 38.26% of household waste collected.

### Dry recycling performance

The 30 top performing recycling Authorities were identified and the type of Local Authority, location, size of population and demographic makeup of each Local Authority was established to investigate if patterns or relationships existed to explain why these areas achieved higher yields of dry recyclates from household waste collections.

Defra classifies Local Authorities according to the urban / rural mix of the area. The six categories are major urban, large urban, other urban, significant rural, rural 50 and rural 80. Each category is represented in the top 30 performing councils, but the dominant category is Rural 80 districts where at least 80 per cent of the population live in rural settlements. The distribution of the sample Local Authorities across these categories is shown in Figure 3.



**Figure 3:** Distribution of Local Authorities across the Defra classification groups (Defra online, 2012)

A diverse range of Local Authorities achieve high yields of recyclates, with there appears to be no common socio-economic or other demographic factors. For example Stratford upon Avon and Rochford are relatively affluent, rural areas and the Metropolitan Boroughs of Newcastle-upon-Tyne and Walsall are densely populated, less affluent urban areas. The Local Authorities are also spread geographically across the UK and do not cluster in specific areas.

### **Local Authorities' organisational differences**

Another possibility was organisational differences and the following questions were researched to establish procedures in waste collections among high performing Local Authorities across the UK:-

- Is the household waste collection service operated by the Local Authority (in house) or an external contractor?
- Are there any charges for bulky waste collections?
- Are there any charges for garden waste collections?

Of the 30 Local Authorities in the sample, 19 are Waste Collection Authorities; responsible only for the collection of household waste and 11 are Unitary Authorities, responsible for the collection and disposal of household waste.

CBC's Household waste collections services are operated by a private contractor, Serco. Of the 354 English Local Authorities 43% have external operators collecting household waste and 36% operate services with their own employees, with 21% having unknown arrangements (WRAP, 2009). Of the 30 top performing Local Authorities for dry recycling collections, 20 have an external service provider and the remaining 10 operate collection services with their own employees.

### **Bulky waste collections**

The term "bulky waste" refers to items too large for standard household waste collections and includes furniture and white goods. Local Authorities can, if they wish, charge for the separate collection of these items. Around 77% of Local Authorities charge a collection fee for removing bulky waste items (APSE, 2009); CBC operates a free of charge bulky waste collection, limited to 9 items (3 x 3 items) per year for each household. Charging for this service could reduce demand for the service encouraging households to seek the retailers to recycle these items.

The bulky waste stream offers valuable opportunities to reduce and recycle waste (Chung et al, 2010). Many household items are discarded before the end of their useful lives; some of these could be used or repaired for reuse (CBC, 2010). Approximately 400 reuse organisations providing a collection and distribution service for second hand furniture and household goods operate in the UK, diverting 90,000 tonnes of waste from landfill annually (Furniture Reuse Network, 2011). Supporting these reuse activities provides additional performance benefits to Local Authorities.

The reuse of bulky waste is often difficult to audit or identify due to lack of knowledge about available donation and reuse schemes. There is a reluctance to use second hand goods; because of "rules" imposed regarding the safe condition of donated materials including meeting the latest fire retardant regulations (Shaw, 2010).

Recognising the benefits of reusing bulky waste items and the limited opportunities there are to capture reusable items CBC have a telephone booking system to organise collection of bulky waste items. A series of questions establish if items are reusable, in

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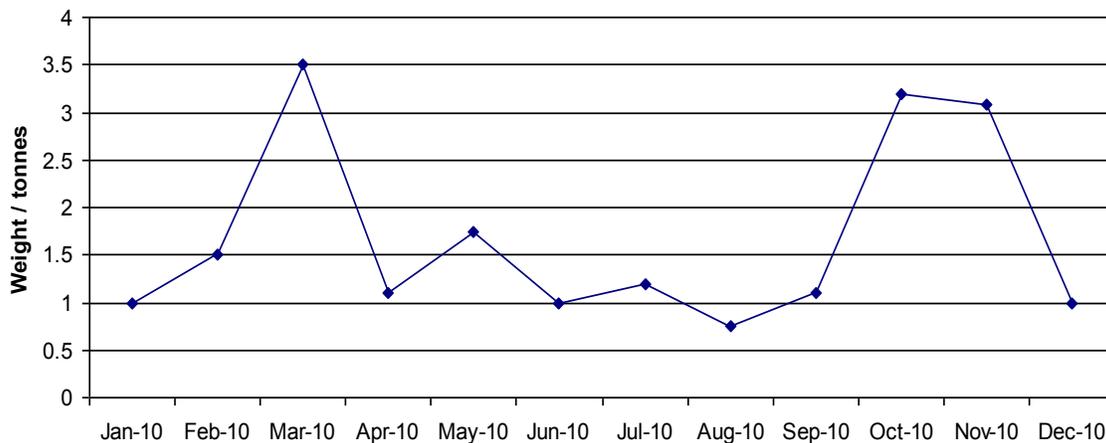
working order and pass current Fire Regulations. If suitable, items are collected by SOFA, one of the furniture reuse organisations CBC works with.

The number of items and corresponding weight of bulky waste collected for reuse through SOFA has varied between 1.3 tonnes and 3.2 tonnes per month, the monthly breakdown of items and weights collected in 2010 are shown in Table 4.

**Table 4:** Bulky waste items collected for reuse, 2010 (Collated from a series of unpublished CBC internal records)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total / Year
Weight/kg	1382	2082	2797	2196	2277	2682	3275	1706	2522	2255	2405	1457	27036
Quantity	38	55	68	60	58	69	98	42	63	58	69	37	715

Many items collected fail safety and fire regulations, are beyond their useful life or are unattractive to the current market for reuse. The metal items (mostly white goods unsuitable for reuse) are removed and sent to a scrap metal dealer for recycling, the weight of these items is shown in Figure 4. Any remaining items unsuitable for reuse are sent to landfill for disposal.



**Figure 4:** Monthly weight of scrap metal recovered from bulky waste collections (Collated from a series of unpublished CBC internal records)

More items are sent for landfill disposal than are reused. For example, in June 2010, 383 tonnes of bulky waste was collected; of this 26 tonnes (69 items) was diverted for reuse via SOFA furniture reuse project and 1.5 tonnes was recycled as scrap metal. Only 7% of the bulky waste collected in June 2010 was therefore recycled or reused, the remaining items were landfilled.

Recycling options for some of these remaining items exist; for example wood in furniture and bookcases and wardrobes can be recycled and specialist recycling centres exist for carpets and mattresses and Waste Electrical and Electronic Equipment (WEEE). The cost

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and logistics of separating these items from the bulky waste destined for landfill will be explored by CBC in an attempt to recycle more of this waste stream.

Of the 30 Local Authorities in the sample, 27 Authorities charge to collect bulky waste items, only three Authorities operate a free of charge collection service. These are CBC, Leicester City Council and Milton Keynes Council.

The free service was introduced to control the level of fly-tipping in the Borough, however fly-tipped waste has risen in CBC since the free collection service commenced, compared to a reduction in fly-tipping nationally. Thus a review of this policy to look at alternatives for this waste could direct more through approved reuse and recycling schemes.

### **Garden waste**

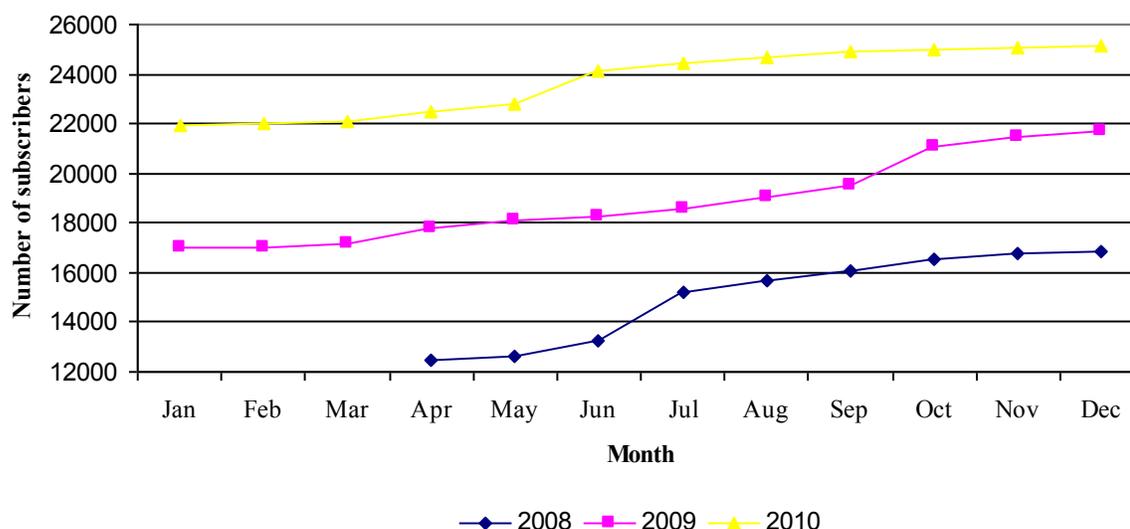
Separate garden waste collections remove significant amounts of organic waste from the residual waste stream collected by Local Authorities, and assist in meeting Landfill Directive targets.

CBC operates an “opt-in” garden waste collection service, costing householders £26 per year. The yield of garden waste collected for composting has increased from 1381.86 tonnes per year in 2004/05 to 6828.68 tonnes per year in 2009/10 (Defra, 2010). This helped CBC’s to improve its composting performance from less than 1% of household waste collected in 2002/03 to 12.79 % of the household waste collected in 2009/10, as shown in Table 5.

**Table 5:** Organic waste collected from households in Charnwood Borough 2004/05 to 2009/10 (Defra, 2010).

<b>Year</b>	<b>Composting (tonnes)</b>
2004/05	1381.86
2005/06	3531.10
2006/07	4282.06
2007/08	4810.72
2008/09	6110.52
2009/10	6828.68

The increase in organic material collected is due to the steady growth in the number of households using this service; rising from 12,500 in March 2008 to 26,300 in April 2011, Figure 5.



**Figure 5:** Number of residents subscribing to the garden waste collections operated by Charnwood Borough Council, 2008-2010 (Collated from a series of unpublished CBC internal records)

Of the 30 Local Authorities in the sample, 18 Authorities charge for the collection of garden waste, nine Authorities operate a free of charge collection service and three Authorities do not operate a garden waste collection service, Table 6.

**Table 6:** Charging policy for household collection of garden waste.

No household collection of garden waste	Charge made for household garden waste collection	No charge made for household waste collection
3	18	9

The three Authorities not operating garden waste collections were City of London, where there is no demand for this service because of the property types in the area; Leicester City Council, who pre-treat all their residual waste to reduce the biodegradable element and recover recyclates before disposing at landfill, rather than removing this waste at source. The other, Uttlesford District Council, was a Rural 80 District with 80% of the population living in rural areas. Uttlesford offers an alternative to kerbside collections with Household Waste Recycling Centres and mobile weekend drop-off points in parish areas for householders to deliver garden waste to.

The two Local Authorities separately collecting the highest percentage of garden waste were South Oxfordshire with 25% and Rutland District Council with 24%. Both of these Authorities charge for this collection service and collect significantly less garden waste than the top performing local Authority in England, Staffordshire Moorlands with a 42% composting rate from the free garden waste collection service they operate in a large rural area where most properties have gardens.

The local decision to implement a charge for these collections, which are offered free of charge in other areas, may have impacted on recycling and composting performance with some residents unwilling to pay an additional charge continuing to use the residual waste container for the disposal of organic material.

To encourage home composting of garden waste rather than using the garden waste or residual waste collections, CBC offers a variety of equipment at subsidised rates through the SWITCH project (Saving Waste in The Charnwood Home). The aim is to further reduce the amount of biodegradable waste landfilled. Households actively using home compost bins divert 4.5 tonnes of organic waste per year from general waste (Leicestershire Municipal Waste Management Strategy: 2010).

### **Food waste collections**

With local investigations into the composition of household waste showing that 42% of residual waste was food waste (WastesWork, 2009) a successful separate food waste collection would significantly reduce the amount of household waste being sent to landfill for disposal. Food waste requires treatment in a State Veterinary Service approved facility to comply with Animal By-Products Regulations, 2005. These Regulations control the composting process ensuring pathogens are inactivated. The process is consequently more expensive than composting garden waste alone, ranging from £26 to £104 per tonne compared to £20 to £36 per tonne for garden waste composting (WRAP, 2010). Many Local Authorities are currently exploring and introducing separate food waste collections utilizing additional financial incentives for renewable energy, CBC do not operate separate collections for food waste and have no immediate plans to do so; food waste is currently collected as a component of residual waste and is landfilled.

### **Conclusion**

The research has found differences in household waste services and policies across the UK; and that these had the potential to impact on recycling performance. The research has confirmed the need for local decision and therefore the ability to tailor services to suit different demographic areas, however, some of the locally originating policies, for example charging householders for the separate collection of garden waste and operating free collections of bulky waste may be restricting performance. Partnership working between Waste Collection and Waste Disposal Authorities such as the Leicestershire Waste Partnership Authorities in the same geographical area provides efficiency gains and improves sustainable waste management.

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## **APPENDIX B PAPER 2: BULKY HOUSEHOLD WASTE MANAGEMENT IN A UK LOCAL AUTHORITY AREA**

### **Full reference:**

Cole, C., Osmani, M., Wheatley, A., Quddus, M., (2013). Bulky Household Waste Management in a UK Local Authority Area: Current Practice, Challenges and Improvement Opportunities. Proceedings of Fourteenth International Waste Management and Landfill Symposium, S.Margherita Di Pula, Cagliari, Italy; September 2013

### **Abstract:**

Charnwood Borough Council (CBC), an English local authority, recently introduced a Zero Waste Strategy encompassing targets for waste minimisation and recycling of household waste above UK Government baselines. To achieve these targets various areas of household waste management need to be amended to improve recycling performance. The bulky waste collection service, collecting large items such as furniture and electrical goods was identified as an area to target for improvement. A case study approach was adopted using data collected on a daily basis by CBC to quantify the number and type of items in the bulky waste stream. Current practices of managing bulky household waste are explored; identifying challenges in dealing with this waste stream such as financial and logistical challenges in identifying, collecting, repairing and storage. However, there is potential to increase recycling of some discarded items, particularly the large numbers of mattresses and some wooden furniture unsuitable for reuse.

**Paper type:** Published conference paper

## 1. Introduction

The term “Bulky waste” refers to items that are too large for standard household waste collections and includes items of furniture and white goods. Local Authorities (LAs) can make a charge, if they wish, for the separate collection of these items (Environmental Protection Act, 1990, section 45, 3b). As such, 77% of LAs charge householders a collection charge for removing bulky waste items (APSE, 2009). It is recognised that the bulky waste stream offers valuable opportunities to reduce and recycle waste (Chung et al., 2010). However, many household items that are disposed of before they reach the end of their useful lives could be used or repaired for reuse (Charnwood Borough Council, 2009).

The revised Waste Framework Directive 2008/98/CE (2008) places increased emphasis on reuse of waste and preparing for reuse and provides the following definitions:

Re-use is “any operation by which products or components that are not waste are used again for the same purpose for which they were conceived” (Waste Framework Directive, 2008, Article 3.13).

“Preparing for re-use” means checking, cleaning or repairing recovery operations, by which products or components of products that have become waste are prepared so that they can be re-used without any other pre-processing” (Waste Framework Directive, 2008, Article 3.16).

Most English LAs support or operate reuse projects for furniture and white goods, with the bulky waste stream offering valuable opportunities to reuse and recycle waste (Chung et al., 2010). Reuse and preparation for reuse of bulky waste items in the UK is carried out via 400 reuse organisations that help divert 90,000 tonnes of bulky waste from landfill annually (Furniture Reuse Network, 2011). It is estimated that between 20-70% of the bulky waste stream could be potentially recycled or reused, of which one third has high potential reusability depending on quality issues and necessary repairs. This is hardly the case in current practices as only 2% is reused (WRAP, 2009).

Whilst many bulky waste items are suitable for reuse, in practice this remains a possibility rather than a certainty (Shaw et al., 2010). The route for reuse is often difficult for a householder to identify. Furthermore, the existence of other reuse barriers including limited or lack of awareness on reuse options, including donation; a reluctance to use second hand goods; and the “rules” imposed by the recipient organisation regarding the condition of donated materials to ensure they are safe, fire retardant and in a good saleable condition often discourages donation (Williams et al, 2012).

This paper presents a case study that investigates the current management methods for household bulky waste in Charnwood Borough Council. The aim of paper is fourfold: outline current collection methods; quantify demand for bulky waste collections; explore opportunities to increase reuse and recycling from the bulky waste stream; and identify barriers to increasing reuse and recycling from the current collection system.

## 2. Current household waste management practices in Charnwood Borough Council

Charnwood Borough Council (CBC) is a Waste Collection Authority (WCA) in the East Midlands of England. Covering an area of 279 km<sup>2</sup>, the Charnwood area is classified as an “Other Urban” area (Defra, 2005), with a population density of 5.5 persons/hectare (Census, 2001). CBC operates a comprehensive kerbside recycling collection to 67,000 households for easily recycled household materials like glass, cans plastics paper and cardboard batteries on a fortnightly basis. There is also a fortnightly collection of organic garden waste and residual waste delivered under contract by an external service provider (Table 1).

**Table 1:** Refuse and recycling collections operated in Charnwood Borough (Jan 2013). (Charnwood Borough Council, 2013)

Service	Materials	Container	Frequency of collection
Recycling	Glass bottles and jars Steel and aluminium cans, plastic bottles, paper and cardboard	240 litre wheeled bin	Fortnightly
Organic waste	Garden waste only Charged for service	240 litre wheeled bin	Fortnightly
Residual waste	Non-recyclable waste	240 litre wheeled bin	Fortnightly
Bulky household waste	Furniture, white goods etc (household items too large for containers supplied)	None supplied	On demand Up to 3 collections of 3 items per year

In 2011/12 CBC collected a total of 56,458 tonnes of household waste, of this 49% (27,293 tonnes) was recycled, reused or composted and 51% (29165 tonnes) sent for landfill disposal (WasteDataFlow, 2012).

In addition to the regular CBC household collections, there is an “on demand” special collection service for household bulky waste, provided free of charge up to three times per year for each household, with a maximum of three items per collection (maximum nine items per household per year) (Table 1). Current CBC collection and reuse practices for bulky waste are outlined below.

### 2.1 Current bulky waste collections

CBC offers a free of charge collection service for bulky waste. Of the 30 high performing recycling LAs in 2010, CBC was one of only three that offered a free of charge bulky waste collection (CBC, 2009). Householders book collections online or by telephone, which are entered on an internal database that records the date, number, and type of items for collection. CBC’s waste contractor makes around 12,000 individual bulky waste collections per annum in the Borough (approx. 250 collections per week).

Items accepted for bulky waste collections are mostly discarded furniture and white goods. However, no previous study has taken place to investigate the number and types

of items that are discarded through CBC special bulky waste collections. A very small number of items are recovered from bulky waste for reuse; the weight of items recovered between 2008 & 2012 is shown in Table 2.

**Table 2:** CBC reuse and recycling of household waste -tonnes per annum (WasteDataFlow, 2012)

<b>Year</b>	<b>Total reuse (tonnes per annum )</b>	<b>Total household waste recycled (tonnes per annum)</b>
2008-09	100.42	15817.29
2009-10	186.43	15868.64
2010-11	131.64	16202.27
2011-12	156.64	16795.51

Alternative disposal points are provided free of charge at three Household Waste Recycling Centres, these are sited at the three main urban centres within CBC’s area.

### **2.2 Current bulky waste reuse opportunities: SOFA furniture reuse project**

A collaboration between SOFA, a local third sector furniture reuse project and CBC has been operating for several years, but has very little impact on the amount of bulky waste diverted from landfill. A small number of items are diverted from the bulky waste collections by recommendation to the reuse project at the time of booking a collection. The total weight of furniture sold for reuse by SOFA annually are shown in Table 3, these items have been donated to SOFA for reuse from a variety of sources, some of these items may have been destined for landfill disposal via the bulky waste collection service.

**Table 3:** Furniture sold for reuse (by weight) by SOFA furniture reuse project, Loughborough, 2008-2012. (SOFA, 2013)

<b>Year</b>	<b>Tonnes reused by SOFA</b>
2008-09	76.9
2009-10	80.7
2010-11	76.2
2011-12	84.1

The SOFA reuse project offers social and environmental benefits to the area in which it operates, these include:

- Cheaper alternative for replacing furniture to needy homes;
- Training opportunities and a pathway into employment for volunteers; and
- Environmental benefits of reducing waste to landfill.

In addition to furniture reuse, some recycling of scrap metal from white goods also takes place via SOFA; this is a relatively small amount, with only 25 tonnes being recycled in 2011/12, from the 61 tonnes of electrical items collected.

### **3. Methods**

The current destination of bulky waste was explored using archive analysis of WasteDataFlow records and CBC internal records.

Bulky waste collection records were used to quantify the amount of bulky waste collected from households in CBC during January to March 2012 and a compositional analysis of this bulky waste stream took place to show the type and number of items collected.

The resulting waste composition was then used together with the Average Weights for Furniture Guide (Furniture Reuse Network, 2012), to produce a table showing the total weights of each category of items over the period studied. The Average Weights for Furniture Guide sets generic weights for the different items which enter the bulky waste stream. LAs & reuse projects use these average weights, under guidance from Defra (Department for Environment, Food & Rural Affairs), a UK Government Department responsible for waste accounting, to calculate the volume of materials in the bulky waste stream without having to weigh individual items.

Using the quantity data of various bulky waste items, it has been possible to calculate an estimate total weight for each category and the subsequent impact on reuse and recycling improvements to make use of various available processes, technologies and outlets.

### **4. Data collection**

#### **4.1 WasteDataFlow**

Monthly records kept by CBC and reported to Defra via WasteDataFlow, showing the amount of waste collected from household and the treatment and disposal routes for that waste. These records for CBC show household waste separated into three different categories: materials collected for reuse and recycling; organic waste (garden waste) collected for bio-treatment; and residual waste (all other waste) collected for landfill disposal

Data of interest to this study concerns the section within the reuse and recycling streams that accounts for items collected as bulky waste that is recycled or reused.

#### **4.2 CBC internal records**

Bulky waste collection data recorded by CBC at the time a householder requests a collection. These records show: collection address; type and number of items to be collected; and any special collection arrangements (e.g. collection time).

A sample of three months data for January, February and March 2012 was extracted from this database to quantify by item type and tonnage the amount of bulky waste collected. The items were then clustered into six bulky waste streams: soft furnishings, wooden furniture, mattresses, carpets & rugs, electrical items, and miscellaneous. Grouping was done in this way to estimate recycling and reuse potential.

A three month period was chosen to keep the data analysis manageable. These months were chosen because the records had been audited for the 2011/12 via WasteDataFlow

reporting schedule and the national performance figures for 2011/12 were available from Defra.

### 5. Data analysis

The analysis was separated into two sections, one solely for general electrical items and one showing the other items commonly collected via this separate collection service. The records maintained by CBC, which enabled the collection of bulky waste to be carried out were a little limited for the purpose of the study. Indeed, several records contained poorly recorded data, with a lot of items described as “other”. This was further impeded by not finding out retrospectively what these items were, so although they are included in the overall weight of items collected it is not possible to include them in the waste composition analysis.

In addition to this, there was no record of the size of the items collected, for instance there was no indication of the size of mattresses, whether they were a single or double mattress, or the size of the carpets collected. For these items an average weight has been used, so the total weights collected have to be treated as estimates.

### 6. Results

The amount of bulky waste sent to landfill is constant throughout the year, with over 22,000 bulky waste items collected from households in 2011/12.

Results reveal that once an item was booked as a bulky waste collection, there was very little opportunity for it being rescued for reuse. Some electrical items (mostly white goods i.e. fridges, washing machines and similar) are recovered for the scrap metal to be recycled via SOFA. In 2011/12 only 25 tonnes of scrap metal recovered from the bulky waste collections, Figure 1 shows the amount of scrap metal recycled each month. Some smaller household electrical items are sent for recycling via Leicestershire County Council, the regional LA responsible for disposal of household waste collected by CBC.

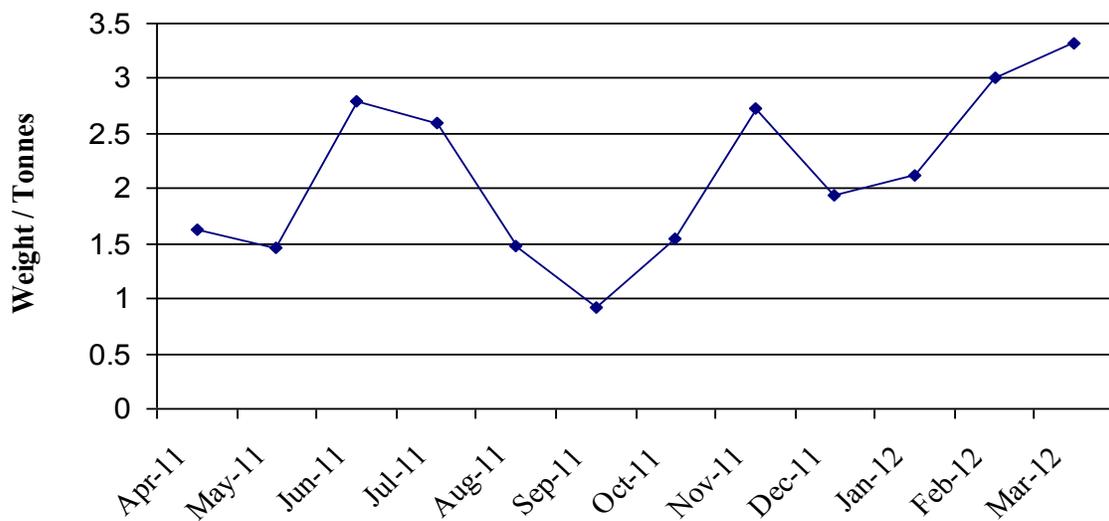


Figure 1: Scrap metal recycling in tonnes (CBC internal records, 2012)

### 6.1 Composition of bulky waste stream

During the three month monitoring period from January to March 2012, CBC collected 5524 items bulky waste items, this amounted to 50.37 tonnes. In order to analyse the bulky waste stream in detail these items were categorised by item. The 12 most commonly discarded items are shown in Table 4.

**Table 4:** Bulky waste items and electrical goods collected January 2012 to March 2012

Type of item	Number of units	Weight/unit (kg)	Total weight (kg)
Mattress	877	10	8,770
Sofa	654	20	13,080
Armchair	171	10	1,710
Sofa bed	14	60	840
Chair	204	3	612
Futon	4	35	140
Bed Base	340	10	3,400
Table	101	10	1,010
Bed	47	20	940
Cabinet	61	15	915
Chest of Drawers	60	10	600
Wardrobe - dismantled	28	20	560
White goods	525		8020
Household electrical items	449		5281

With a large variety of items included in the analysis, it was necessary to cluster bulky waste streams into groups of items (Table 5). The groups chosen were outlined in section 4.2.

**Table 5:** Weight of bulky waste items collected (January to March 2012)

Group of items	Weight collected Jan-Mar 2012 (kg)
Soft furnishings	16,382
Electrical items (including white goods)	13,301
Wooden furniture	9,650
Mattresses	8,770
Carpets, rugs etc	3,445
Miscellaneous	437

The most dominant group of items collected is furniture, with this group being made up of mostly sofas, and mattresses. Many items collected on the bulky waste collection service are not suitable for reuse since they are beyond their useful life, do not regularly pass safety and fire regulations for reuse, or are unattractive to the current market. However, there may be recycling opportunities to explore where items can be dismantled or deconstructed and the metal, wood or fabric contained within them can be recycled.

Removing wood from the bulky waste stream in this way for recycling would also reduce the amount of organic waste sent for landfill disposal.

## **6.2 Estimating and identifying bulky waste potential reuse and recycling opportunities**

WRAP's Waste Prevention Toolkit (WRAP, 2009) estimates the potential for reuse and recycling opportunities from the bulky waste stream as follows:-

- Furniture, reusable in current condition 20%
- Furniture, potentially repairable 25%
- White goods, potentially repairable 7.5%
- White goods & other metal, recyclable 20%
- Unrecoverable items not suitable for repair or reuse 27.5%

CBC collected 227 tonnes of bulky waste in 2011/12, if 72.5% of this was recovered (as outlined in the WRAP study), then there is the potential to increase CBC's annual recycling rate by 4%. This would require the segregation of reusable and potentially reusable items from the bulky waste stream.

During the three month study period, 18% of the total number of items (1013 items) collected could not be matched to the generic items due to incomplete data, or being classified as "other", because there was no information other than the number of items; and as such it is not possible to give an accurate estimate of the weight of these items. Over the course of a year this exceeds 4000 items, which could potentially add up to 40 tonnes of recoverable items and materials if each item weighed an average of 10kg. Improved data collection would be able to confirm this.

## **6.3 Alternative recycling and reuse options**

There are recycling options available for some of the items not suitable for reuse; for instance, it is possible for the wood in wooden furniture e.g. bookcases and wardrobes to be recycled and there are specialist recycling treatment centres for carpets, which already process some carpets for LAs in the UK (Carpet Recycling UK, 2013) and mattresses (MRW, 2010). Mattresses and sofas appear in the bulky waste stream in sufficient quantities to make their segregation worthwhile. There are around three tonnes of each present in the waste stream each month. These items can be dismantled and different materials used in their manufacture, for example metals, wood and textiles can be recycled through existing recycling routes.

Alternative routes for reuse of bulky household waste exist; these include online sites such as eBay, freecycle, free local newspaper advertisements, second hand furniture shops, and car boot sales, and take back disposal schemes via retailers which operate for a limited number of items (e.g. mattresses WEEE).

These alternative recycling and reuse routes have different logistical challenges, but the promotion of these alternative routes for bulky waste could prevent it entering into CBC household waste stream.

#### **6.4 Categorising items for reuse, repair or recycling**

There is only a limited understanding of the type of items collected by the bulky waste service. Quantifying the bulky waste streams in terms of type of items and weight of individual categories highlights the areas to target for reuse and recycling opportunities in order to reduce the quantity sent for landfill disposal. In addition, it is unknown how many items are reusable in the condition they are discarded, or how many just require slight repair to become reusable. Currently no segregation takes place at either the collection point or prior to disposal. It would be useful to assess items at an early stage and categorise them as reusable; require minor repair; require major repair; not repairable but recyclable; and neither repairable nor recyclable.

Items suitable for reuse and/or recycling need to be separated early in the collection system; and identify items with reusability or recycling challenges related to fire safety, quality issues, repairs required, etc. The current collection arrangements provide no facility for separating reusable items. Reuse is labour intensive as it involves collection, sorting, testing, refurbishment and reselling. The current contract arrangements do not make specific requirements for maximising reuse and recycling opportunities from the bulky waste stream.

#### **6.5 Drivers for improving reuse / recycling**

The revised Waste Framework Directive has an increased focus on reuse as it seeks to move waste up the waste hierarchy towards the preferred options of waste reduction and reuse ahead of recycling.

CBC has been ambitious in its attempts to reduce the amount of household waste collected and sent for landfill disposal by operating a comprehensive kerbside collection of recyclable materials and garden waste. In order to meet the targets it has set itself in the 2012 Zero Waste Strategy, CBC will have to continue to strive to increase the proportion of waste collected for recycling and reuse.

#### **6.6 Barriers for reuse and recycling**

CBC has responsibility for the collection of household waste; the regional LA (Leicestershire County Council) is responsible for disposal of the waste. This sometimes prevents a holistic approach to waste management. However a good working partnership enables both parties to make appropriate decisions regarding the sustainable management of waste.

Other factors that make it difficult to improve the proportion of bulky waste that is reused and recycled include poor and incomplete data, limited capacity for handling furniture at the reuse projects and the current collection methods. Without segregation at the collection point, or at least prior to disposal there will be no improvement in the number of recovered items.

Amending the charging policy to introduce a fee for bulky waste collections may encourage residents to seek alternative routes for the disposal of this waste, with the

possibility that more of it would be directed through reuse and recycling schemes, or any of the routes mentioned above.

## **7. Conclusion**

Monitoring the bulky waste stream for a period of three months provided information on the type and number of items that have been collected from households through the special bulky waste collections. This waste stream is varied in composition; however, some data was missing. Providing more accurate data regarding the composition and quality of items collected would aid planning sustainable treatment and disposal routes for this waste stream.

Furniture was the most dominant type of bulky waste collected. There is potential for reuse of these items if they pass the quality standards required to make them acceptable for second hand use. An early assessment of the items regarding their potential for reuse, repair or recycling could lead to possible improvements in the CBC reuse and recycling rates.

The current CBC collection system for bulky waste is not operated in a way to encourage reuse or recycling of these items. It is set up to provide an efficient removal service for waste disposal at landfill sites. A range of changes would be needed to reverse this trend; these include:

- Operating a free of charge collection for residents may discourage them from trying to find alternative routes for their bulky waste item.
- Communication material that promote reuse and recycling.
- Publicity for local furniture reuse businesses such as SOFA project.
- Changing householders' behaviour studies.
- Maximising reuse and recycling opportunities in partnership with internal and external stakeholders.
- Improving coordination of services between waste contractor and LA regarding the potential for increasing reuse.
- Examining the cost and logistics of separating realistically reusable, repairable or recyclable items from genuine waste, identifying at referral and collection points.
- Storing items in a dry place before collection.
- Improving logistics, including handling and delivery and avoiding the use of a compaction vehicle for the collection round.

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## **APPENDIX C PAPER 3: MOVING TOWARDS ZERO WASTE IN A UK LOCAL AUTHORITY AREA: CHALLENGES TO THE INTRODUCTION OF SEPARATE FOOD WASTE COLLECTIONS**

### **Full reference:**

Cole, C., Osmani, M., Wheatley, A., Quddus, M., (2014) Moving towards Zero Waste in a UK Local Authority area: Challenges to the Introduction of Separate Food Waste Collections, Proceedings of International Conference on Environment and Waste Management, Copenhagen, Denmark (12-13 June 2014).

### **Abstract**

EU and UK Government targets for minimising and recycling household waste has led the responsible authorities to research the alternatives to landfill. In the work reported here the local waste collection authority (Charnwood Borough Council) has adopted the aspirational strategy of becoming a “Zero Waste Borough” to lead the drive for public participation. The work concludes that the separate collection of food waste would be needed to meet the two regulatory standards on recycling and biologically active wastes.

An analysis of a neighbouring Authority, Newcastle-under-Lyme Borough Council (NBC), a similar sized local authority that has a successful weekly food waste collection service was undertaken. Results indicate that the main challenges for Charnwood Borough Council (CBC) would be gaining householder co-operation, the extra costs of collection and organising alternative treatment. The analysis also demonstrated that there was potential offset value via anaerobic digestion for CBC to overcome these difficulties and improve its recycling performance.

**Keywords :** England, Food Waste Collections, Household Waste, Local Authority.

**Paper type:** Published conference paper

## **1. Introduction**

As awareness of the climate and demographic risks to the natural environment has increased more sustainable waste management practices have been sought. These are usually divided into techniques to reduce, reuse and recycle household waste in preference to either landfill disposal or in the UK incineration. This has led Local Authorities (LAs) to adopt strategies and operational practices to introduce source separation of household waste collections. Traditional weekly collections of household waste for landfill disposal have changed to several collection rounds for different materials; sometimes on different timescales. The most commonly adopted practice is alternate weekly collection of dry recyclables (paper, cardboard, plastic and glass) re-separated at a central facility and residual waste (Watson & Bulkeley, 2005).

This has seen England achieve a national average recycling rate of 43.3% (Defra, 2014), below the 50% required by the Regulations by 2020. In particular, food and garden waste need special attention in order to meet phased targets in the EU (Landfill Directive 1999/31/EC) for reducing landfill disposal of biodegradable municipal waste (Price, 2001). Thus the UK Government Waste Strategy for England, 2007 (Defra, 2007), Review of Waste Policy, 2011 (Defra, 2011) and the Waste Prevention Programme for England (2013) (Defra, 2013) identify food waste as the priority for meeting these targets. The Roadmap to a Resource-Efficient Europe (European Commission, 2011) also highlights the food sector as a critical area for action. These policy statements have led to a number of UK-based initiatives focused on food waste. These include the introduction of Landfill Tax (£80 per tonne from April 2014); and WRAP (Waste & Resource Action Programme) initiatives such as the 'Courtauld Commitment' (a voluntary agreement to improve resource efficiency and reduce waste within the UK grocery sector), and 'Love Food, Hate Waste' (food waste reduction educational and behaviour change campaign).

## **2. Food Waste Predicaments**

Around 30-50% of all food produced is never eaten (IMechE, 2013) and this is from production, retail handling and household waste. One third of the waste is reported to be domestic (WRAP, 2012). Household Food Waste is defined as unconsumed food and waste generated during the preparation of meals, it does not include packaging materials (WRAP, 2012). A number of LAs have already introduced separate food waste collections using a separate container at the kerbside for treatment and recovery of by-products. The strong link between sustainability indicators and transport however has led the larger authorities to undertake reviews of the alternatives.

## **3. Waste Composition Analysis**

The main waste categories present in residual waste are kitchen/food waste, around 31% by weight, and paper/cardboard around 16-18% by weight (Iriate et al, 2009). Waste composition analysis of household waste from eight Scottish LAs found 18% of household waste is food waste (Zero Waste Scotland, 2010). However, this increased to 31% of residual household waste (estimated to be approx 3.2 kg/household per week) following removal of the standard dry recyclable materials. There was no seasonal variation detectable in the amount of food waste present.

Other waste composition studies carried out by Burnley (2007) found combined garden and food waste to be between 35% and 38% of household waste, whilst Demirbas (2011) reported a total organic fraction between 18% and 21%. This figure was much lower than other studies and was accounted for by seasonal reductions in garden waste. The high proportion of food waste present in household waste suggests separate collection and bio-treatment of this waste fraction would assist in meeting weight based targets and reduce biodegradable waste sent to landfill (Cole et al, 2011).

#### 4. Treatment Process for Organic Household Waste

Biodegradable municipal waste as defined by the Landfill Directive as food and garden waste. These waste materials can be collected separately, or together which then determines the treatment procedure. Food waste containing cooked or raw meat or fish is covered by the Animal By-Products Regulations, 2005, which controls the treatment conditions and uses of the composted material produced. The ABPR includes inspection of facilities and monitoring of products for pathogens by the State Veterinary Service. If garden and food waste are collected in the same container, or vehicle, the organic waste must be processed in compliance with ABPR.

Food waste is quickly biodegraded and has historically been anaerobically digested via landfills for its biogas. Anaerobic digestion in bioreactors is therefore an attractive substitute treatment option (Xian et al, 2013) to recover this renewable energy. This would require source separation of the two organic streams allowing garden waste that does not contain animal residues to be composted using simple open windrows. Processing food waste in enclosed reactors is more expensive than composting garden waste alone, ranging from £26 to £104 per combined tonne compared to £20 to £36 per tonne for garden waste alone (WRAP, 2010).

#### 5. Current Household Waste Management Practices in the UK

LAs have a key role in supporting sustainable development through their range of public activities, for example planning, education and waste management (Williams & Wilson, 2007). Many have chosen therefore to introduce separate collections of garden and food wastes for bio-treatment or a mixed organic waste (Table 1).

**Table 1:** Percentage of Local Authorities Collecting Food Waste (Wrap, 2012)

	Percentage of Local Authorities collecting food waste*			
	Separate food waste collections	Collect food waste mixed in garden waste	Combination of both separate food waste only and a mixed food & garden waste collections	None
England	29%	22%	2%	47%
Wales	95%	0%	5%	0%
Scotland	34%	22%	6%	38%
Northern Ireland	4%	58%	8%	31%
UK	32%	23%	3%	42%

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\*This information represents WRAP's best understanding of kerbside food collection schemes in operation by local authorities in the UK in 2012. In any authority the scheme may not be available to every household. Where LAs collect only fruit and vegetables with garden waste this does not count as a food or mixed organic waste collection.

An annual "league table" of individual LAs recycling performance, including dry recyclable materials and organic wastes for bio-treatment is issued annually by the UK Government Dept for Environment, Food & Rural Affairs (Defra), (Table 2).

**Table 2:** Top 20 Performing Recycling & Composting LAs 2012/13(Cole et al, 2011).

<b>Local Authority</b>	<b>Percentage of household waste sent for reuse, recycling and composting</b>
South Oxfordshire District Council	65%
Vale of White Horse District Council	65%
Surrey Heath Borough Council	64%
Three Rivers District Council	62%
Stockport MBC	61%
Calderdale MBC	61%
Stratford-upon-Avon District Council	60%
West Oxfordshire District Council	60%
Rutland County Council	60%
Oxfordshire County Council	60%

All the 2012/13 top 10 performing recycling councils operate some form of segregated food waste collection for householders. CBC currently offers no collection service for food waste, other than landfill disposal with residual waste.

CBC recycled and composted 49% of household waste it collected in 2012/13 which placed CBC 84<sup>th</sup> out of 433 LAs in recycling performance in England.

## **6. Methodology**

This paper reports a case study comparison between two neighbouring LAs Charnwood Borough Council (CBC) & Newcastle-under-Lyme Borough Council (NBC). The two have similar demography and size and have been classified as comparable by the Chartered Institute of Public Finance and Accountancy (CIPFA). This model was developed to aid local authorities carry out comparative and benchmarking exercises based on a wide range of performance indicators. These include socio-economic as well as the statistics on wastes. It is used by Central government and Audit Commission to compare LAs performance.

NBC provides weekly food waste collection to all householders. Thus a comparison would show the improvement on the recycling performance of CBC by processing of food waste.

Research was also undertaken to establish the amount of support there was from CBC householders for food waste collections. This included thirteen quarterly telephone surveys carried out since January 2010. Participants are chosen to achieve a demographic and geographic representation of the Borough. The number of responses is set at 10 per 10,000 population per annum. Respondents were asked “How likely would you be to participate in a food waste collection service?” using a Likert scale, where 1 = not at all likely and 4 = very likely. They were also asked why they would, or would not participate in separate food waste collections.

Two focus groups formed to assist the development of a Zero Waste Strategy were used to assess support for food waste collections. One focus group consisted of political representatives of the Council; the other focus group consisted of residents from the Borough, using a similar sampling procedure to the telephone surveys to achieve a demographic and geographic representation of the Borough. Using a scoring matrix the focus groups were asked to priorities a selection of policy and operational measures, including separate food waste collections, that could be introduced to improve the performance of the household waste and recycling collections. Analysis was carried out to rank the options for both focus groups and also to combine the results from the two groups to produce an overall ranking.

Additionally, a six week public consultation exercise on the Zero Waste Strategy during October and November 2012 used a questionnaire that offered the opportunity to provide free-text comments on waste and recycling operations of CBC, or related subjects. The consultation was promoted through a series of public meetings, leaflets, posters, text alerts and the LAs Twitter account and a dedicated webpage on CBC website.

## **7. Results**

### ***7.1 Telephone Survey of Residents***

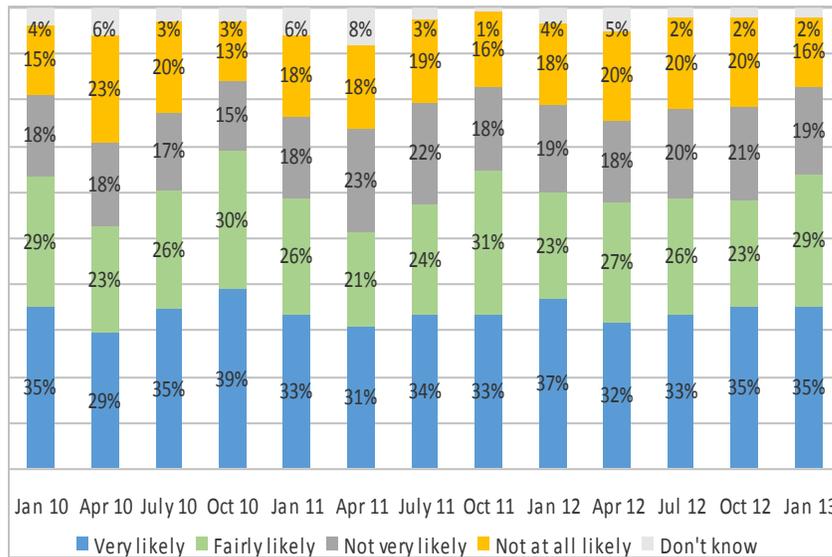
Results from the thirteen quarterly telephone surveys carried out show that show 60% of respondents are likely or very likely to use a food waste collection (Figure 1).

Respondents were also asked why they would or would not participate in food waste collections. Results gave the following reasons for participating:

- It is a good service to offer;
- Better than putting food waste in with residual waste; and
- Better than going to landfill and good for the environment.

Reasons for being unlikely to participate included:

- Residents already disposing of food waste themselves;
- Not having a lot of food waste;
- Too much hassle;
- Unhygienic and attracts pests;
- Not wanting another container



**Figure 1:** CBC householders' likelihood of using a separate food waste collection?

### 7.2 Zero Waste Strategy (ZWS) Focus Groups and Public Consultation

Two facilitated focus groups were conducted: with local politicians; and with residents to identify the most important waste service and policy issues and whether the participants would support the introduction of food waste collections. The results from the focus groups had varying levels of support for the introduction of separate food waste collection. The resident's focus group expressed a higher level of support than the politician's focus group. The degree of success would depend on the system of collection. The two existing possibilities for food waste were:

- Additional mechanical recovery from the residual waste stream, if the potential yield was high enough to justify the additional resources involved.
- The technically easier collection and treatment by separate food waste collection for anaerobic digestion or composting.

This was incorporated into the ZWS draft, for public consultation via a questionnaire available on the LAs website, in paper form at roadshows and events. The public consultation suggested how food waste collections would assist the LA in its aspirational aim to be a Zero Waste Borough and gauged the level of public support. This consultation had 300 responses, with 1% of participants saying they would not support the separate collection of food waste, which is better than the random telephone survey as was anticipated.

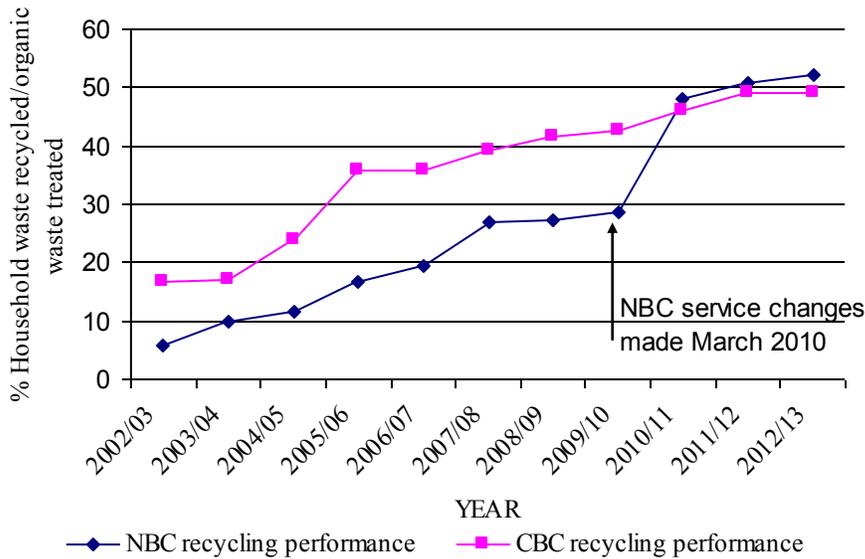
### 7.3 Comparing CBC & NBC Organic Waste & Recycling

CBC is in Leicestershire (East Midlands) and NBC Staffordshire (West Midlands). Both are mainly rural with two large urban centres (NBC Kidsgrove and Newcastle, CBC Loughborough and Shepshed) both also have Universities and transient student

## DEVELOPING SUSTAINABLE HOUSEHOLD WASTE MANAGEMENT – A LOCAL AUTHORITY APPROACH TO ZERO WASTE

populations (NBC Keele University, CBC Loughborough University). CBC has 67,000 households and NBC 52,000.

Historically, NBC had a low recycling rate for the separate treatment of dry recycling and organic waste (Fig. 2) and was in the lower quartile of the recycling performance table (Audit Commission, 2005; Audit Commission, 2009).



**Figure 2:** CBC & NBC recycling performance (since 2002) source Waste Data Flow

Recycling performance improved following the simplification of collection system to the common alternate weekly scheme in 2009/10. Recycling has now increased to 50.3% in 2012/2013 (Figure 2). NBC is now 57<sup>th</sup> highest performer nationally (50.3% for 2012-13) (Table 3) compared to Charnwood which is 84<sup>th</sup> out of 433 LAs nationally, with a recycling rate of 49% for 2012-13.

**Table 3:** Comparing Household Waste Performance (2012/13)

	<b>CBC</b>	<b>NBC</b>
Recycling rate 2012-13	49%	50.3%
Position nationally for recycling performance	84 <sup>th</sup>	57 <sup>th</sup>
Waste collected kg/hh	429kg	422kg

Both LAs currently operate identical waste management schemes except that CBC charges for garden waste and NBC also collects food waste (Table 4) (Hassall, 2013).

**Table 4:** Comparing CBC's and NBC'S Household Waste Collections (Feb2014)

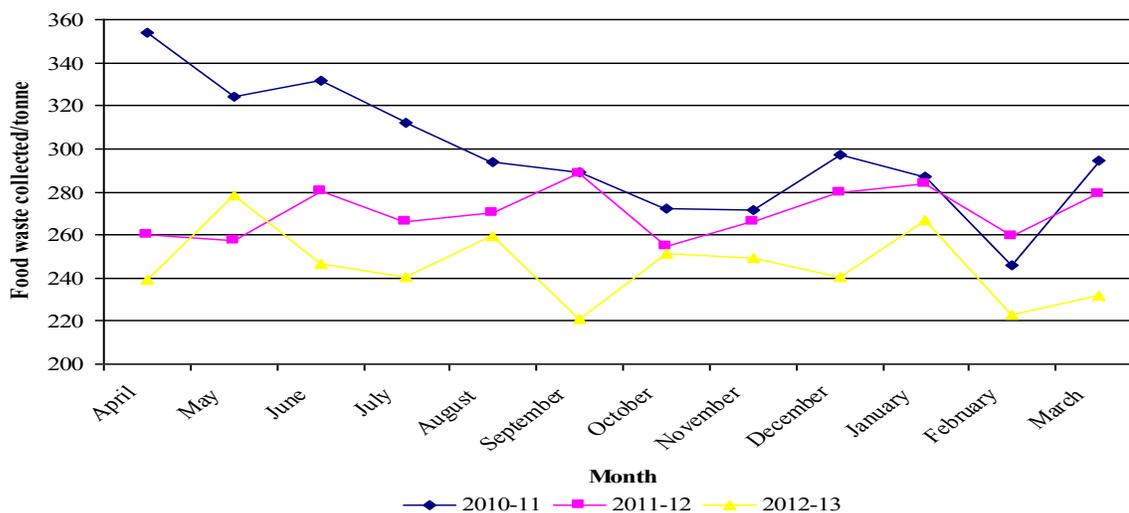
	<b>Recycling collections</b>	<b>Garden waste collection</b>	<b>Residual waste collections</b>	<b>Food waste collections</b>
CBC	Fortnightly collections paper, cardboard, glass bottles and jars, metal and aluminium cans, plastics, batteries & textiles	Fortnightly charged for service in CBC 31,371 households Feb 2014 (47% coverage)	Fortnightly collection	No separate food waste collection
NBC	Fortnightly collections paper, cardboard, glass bottles and jars, metal and aluminium cans, plastics, batteries & textiles	Fortnightly free of charge collection to all households	Fortnightly collection	Weekly food waste collections since 2010 to all households

NBC has collected food waste weekly from all households since the changes noted in 2009/2010. The total weight of food waste collected annually and the average amounts per household are shown in Table 5.

**Table 5:** Weight of Food Waste Collected Separately from Households in NBC 2010 to 2013. (WasteDataFlow, 2013)

<b>Year</b>	<b>2010/11</b>	<b>2011/12</b>	<b>2012/13</b>
Total weight of food waste collected (tonnes)	3573.26 Tonnes	3244.88 Tonnes	2709.26 Tonnes
Average weight per household/per year (kg)	67.9 kg	61.7 kg	51.5 kg
Average weight per household/per month (kg)	5.6 kg	5.1 kg	4.3 kg

NBC's food waste figures show a range between 51.5kg /household/year (2012/2013) and 67.9 kg/household /year (Figure 3).



**Figure 3:** NBC food waste collected 2010-2013

NBC’s food waste collections have recovered declining amounts of food waste each year the service has been operated (Table 6). This decline has been replicated to show how much food waste CBC could potentially recover (Table 7).

**Table 6:** Potential yield of food waste from CBC households if replicating the collections operated by NBC

	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>
Average weight per household / per year (kg)	67.9 kg	61.7 kg	51.5 kg
Possible yield per year (tonnes) from 67,000 households	4549.3 t	4133.9 t	3450.5 t

If CBC were to introduce a similar scheme achieving the average NBC figures this could add 4000 tonnes per year or up to 7% to the total recycled materials (Table 7). It could also via anaerobic digestion provide renewable energy.

**Table 7:** Potential Recovery of Food Waste in CBC and Impact on Recycling Rate

	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>
Residual household waste collected in 2012/13 (tonnes)*	29848	29848	29848
Recycling and bio treatment collected in 2012/13 (tonnes)*	28676	28676	28676
Potential recovery of food waste (tonnes) – if replicating kg per household recovered by NBC** x 67000 households	4549.3	4133.9	3450.5
Amended residual waste figure assuming recovery of food waste and no increase from 2012/13 figure (tonnes)	25298.7	25714.1	26397.5
Amended recycling and composting waste figure assuming recovery of food waste (tonnes)	33225.3	32809.9	32126.5
Potential recycling rate (% of household waste collected that is recycled or bio-treated) assuming replicating recovery of food waste kg per household as recovered by NBC. (Assuming residual waste and recycled waste remain at 2012/13 figures other than the amendment for food waste).	56.8%	56%	54.9%

\* actual figures for 2012/13 from Waste Data Flow

\*\* assuming collect 67.9kg per household in year 1, 61.7kg in year 2 and 51.5kg in year 3.

## **8. Discussion**

National plans have previously been effective to increase recycling rates, especially through the transposition of EU Directives and policy such as Landfill Tax and Household Waste Recycling Act 2003 (Martin et al, 2006). Some UK policies have now been devolved.

The devolved Governments in Scotland and Wales require LAs to introduce separate food waste collections (70% of households in Scotland must have a food waste collection by 2016) (Waste (Scotland) Regulations, 2012). This differs in England, legislation has not been introduced and funding opportunities are not available to LAs; therefore further separate collections are difficult to justify financially in many areas, including CBC.

Both CBC and NBC have future plans to further reduce waste with CBC adopting a Zero Waste Strategy (Charnwood Borough Council, 2013) and NBC a part of the Staffordshire Joint Municipal Waste Management Strategy (Staffordshire Waste Partnership, 2013) which includes aspirations to reach Zero Waste to landfill.

The findings of this research show that both garden and food waste have a high impact with food waste making up as much as 30% of current residual household waste, confirming previous work (Zero Waste Scotland, 2010; Defra, 2008; WasteWorks, 2009). Separate collection of food waste will ultimately be needed by CBC if it is to reach the targets set in the ZWS. This is in contrast to some other materials suitable for recycling such as bulky waste and textiles which would offer lower potential benefits from segregation.

The results also show the amount of food waste collected by NBC has been reduced each year. This may be due to less food being wasted by householders or more self-composting. Participation monitoring and a communications campaign would be needed to clarify why the amount of food waste being collected from households has reduced and whether this would affect CBC introducing food waste collection. Access to suitable collection equipment and local treatment facilities need to be investigated before implementation.

## **9. Conclusions**

CBC has ambitious plans to reduce the amount of household waste sent for landfill disposal, referred to as the Zero Waste Strategy for Charnwood Borough, 2012-2024 (Charnwood Borough Council (2013)). With a high proportion of food waste in the remaining residual waste, introducing a separate weekly food waste collection operated in a similar way to a neighbouring authority (NBC) would achieve the current targets for recycling and landfill disposal.

The separate food waste collections operated by NBC avoids landfill disposal for some biodegradable material and using anaerobic digestion produces a compost like material and generates electricity.

Some more work is needed to adapt food waste collection to the local CBC conditions. The separate collection of organic materials for bio-treatment for example was shown to be dependent on facilities available and the reasons for a decline in the amounts of food waste collected in the case study over the three year period examined was not resolved.

### **Acknowledgment**

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## **APPENDIX D PAPER 4: THE IMPACT OF LOCAL AUTHORITIES INTERVENTIONS ON HOUSEHOLD WASTE COLLECTION: A CASE STUDY APPROACH USING TIME SERIES MODELLING**

### **Full reference:**

Cole, C., Quddus, M., Wheatley, A., Osmani, M., (2014). The impact of Local Authorities' interventions on household waste collection: a case study approach using time series modelling. *Waste Management*, 34 (2) 266-272.

### **Abstract:**

At a local Government level there have been many interventions and changes made to household waste collection services to meet new regulatory requirements. These changes include separate collection of recyclable and organic materials. This paper has used a time series model to quantify the success of interventions introduced by a LA.

The case study was a medium sized UK LA, Charnwood Borough Council (CBC), the research analyses monthly data of quantities of recyclates, garden waste for composting and residual waste for landfill disposal. The time series model was validated with a five year data set and used to measure the impacts of the various changes to identify which intervention was the most successful, while controlling for season and number of working days. The results show the interventions analysed both had abrupt and permanent positive impacts on the yield of recyclable materials, and a corresponding negative impact on the residual waste.

The model could be added to the National data base to help LAs to compare interventions and to understand which schemes encourage householder participation and improve recycling performance.

**Keywords:** intervention; time series analysis; recycling; household waste

**Paper type:** Published peer reviewed journal

## 1. Introduction

Concerns about volumes of waste generated, long term resource depletion and the environmental impact of waste has led to legislation and fiscal measures to control waste. Local Authorities (LAs) have had to rethink household waste management to focus more on prevention, reuse and recycling. The revised Waste Framework Directive, 2008 aimed to ensure reuse and recycling reached levels of at least 50% of waste materials (paper, metal, plastic, glass and biodegradable waste) from households by 2020. In the UK Local Authorities (LA) have the responsibility for household waste management and the policies for reuse and recycling.

The case study is from Charnwood Borough Council (CBC), a Waste Collection Authority in the East Midlands of England. This paper uses a time-series model to assess the impact of interventions made by the LA in its efforts to recycle more. These interventions include simplifying sorting and separation requirements for collection and recovering new materials.

## 2. Recycling Household Waste

The Waste Strategy for England, 2007 increased existing targets for English LAs to recycle and compost household waste. These targets and the increasing cost of landfill disposal due to the escalating Landfill Tax encouraged LAs to collect materials for recycling and bio-treatment separately from households.

Separate kerbside collections of common, heavy, easily recyclable materials (glass, metals, cardboard and paper) enabled UK LAs to achieve 43% recycling in 2011/12 (Defra, 2012). Annual amounts recycled since 2001/02 increased from 3.2 to 10.7 million tonnes in 2011/12. The additional separate collection of organic waste, garden and/or food waste by some LAs has achieved reductions in household waste disposal up to 69% (Defra, 2012).

The devolved governments of Wales, Scotland and Northern Ireland have different strategies with progressively higher targets (Table 1) than the UK as a whole (which is to reuse, or recycle 50% of household waste by 2020, to meet the EU revised Waste Framework Directive.

**Table 1:** Recycling targets set by the individual UK governments. Source - Waste Strategy for England, 2007; Scotland, Zero Waste Plan (2010); Wales, Towards Zero Waste (2010); Northern Ireland - Towards Resource Management: The Northern Ireland Waste Management Strategy 2006 - 2020 (2006)

	2010	2013	2015	2016	2020	2025
<b>England</b>	40%		45%		50%	
<b>Scotland</b>	40%	50%			60%	70%
<b>Wales</b>	40%	52%		58%	64%	70%
<b>N Ireland</b>	35%		40%		45% (with plans to increase to 60%)	

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Jenkins et al. (2003) found LAs that provided households with a kerbside collection rather than relying on householders to take recyclable materials to a specified collection point achieved twice as much recycling (by weight). It is now agreed source separation is critical to meet the target of 50% recycling of household waste by 2020 (Barr and Gilg, 2005; Dahlen and Lagerkvist, 2010). The majority of UK LAs operate separate collections of recyclates and residual waste (WRAP, 2009). However, this increases the complexity of waste collection from one container to several collections of multiple materials; often working to different timescales (i.e. alternate weeks). The success of these separations is increasingly dependent on co-operation from householders (Watson and Bulkeley, 2010). It is generally easy to obtain the involvement of the aware and informed but even in the best performing areas about 20% of households do not use the recycling collection service (Harder and Woodward, 2007). This paper reports on a technique for analyzing the success of various interventions.

One generally reported factor is collection complexity, simpler and more convenient collection systems get better householder participation (Woodward et al., 2005; Read, 1999; Barr and Gilg, 2005). For example, Barr and Gilg (2005) found that householders were confused when asked to separate materials into different containers and consequently produced more residual waste. Similarly, Oom do Valle (2009) argued that collection services with many different containers had lower participation rates. Martin et al. (2008) reported collection schemes limited to two containers, one for recyclates and one for waste, were more popular with residents than those with multiple containers.

Research into householders' participation found collection services designed to suit property types produced higher levels of recycling (Wilson and Williams, 2007). For example, available space might preclude large multiple containers for some households (Tucker et al., 2001; Barr and Gilg, 2005), therefore, the use of smaller containers (bags or boxes) for those with limited storage space increased participation in apartments blocks (Barr and Gilg, 2005; den Boer et al., 2007).

Previous work noted an influence from frequency of collections, LAs reducing collections of residual waste to fortnightly from weekly achieved more recycling (WRAP, 2009). This study suggested that the reduced collection frequency forced householders to manage their waste by recycling. The 10 LAs in England with the highest recycling rates used fortnightly rather than weekly collections and achieved 30% more separation (LGA, 2007). This was corroborated in data from McLeod and Cherrett (2007) who measured a 20% shift from residual waste into recycling following a change to fortnightly collections with separated garden waste.

Availability of centralised separation, treatment methods and appropriate vehicles, influences the type of householder separation used (ICE, 2011; Eriksson et al., 2005). Therefore, there are a variety of LA waste collection systems in use, which vary according to housing types (Muhle et al., 2010), population density (Emery et al., 2007), and available waste infrastructure.

LAs have a statutory duty to collect and keep records of waste collected from households (Environmental Protection Act, 1990). This data records the weight of waste, its origin and ultimate disposal or treatment routes. Waste quantities are measured using weighbridge figures (waste transfer notes), providing an auditable mass balance. Quantities recycled or treated are compiled by type and as a percentage of the household waste collected. Information is reported quarterly to the Department for Environment, Food & Rural Affairs (Defra), the UK Government Department responsible for waste treatment, via a web based spread sheet (WasteDataFlow), enabling Defra to compare trends in recycling, disposal and treatment between LAs.

### **3. Previous time series modelling of household waste**

The requirement to provide monthly returns for WasteDataFlow has provided an archive of data from April 2005, and the time series analysis model (Box and Tiao, 1975) could provide a guide to the success of increasing the simplicity of sorting compared to dissemination campaigns on the amounts recycled.

Beigel et al. (2008) provides a review of models used for predictions of waste generation. These include planning of waste collection services, waste treatment facilities and the development of waste management strategies. The study concluded that there were many differences in the way time series models had been used and there were also differences in the way the original data was collected. Sample sizes for example, varied from household to city level and this meant that the independent variables used in models also differed greatly. The alternative definitions used for waste streams and waste streams complicated the comparison of results.

Previous use of time series or statistical analysis with data to forecast future amounts of waste to aid planning includes Matsuto and Tanaka (1993) who used a moving average of daily waste collected in a Japanese city to understand the impact of seasons and holidays and collecting waste on different days of the week. Chang and Lin (1997) also used monthly time series data, from a similar sized community to this study, alongside social and demographic information to predict future waste. Results were used to aid the decision between building incinerators or more complex infrastructure for recycling and recovery.

Hsu and Kuo (2005) were able to use multiplicative ARIMA (Autoregressive Integrated Moving Average) model to predict changes in the amounts and categories of household waste generated and their rates of recycling. From this analysis they were able to predict the impact of separate collection of the increasing amounts of household electrical and electronic appliances in Taiwan.

## **4 Methods**

### **4.1 Charnwood Borough Council (CBC) case study**

To meet the regulations, CBC has, in common with most other LAs, introduced a door-to-door kerbside collection of recyclables. It has also carried out campaigns to raise public awareness and encourage the use of these schemes. There has been little published on how effective these changes to LA collection practices have been in achieving waste reductions. Waste collections in CBC area cover 67,000 households and in 2010/11

46.1% was recycled and composted. This paper uses time series analysis to measure the performance of three different types of intervention. This analysis was then used to forecast the trends in household waste and how to achieve the EU targets.

The three CBC intervention events examined in this research are:

- August 2007, collection of mixed plastics and Tetrapak (drinks) containers were added to the existing segregated collections of paper, cardboard, glass and metals. As these are lightweight, it was unknown how useful their inclusion would be on the recycling target.
- August 2009, the number of containers used for the separate collection of recyclates was reduced from four to three (including garden waste). Dry recyclates were now separated into just two containers, one for glass; and one for all plastics, metals, paper and cardboard. The literature suggested that simplification would help avoid confusion for householders about which container, if any, to sort their waste types into. An increase in householders' participation was anticipated.
- During September 2011, the household waste collection was simplified further to three wheeled bins. One was for all dry recyclable materials, this included paper, cardboard, glass, metals and mixed plastic items. The two other wheeled bins were for the separate collection of organic (garden) waste and the remaining residual waste for disposal. This was a further simplification to compare with the August 2009 change.

The movement of recyclable materials from the residual landfill waste stream into the recycling stream was also monitored to confirm the correlation with a reduction in the amount of landfill disposal.

#### **4.2 Archived CBC household waste data**

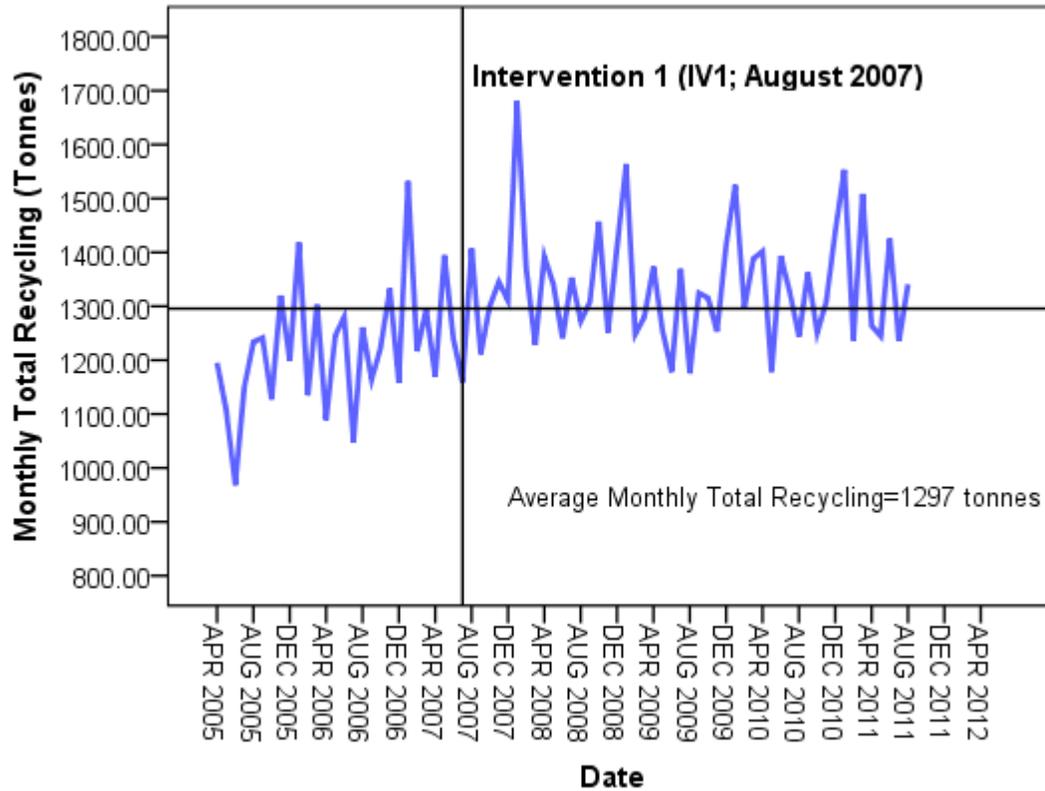
Archived data of the monthly local waste records kept by CBC for reporting to the UK Government Department, Defra (Department for Environment, Food & Rural Affairs) is divided into three categories:

- materials collected for reuse and recycling;
- garden waste (organics) for composting; and
- residual waste (all other waste) for landfill disposal.

The data set covered seven years (April 2005 to March 2012) to include a period prior to and then the three interventions in 2007, 2009 and 2011. A mass balance was possible of materials passing the three streams to corroborate shifts from the residual landfill waste stream into the recycling stream.

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Administrative records together with internal reports and public records were also used to compile a history of changes to practice in case there were other changes to confound the data. Figure 1 shows a time series plot of monthly data of waste collected for recycling, that exhibits both trend and seasonality.



**Figure 1:** A sequence chart of monthly total recycling (April 2005 to March 2012)

## 5. Time series model

The changes in the materials collected and methods of collection are shown in Table 2.

**Table 2:** Amendments made to the household waste and recycling collections in Charnwood Borough Council. (Authors research using Charnwood Borough Council archived Council Committee Papers, 2004- 2009).

Year	Materials collected	Containers	Amendment to waste service
2004	Paper	Red bags	Introduction of kerbside recycling collections
	Steel & aluminium food & drink cans	Green bags	
	Residual waste for landfill	Black bags	Weekly collection of residual waste
2005 (Feb)	Paper & cardboard	Red bags	Cardboard added to collections
	Steel & aluminium food & drink cans	Green bags	
	Glass	55 litre box	Separate container issued for collection of glass
	Residual waste to landfill	Black wheeled bins	Introduction of black wheeled bins for household waste Collection frequency changed from weekly to fortnightly
2005	Garden waste	Brown wheeled bins	Introduction of fortnightly garden waste collection – opt in service with an annual charge to householders
2007 (Aug)	Paper & cardboard	Red bags	Addition of mixed plastics and tetra-paks to the recyclable materials collected
	Steel & aluminium food & drink cans	Green bags	
	Glass	55 litre box	
	Residual waste to landfill	Black wheeled bins	
2009 (Aug)	Paper, cardboard, steel & aluminium cans & mixed plastic	Purple bags	Simplifying collection scheme – reduction in number of containers issued to householders, less sorting for the householder
	Glass recycling	55 litre box	
	Garden waste	Brown wheeled bins	
	Residual household waste	Black wheeled bins	
2011 (Sept)	Paper, cardboard, steel & aluminium cans & mixed plastic	Green wheeled bin	All collections fortnightly Recyclates collected in one container
	Garden waste	Brown wheeled bin	Opt in service with an annual charge to householders- Fortnightly collection Fortnightly collection
	Residual waste	Black wheeled bin	

Data was analysed using an ARIMA (Autoregressive Integrated Moving Average) time series model as suggested by Hsu and Kuo (2005). Analysis of the three waste streams used the following model:

$$y_t = f(I, X) + N_t \quad (1)$$

- $t$  is the discrete time (e.g. month in this case),
- $y_t$  is the appropriate Box-Cox transformation of  $y_t$ , say in  $y_t$ ,  $y_t^2$ , or  $y_t$  itself (e.g. Box and Cox, 1964),  $y_t$  is the dependent variable for a particular time  $t$  representing the total monthly household waste, or garden waste or waste for recycling,
- $f(I, X)$  is the dynamic part of the model which contains the intervention component ( $I$ ) and the deterministic effects of independent control variables ( $X$ ), and
- $N_t$  is the stochastic variation or noise component.

Noise and intervention components, control variables and cross correlation between data are briefly discussed below for completeness.

### 5.1 Intervention function f(I):

Intervention functions are used to examine the impact of an identified change in time series data (Box and Tiao, 1975; Jorquera et al., 2000). In this research, these are amendments to collection methods and range of recycled materials shown in Table 2. Interventions may produce both the onset (i.e. abrupt or gradual) and duration (permanent or temporary) effects meaning that there are four possible combination effects. The connection between an intervention and its likely effects is termed as a transfer function. For instance, an impulse transfer function is likely to occur once with abrupt onset and temporary duration. On the other hand, a step transfer function is likely to produce an effect with abrupt onset and permanent or long duration (i.e. an immediate impact and continue over the long term). It was envisaged that the interventions were likely to be step functions and this was used to define the changes as follows:

$$f(I_t) = \varpi_0 I_t \quad (3)$$

where  $\varpi_0$  is a constant, and  $I_t$  is the intervention variable which takes a value of 0 for every month before the implementation date of the amendment and a value of 1 for every month thereafter, i.e.,

$$I_t = \begin{cases} 1 & \text{for } t \geq t' \\ 0 & \text{elsewhere} \end{cases}$$

Then equation (3) becomes

$$f(I_t) = \begin{cases} 0 & \text{for } t < t' \\ \varpi_0 & \text{for } t \geq t' \end{cases} \quad (4)$$

and the general intervention model takes the following form:

$$y_t = \varpi_0 I_t + \beta X + \frac{\theta(B)\Theta(B)u_t}{\phi(B)\Phi(B^s)(1-B)^d(1-B^s)^D} \quad (5)$$

Intervention analysis starts with the identification of a SARIMA model (i.e. noise component) parameters  $p, d, q, P, D,$  and  $Q$  using the autocorrelation function (ACF) and the partial autocorrelation function (PACF) of a series, their estimation and diagnosis of the observations before intervention. The next step is to re-estimate the model for the entire series by including intervention variables (usually dummy variables) that represent the timing of the intervention. Some other independent variables (usually control variables) can also be added in the re-estimation step. The statistical significance of the intervention variables, in our case  $\varpi_0$ , explains whether the intervention has any effect on the time series and the magnitude of their coefficients measures the substantive effect of the intervention.

## 5.2 Control variables

There are three main components to the models: the intervention variables, the seasonal ARIMA parameters, and a control variable – number of working days per month. Waste collection services in CBC are operated following a four day working week between Tuesday and Friday. The number of working days during each month was also calculated. These were included to take account of the availability of collection services.

## 5.3 Cross-correlation among the series

It was assumed, because of the mass balance, that materials recycled would be lost from the residual waste stream. It could, therefore, be hypothesized that the recycling data will lead the residual waste data. This can be examined by the cross-correlation of the white noises from these two series (Box et al., 1976). Cross-correlation can reveal the inter-relationships between the series, their significance and the lead/lag in any correlation.

If  $u_t, v_t$  denote the white noises (i.e. residuals) from the waste for recycling and residual waste series, the cross-correlation coefficient at lag  $k$  between these white noises can be expressed as (Box et al., 1976):

$$r_{uv}(k) = \frac{C_{uvw}(k)}{S_u S_v} \quad (6)$$

$C_{uvw}(k)$  is the correlation at lag  $k$  and  $S_u$  and  $S_v$  are the standard deviations of the white noises.

#### 5.4 Noise component (Nt):

If a purely random component ( $N_t$ ) is present it follows either a standard Autoregressive Integrated Moving Average (ARIMA) model, denoted as ARIMA ( $p,d,q$ ) or a Seasonal Autoregressive Integrated Moving Average (SARIMA) model (e.g. Box and Tiao, 1975), denoted as SARIMA ( $p,d,q$ ) $\times$ ( $P,D,Q$ ) $_s$ ; if there are seasonal effects on the sequence of observations). In both models,  $p$  is the order of the non-seasonal autoregressive (AR) process;  $P$  is the order of the seasonal AR process;  $d$  is the order of the non-seasonal difference;  $D$  is the order of the seasonal difference;  $q$  is the order of the non-seasonal moving average (MA) process;  $Q$  is the order of the seasonal MA process; the subscript  $s$  is the length of seasonality (for example  $s=12$  with monthly time series data). The SARIMA ( $p,d,q$ ) $\times$ ( $P,D,Q$ ) $_s$  model can be expressed as (see Box et al., 1994):

$$\phi(B)\Phi(B^s)(1-B)^d(1-B^s)^D N_t = \theta(B)\Theta(B)u_t \quad (2)$$

where

- $\phi$  and  $\Phi$  are the regular and seasonal AR operators,
- $\theta$  and  $\Theta$  are the regular and seasonal MA operators,
- $B$  and  $B^s$  are the backward shift operators, and
- $u_t$  is an uncorrelated random error term with zero mean and constant variance ( $\sigma^2$ ).

## 6 Results

### 6.1 Results from the intervention models

Changes in monthly recycling waste, garden waste, and residual waste were measured in the model to compare the impact of the three interventions noted at 4.1.

At the time of writing monthly waste flow data for CBC was available until March 2012; and analysis of the third intervention is unreliable due to lack of sufficient observations (i.e. only seven observations are available). Therefore, results are based on the first two interventions.

Table 3 shows results and relevant statistics of three intervention models, disaggregated by waste category. The autocorrelation function (ACF) and partial

autocorrelation function (PACF) of the series and the residuals and the modified Box-Pierce (Ljung-Box) Q statistic are used to identify the model parameters. It is noticeable that the patterns among these series are quite different as total recycling follows a SARIMA (0,0,0)x(1,0,0) model containing only a first order seasonal AR(1) term, the garden waste follows a SARIMA (0,0,0)x(1,1,0) containing only a first order seasonal AR(1) term but the residual waste follows a SARIMA (2,0,0)x(2,0,0) model with two non-seasonal AR terms and two seasonal AR terms. In the case for the garden waste –it was essential to carry out one seasonal ( $D=1$ ) difference to obtain a stationary time series. However, none of the series contains any  $q$  terms in the patterns suggesting that there are no lingering effects of preceding random shocks in any of the studied series. The results show that residuals from all series exhibit white noise which confirms that the developed intervention models are reliable.

**Table 3:** Results from the time-series intervention models

<b>Intervention Models</b>		<b>Total Recycling</b>		<b>Garden Waste</b>		<b>Residual waste</b>	
		<b>SARIMA (0,0,0)x(1,0,0)</b>		<b>SARIMA (0,0,0)x(1,1,0)</b>		<b>SARIMA (2,0,0)x(2,0,0)</b>	
<b>Noise Components</b>		<b>Coefficient</b>	<b>t-stat</b>	<b>Coefficient</b>	<b>t-stat</b>	<b>Coefficient</b>	<b>t-stat</b>
Constant				92.49	8.73	583.16	3.94
Autoregressive, AR(1)						0.047	3.98
Autoregressive, AR(2)						0.30	2.64
Seasonal SAR(1)	Autoregressive,	0.73	8.56	-0.59	-3.87	0.23	2.35
Seasonal SAR(2)	Autoregressive,					0.43	3.87
<b>Control Parameter</b>							
Number of working day		70.67	48.53			121.62	14.50
<b>Intervention</b>							
Amendments made in Aug 2007 (increasing household waste recyclable material streams)		90.58	4.22			-119.97	-3.71
Amendments made in Aug 2009 (simplification of household waste collection)		110.71	4.03			-176.24	-4.16
<b>Descriptive statistics</b>							
Series Length		77.00		77.00		0.77	
Pseudo R-squared		0.61		0.82		0.76	
Ljung-Box Q statistics (p-value)		10.37 (0.89)		14.96 (0.59)		12.43 (0.57)	

The - number of working days per month – (control variable) was found to be statistically significant with a positive coefficient in the waste for recycling and residual waste models and not significant in the garden waste model. This may be due to the strong seasonal effect on this waste stream and this waste stream is a standalone collection, with no impact on the other waste streams. The model indicates that one additional working

day per month would increase waste for recycling by about 70 tonnes per month and residual waste by 121 tonnes per month.

Both intervention variables when assumed to follow a step function were found to be statistically significant in the waste for recycling and residual waste models but were not significant in the garden waste model.

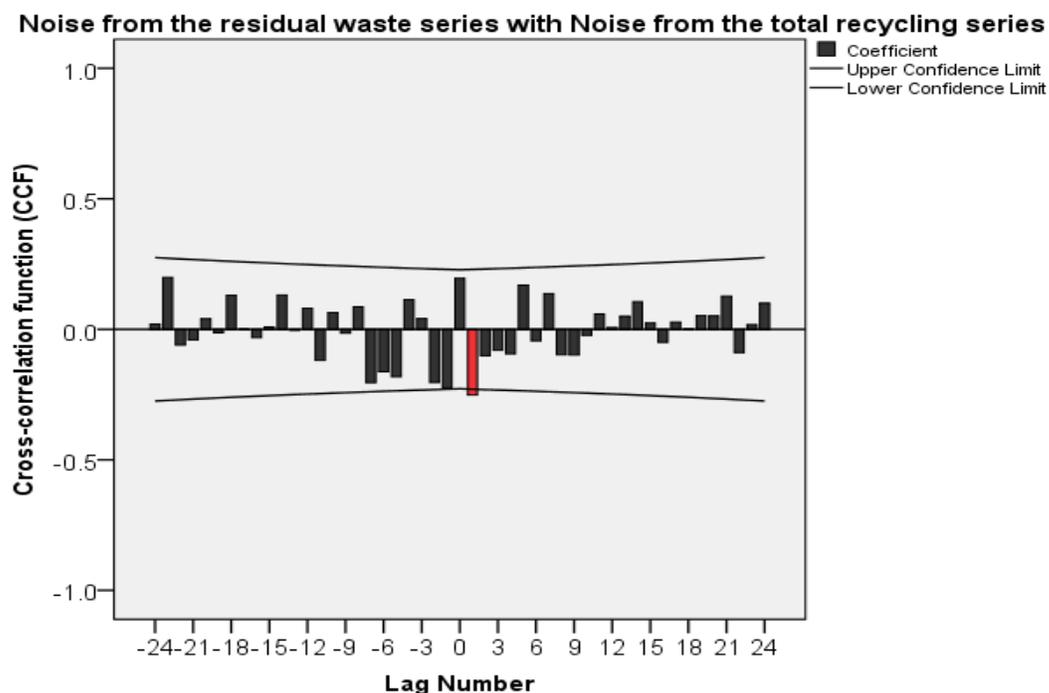
The amendments made both brought about an abrupt and permanent positive impact on the waste collected for recycling, which increased by about 91 tonnes per month from the first intervention (Aug 2007) and 111 tonnes per month from intervention 2 (Aug 2009, Table 2).

Both interventions were found to have a significant and negative impact on the residual waste; reducing the amount collected by 120 tonnes per month after the implementation of the first intervention, with a larger reduction (i.e. 176 tonnes) after the implementation of second intervention.

The amendments were statistically insignificant in the garden waste model because no changes were made to the way garden waste was collected. These collections continued as before following the same fortnightly collection frequency and same four day working week pattern.

## 6.2 Cross-correlation between residual waste and total recycling

The cross-correlation function as denoted by equation (6) between the white noises of the waste for recycling and residual waste series was used to support the assumption that an increasing in recycling would lead to a corresponding decrease in residual waste for landfill. The cross-correlation coefficient values up to lag 24 are plotted and shown in Figure 2.



**Figure 2:** Cross-correlation function between noise residuals from the residual waste and total recycling models

Figure 2 shows the correlations are small with both positive and negative lags. A negative lag suggests that the first series (i.e. monthly residual waste) follows the second series (i.e. the monthly waste for recycling) . The value of the cross-correlation coefficient is negative at a positive lag 1 (i.e. -0.252) suggesting that an increase in the values of the leading series (i.e. recycling) will cause a decrease at the values of the second series (i.e. residual waste) one month later.

### 6.3 Model performance

The performance of the models was estimated using Mean Absolute Error (MAE) as shown below:

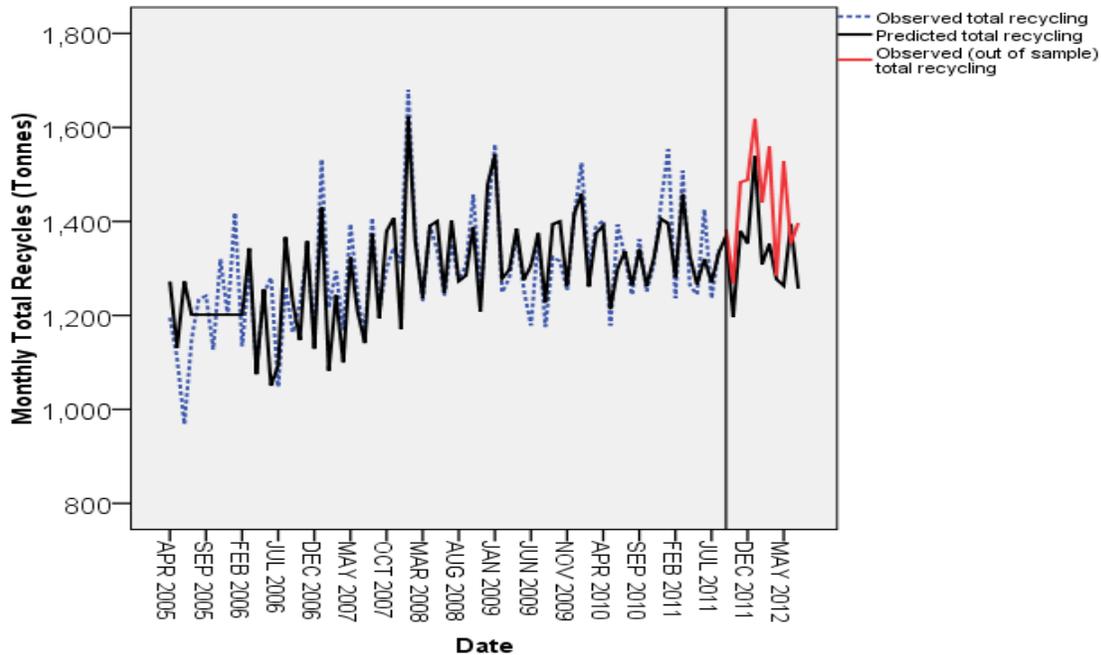
$$MAE = \frac{1}{N} \sum_{i=1}^N |[(Observed\ Value]_i - Predicted\ Value_i)| \quad (7)$$

Data was divided into two groups (1) sample observations (April 2005 to August 2011) that were employed in estimating the models and (2) the smaller number of sample observations not used in modelling (September 2011 to March 2012). MAE in predicting monthly recycling/residual wastes was then calculated for both cases (see Table 4). The results show that the model is better at predicting waste for recycling than residual/garden wastes.

**Table 4:** Mean Absolute Error from the models

	Mean Absolute Error (MAE)		
	Pseudo R-squared	Within sample	Out of sample
Total recycling	0.61	60.98	108.9
Garden waste	0.82	131.79	159.0
Residual waste	0.76	101.02	118.9

The pattern of prediction is compared with actual recycled amounts in Figure 3.



**Figure 3:** Comparison of observed and predicted data

The performance of the model deteriorates after July 2011, when the third intervention took place. This suggests that further validation of the model after this change would be necessary to refine its ability to predict seasonal changes.

## 7. Discussion

The time series model shows the long term upwards trend in recycling by households within CBC, which follows the national pattern. The interventions taken by CBC were shown to cause step and permanent improvements to the amounts of recyclate recovered from households. The second, simpler separation better than the first (more materials). Nevertheless the results have demonstrated the importance of having facilities to extend the range of materials collected.

Previous studies show existing household recyclers are most likely to support new recycling schemes (Burnley and Parfitt, 2000). This may be due to regular interventions raising awareness of recycling, it would be interesting to analyse schemes using just communication campaigns and advisory leaflets.

There are other external factors to be considered. The reduction in economic activity since 2008 encouraging householders to behave in a more sustainable way, to waste less food, replace consumer goods less often and buy and sell second-hand items instead of disposing of them as waste. Manufacturers and retailers taking part in the Courtauld Commitment (WRAP, 2010) and legislation such as the Producer Responsibility Obligations (Packaging Waste) Regulations, 2007 reducing quantities of packaging waste generated within households.

## **8. Conclusion**

This study has used an established time series intervention model to investigate the success of various amendments made to CBC household waste and recycling collection services. A cross-correlation technique has employed to examine the interrelationship between monthly recycling and residual waste streams.

The model was able to quantify the success of the two interventions analysed (the increase in materials collected separately by CBC for recycling and the simplification of the collections for householders). Both showed abrupt and permanent increases in the waste collected for recycling, alongside a significant reduction in the residual waste stream. From the cross-correlation analysis, it was concluded that interventions aimed at increasing the recycling stream would lead to an immediate (with a lag of one month) decrease in residual waste stream.

The time series model was able to predict the impact of seasons and number of working days on amounts recycled. Using updates and validation of data from WasteDataFlow it would be a useful tool to Local Authorities in devising interventions and policies associated with household waste, recycling and collection services.

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## **APPENDIX E PAPER 5: TOWARDS A ZERO WASTE STRATEGY FOR AN ENGLISH LOCAL AUTHORITY**

### **Full reference:**

Cole, C., Osmani, M., Quddus, M., Wheatley, A.D., Kay, K. (2014) Towards a Zero Waste Strategy for an English Local Authority. *Resources, Conservation and Recycling*, 89 (2014) 64-75.

### **Abstract:**

Many developed countries are using a challenging Zero Waste concept to change current waste management practices to more sustainable methods of managing waste, including household waste. The concept includes waste prevention; high levels of recycling and recovery of all resources from waste; and behavioural change. This research provides a case study on the development of a Zero Waste Strategy (ZWS) for Charnwood Borough Council (CBC), an English Local Authority, which has an established household waste management system.

This paper describes the steps taken by the authors, together with CBC to devise and implement a ZWS. A series of focus groups were held involving elected members of the LA and members of the community. The aim was to identify the core aspects of environmental, operational and social demands in order to prioritise actions to be included in a draft ZWS. The draft underwent wider public consultation, which highlighted areas for revision, and following revision has been adopted by the LA. The ZWS takes into account local issues, local policies, alongside national strategies and legislation.

Many of the options identified during this research complement each other and if used in combination may see large steps taken towards Zero Waste. This is difficult to achieve without an holistic approach to waste generation, collection, treatment and disposal. Key findings from this research are to switch the focus from recycling to reuse and waste prevention, alongside increasing education and behaviour change programmes for householders. Additionally, the potential value of separately collecting food waste, with a recognised high potential yield, must be explored to ensure meeting targets set in the ZWS and the requirements of the Landfill Directive.

**Keywords:** Zero Waste Strategy, household waste management, recycling, Charnwood Borough Council, England.

**Paper type:** Published peer reviewed journal

## 1. Introduction

The Brundtland Report “Our Common Future” (WCED, 1987) brought the concept of sustainable development into the mainstream of business and political thought. Since then, legislation has been introduced at European and National levels with the aim of improving environmental performance. This includes better waste management practices. On a local level, this has led to strategies and operational practices including the introduction of separate household collections for organic (compostable) waste and recyclable materials. Local Authorities (LAs) have a key role in supporting sustainable development through many of their activities, planning, education and waste management (Wilson and Williams, 2007).

Resource depletion, climate change and rising consumer awareness are providing challenges for more sustainable solutions to waste management and treatment. For many years, the focus in the UK has been on increasing the amount of household waste (HW) that is collected for recycling and reducing landfill disposal (Defra, 2007). Recycling targets, source separated kerbside collections have been implemented and education programmes for householders to encourage recycling have been undertaken (WRAP, 2009). As such, annual amounts of recycled HW increased from 3.2 to 10.7 million tonnes between 2001/02 and 2011/12 (Defra, 2012).

Zero Waste is one of the most visionary concepts for addressing waste problems and encompasses many different strategies developed for sustainable management of waste; these include waste reduction, repair, reuse and recycling (Welsh Assembly Govt., 2010).

The aim of this paper is to describe the process undertaken by the authors with CBC to develop a draft Zero Waste Strategy (ZWS) that will integrate alongside an established household waste management system.

## 2. Research context – Household waste management in the UK

Household waste makes up approximately 9% of all waste collected and treated in the UK each year (Defra, 2007). Environmental, social, governmental and fiscal pressures have led to a range of measures being introduced that have impacted on the way HW is collected and treated. These include the introduction of separate kerbside collections for recyclable materials, and organic waste for composting alongside collections of residual waste for treatment or landfill disposal (LGA, 2013). A well operated HW collection system can have a considerable impact on increasing recycling levels (Barr and Gilg, 2005).

In the best performing areas, approximately 20% of households do not make use of their recycling collection service (Harder and Woodward, 2007). Changing behaviour to more sustainable patterns remains one of the biggest waste management challenges (Price, 2001). This requires raising awareness in waste prevention and reuse and providing information on a wider range of sustainable actions rather than concentrating on recycling. However, funding for such schemes is now under significant threat due to the continued reductions in Local Government spending and impact of these activities is very difficult to monitor (Read *et al.*, 2009). Holistic approaches to material flow, resource use and long term sustainability are required for a truly sustainable Zero Waste City (Zaman and Lehmann, 2011).

## 3. Defining Zero Waste

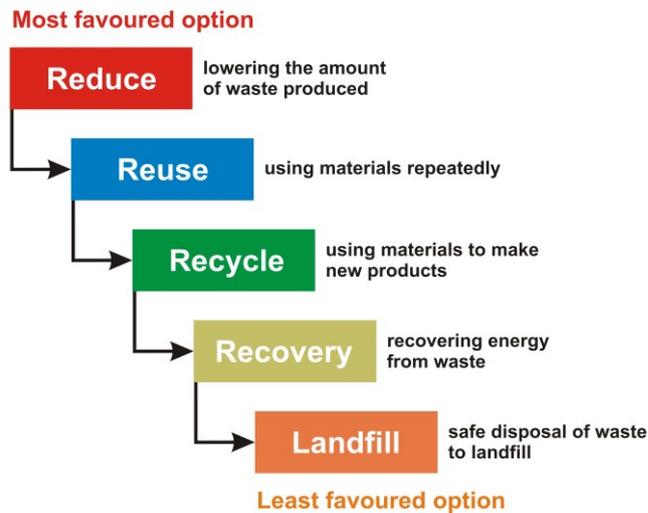
A variety of definitions exist for Zero Waste depending on the primary focus. These include ‘Zero Waste to Landfill’ and ‘Zero Waste emissions to land, sea and air’. However, all focus

on sustainable waste management and comprehensive use of resources. This, together with sustainable design and management of products and processes brings a move towards a Circular Economy (Ellen MacArthur Foundation, 2010) with a holistic approach to preventing and managing waste. Definitions of Zero Waste taken from a variety of sources, including strategy documents, are outlined in Table 1.

Table 2 – Selection of definitions for “Zero Waste”

Location	Definition	Source
England (Defra)	<i>“Going further than maximising recycling, to stopping things being discarded and moving on to waste prevention”</i>	Waste Strategy for England, 2007 (Defra, 2007)
	<i>“A simple way of encapsulating the aim to go as far as possible in reducing the environmental impact of waste.</i>	Defra’s guidance for Zero Waste Places (Defra,2008)
	<i>“Material resources are reused, recycled or recovered wherever possible and only disposed of as the option of last resort”.</i>	Waste Management Plan for England (Defra, 2013)
Scotland – The Scottish Government	<i>“A means of eliminating the unnecessary use of raw materials; sustainable design; resource efficiency and waste prevention; re-using products where possible; and recovering value from products when they reach the end of their lives either through recycling, composting or energy recovery, in accordance with the waste hierarchy”</i>	Scotland’s Zero Waste Plan (Scottish Government, 2009).
Wales – Welsh Assembly Government	<i>“An aspirational end point where all waste that is produced is reused or recycled as a resource without the need for any landfill or energy recovery”</i>	The Welsh Government’s waste strategy document “Towards Zero Waste defines Zero Waste as: (Welsh Assembly Govt, 2010).
Charnwood Borough Council	<i>“Zero Waste means treating waste in a way that has least impact on the environment, challenging the long held practice of disposal of materials. This is far more than increasing the amount of recycling we do; the focus lies on waste prevention, thus reducing the amount of waste requiring treatment and treating the waste we do manage as a resource”</i>	Zero Waste Strategy for Charnwood Borough (2012-2024) (Charnwood Borough Council, 2012a)

Recent research also recognises that Zero Waste utilises a range of measures aimed at eliminating waste and challenging conventional ways of thinking, to view waste as a resource with value rather than a problem to be dealt with (Curran and Williams, 2012). The concept of Zero Waste goes beyond maximising recycling and focusing on the Waste Hierarchy (Figure 1) by targeting recovery of all resources, and aiming to reduce the amount of waste collected, whilst reusing and recycling progressively higher proportions and designing and managing production processes to eliminate waste and encourage recovery of all resources to mitigate the impact of waste (Scottish Government, 2010).



**Figure 5** – The Waste Hierarchy (EU Waste Framework Directive, 2008).

In this research ZW is defined as an aspirational end process where all waste that is produced is reused or recycled as a resource without the need for any landfill or energy recovery.

### 3.1 Zero Waste – The International Context

Zero waste has developed from a concept started by the Lean Movement in the automotive industry, where there was a refusal to accept the inevitability of waste (Womack & Jones, 2003). Many of the world’s major cities such as Adelaide, San Francisco and Stockholm are now working towards Zero Waste and “Zero Waste commitments” have been introduced in many countries. These include USA (California), Canada (Nova Scotia), Australia, New Zealand, Lebanon, Taiwan and China (Greyson, 2007).

In 2005 Victoria, Australia approved a strategy to move towards Zero Waste, with the aim of annual reductions in waste generation and an overall recycling target to recycle 75% of waste collected by 2010. However, the draft Victorian Waste and Resource Recovery Policy, 2012 (Victoria Govt, 2012) recognised that these targets had not been met through a variety of factors including increasing population, additional waste generation and a plateau in recycling recovery rates. A Zero Waste approach is challenging because it requires a holistic method encouraging designers, manufacturers, retailers and householders to take a variety of actions, from sustainable design and production methods to reuse and recycling of discarded items (Clay *et al.*, 2007).

Matete and Trois (2008) researched the impact of Zero Waste strategies and behaviour change campaigns on HW generation, concluding the success of such schemes is dependent on the participation rate of households, with “the drive towards Zero Waste requiring a positive attitude towards waste minimisation and recycling among residents”. Behavioural change can be improved by designing educational campaigns to reinforce positive attitudes among householders, taking into account demographic information, for example income levels, educational background and the nature of the waste stream.

Numerous waste legislative and fiscal measures around the world, such as charges for waste collection and kerbside recycling collection services, have been introduced to successfully support HW recycling (Cole *et al.*, 2011). The Landfill Allowance Trading Scheme (LATS) resulted in waste reduction and an increase in recycling performance among UK LAs (Calaf-

Forn *et al*, 2014) and the introduction of Landfill Tax in the UK encouraged an improvement in environmental performance (Mirata, 2004). Although, this may serve as a driver for reducing costs rather than serving society (Chin-Huang Lin *et al*, 2009). Greyson (2007) concluded it is ironic that the world's efforts to reduce its problems may block a preventive approach. He concluded that Zero Waste, sustainability and continued economic growth may not be achievable as they are currently practiced. However, policy is a dynamic process rather than a static object (Wenteng and Boons, 2014) and development over time will address this issue.

### 3.2 Zero Waste – The UK Context

The devolved Governments of Wales, Scotland and Northern Ireland have taken far more ambitious strategic views on HW management and treatment than England. The devolved Governments have set higher progressively increasing targets for recycling than those for England, or for the UK as a whole. Table 2 summarises the targets currently set out by the various UK Governments from 2010 to 2025. England is aiming for a target of recycling 50% of household waste collected by 2020 and Scotland and Wales are aiming for a target of 70% by 2025.

**Table 2** - Recycling targets set by the individual UK governments (Waste Strategy for England (2007); Scotland, Zero Waste Plan (2010); Wales, Towards Zero Waste (2010); Northern Ireland, Towards Resource Management: The Northern Ireland Waste Management Strategy 2006-2020 (2006).

	Initial recycling target (as a % of household waste collected)		Further targets		
England	40% by 2010 achieved 41%	45% by 2015	50% by 2020	Later targets not specified.	
Scotland	40% by 2010 achieved 38%	50% by 2013	60% by 2020	70% by 2025	Later targets not specified
Wales	40% by 2010 achieved 44%	52% by 2013	58% by 2016	64% by 2020	70% by 2025
Northern Ireland	35% by 2010 achieved 37%	40% by 2015	45% by 2020	Exploring increasing 2020 target to 60%	Later targets not specified

Movements towards a comprehensive ZWS including thorough plans for improving resource efficiency are likewise being led by the devolved Governments. Each of which, have published strategies that target Zero Waste and improved resource management. These differing approaches are discussed in the section below and summarised in Table 3.

#### 3.2.1 England

Following the review of waste policy in England in 2011 (Defra, 2011), the UK set commitments to move towards a Zero Waste Economy, by prioritising the management of waste in line with the Waste Hierarchy and reducing the carbon impact of waste (Defra, 2013). However, no statutory obligation was placed on LAs to develop a ZWS. Therefore, any actions towards reaching this ambitious goal are open to LAs to interpret and perform within a local context. Additionally, a Zero Waste Places (Defra, 2008) initiative to encourage sustainable waste management launched in the Waste Strategy for England, 2007 (Defra, 2007), was withdrawn in 2010 due to the economic downturn. This has led to the 2011 Waste

Review, being seen as “unambitious” and “a lost opportunity to mirror the delivery of Zero Waste by the devolved Governments” (Hassall, 2013).

### **3.2.2 Northern Ireland**

The Northern Ireland Waste Strategy uses many of the concepts of Zero Waste, resource management, waste prevention, recycling and sustainable treatment methods. There are also progressively increasing targets for the lifetime of the strategy which runs from 2006 to 2020 (DoENI, 2006). In 2013 a consultation process was launched to seek opinion on a Recycling Bill that would include targets of 60% recycling by 2020, and whether this should be one target or a “stepped approach” (DoENI, 2013)

### **3.2.3 Scotland**

The Scottish Government has implemented a far more ambitious programme for sustainability in waste and resource management. The Scotland, Zero Waste Plan (Scottish Government, 2010) is backed with the provision of funding of £154 million between 2008 and 2011 at both National and Local levels. Zero Waste Scotland is the delivery body for and is supporting LAs in Scotland (Gulland, 2011). The introduction of The Waste (Scotland) Regulations, 2012 demonstrate a wide range of strategies for resource management rather than waste treatment.

### **3.2.4 Wales**

The Welsh Government outlines plans for a sustainable future with waste treated as a resource. The Welsh Strategy “Towards Zero Waste” is a long term plan, which includes targets to recycle high levels of household waste (70% by 2025). Welsh environmental legislation, waste strategy, and comprehensive series of sector plans recognise actions that need to be taken for Wales to work towards becoming a sustainable nation. This challenges the way waste is handled, transported and treated in Wales with the overall aim to reach Zero Waste by 2050.

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**Table 3 - Comparing UK waste strategies**

	England	Wales	Scotland	Northern Ireland
<b>Waste strategy</b>	Waste policy review in 2011	Toward Zero Waste - Overarching long term plan for resource efficiency & sustainable waste management – implementation via 6 sector plans (Welsh Assembly Govt., 2010).	Scotland’s Zero waste Plan (Scottish Govt, 2010) delivering a long term overarching plan for resource efficiency & sustainable waste management - implementation via requirements of Waste (Scotland) Regulations, 2011	Waste Strategy is under review but there is appears to be a move from ”resource management” to “ resource efficiency” (DoENI, 2013)
<b>Key targets</b>	50% by 2020 - As per EU Waste Framework Directive	Recycling, preparation for reuse or composting of LA <b>municipal waste</b> - 52% by 2012-13 (achieved) 58% by 2014-15, 64% by 2019-2020, 70% by 2024-25 90% reuse/recycling of C&D waste by 2025. Maximum 30% residual waste by 2025.	Recycling, preparation for reuse or composting of LA <b>household waste</b> 50% by 2013 60% by 2020 70% by 2025	Currently as Waste Framework Directive requirements, but new Recycling Bill set to be introduced 2014 with mandatory 60% target for LA municipal waste by 2020. Draft bill appears to follow Welsh model with staggered targets & possible penalties for failure to achieve targets.
<b>Waste Prevention Programme</b>	Consultation completed – results due autumn 2013	In consultation - Proposed targets -Waste reduction by 1.2% per year to 2050 (based on 2006/7 levels) Aim to achieve 27% reduction in waste by 2025 “Zero Waste” by 2050) either prevented, reused, recycled/composted. Action focused on food, paper, clothing, consumer goods, plastic (packaging). Key objective to break link between economic growth & waste generation i.e. making best use of resources from efficient processes & product design (designed for disassembly, & reuse or recycling). Recycling processes to be closed loop or “up-cycling”. Where possible recyclates to be used in Wales.	Scottish Government consulted on “Safeguarding Scotland’s Resources – a programme for the efficient use of resources” in Oct 2012. Key aspect was development of a dedicated Business Resource Efficiency Service & Resource Efficient Scotland was launched in April 2013	Consultation in progress
<b>How?</b>	Market driven by Landfill Tax escalator – Government will only intervene where there are clear market failures	Mandatory recycling & recovery targets & potential fines of £200/tonne if target not achieved. Proposed 4Es model of behaviour change for Waste Prevention campaigns: engaging, enabling, encouraging, exemplifying	The Waste Scotland Regulations 2012. Phased approach adopted to rolling out key measures in the regulations including:- Businesses to present metal, glass, plastic, paper/card for separate collection from Jan 2014 Food businesses producing over 50kg of food waste/week to present food waste for separate collection from Jan 2014. (producing over 5kg/week from Jan 2016) Ban on key separately collected recyclables being incinerated or landfilled from Jan 2014 (plastic, card/paper, glass, metal, food waste) Ban on BMW to landfill from Jan 2021	Recycling Bill may follow Welsh model
<b>Economic benefits</b>	Benefits recognised, but leaving market to develop	Key aim of Zero Waste plan is to design out waste, develop technologies to deal with the waste that is produced as sustainably as possible & to manage waste within Wales where possible, in doing so, waste will be reduced (saving money, jobs & markets will be created within Wales. New technologies being tested –e.g. nappy recycling trial.	Key aim of the Zero Waste strategy plan is to talk about resources rather than waste. To reduce resource use via smart product & packaging design, deal with waste that is produced as sustainably as possible & get as much economic value from waste as possible New technologies being tested – nappy recycling trials with 4 Scottish councils	The proposed move toward “resource Efficiency” will have similar aims to Scotland & Wales: saving money through waste prevention, trying to maximise value of waste & to deal with waste as locally as possible. Consultations on Recyclate quality, MRF Code of Practice due soon

### **3.3 Monitoring household waste and recycling performance**

A reporting tool (WasteDataFlow) exists for UK LAs to report to Central Government quantities of HW and recycling collected and the treatment and disposal methods used. This can be used for benchmarking and tracking progress. However, using solely the recycling rate (a measure of the proportion of waste that is recycled) does not take into account waste prevention and avoidance activities (Read *et al.*, 2009). Successful performance from an LA perspective would include a continuing decline in the overall weight of waste collected, with recycling rates increasing year on year. In addition, there is the challenge of resource management that encompasses design, repair, reuse and disposal of manufactured goods and educating towards good purchasing decisions.

Gentil *et al.* (2011) found waste prevention is more beneficial when landfilling is the dominant waste management technology. The prevention of food waste (in particular meat waste) showed the highest benefits, whilst noting the importance of recycling and energy recovery. They concluded, despite the difficulties in implementation and monitoring, waste prevention has a significant role to play and should be promoted as a very strong policy driver. Wilson *et al.* (2012) recommended an approach building on existing recycling rates, whilst also using measures to control waste growth. Emphasising that every tonne of waste reduced, reused or recycled is a tonne of waste that the LA does not have to pay collection and disposal costs on.

The key to moving towards achieving a Zero Waste society could be represented by a shift of public opinion. With households, this will include: rejecting junk mail; reusing food leftovers; home composting; donating electrical goods to charities, buying second hand clothes; avoiding single-use bags; and extending the service life of products (by not replacing a product unnecessarily) or purchasing products that generate less packaging (Bartl, 2011). The diversity of these actions makes the development of a social norm and monitoring more challenging. Zaman and Lehmann (2013) suggest a Zero Waste Index (ZWI) to measure holistically a city's performance and move towards Zero Waste. ZWI provides a measure of "virgin material offset by recovery of resources" using data showing commonly recycled materials from household waste and would give an indication of waste avoidance.

New approaches to campaigns promoting pro-environmental behaviour are needed, as is an understanding that campaigns need to have a wider focus than just covering waste management issues (Philips *et al.*, 2011). It is, however, recognised that the shift towards Zero Waste is difficult without a clearly defined action plan and implementation schedule that fully explores the value of food waste, e-waste and other waste streams (Curran and Williams, 2012).

### **4 A Zero Waste Strategy for Charnwood Borough Council**

The case study was CBC, an English Waste Collection Authority undertaking the development of a ZWS. The ZWS is seen by CBC as a long term plan to improve the environmental performance of the LAs waste management activities, setting specific objectives and targets for improvement. There is no statutory obligation on the LA to produce a ZWS. This research offers commentary on the innovative approach that the English LA has taken, given the freedom of less prescriptive legislation than the devolved UK Governments of Scotland and Wales. It is recognised that the success of the Zero Waste management scheme relies upon the local context, with extent of community motivation for involvement in

waste management, waste reduction and recycling activities being major factors (Colon and Fawcett, 2006).

#### **4.1 Context - Household waste management in Charnwood Borough Council, UK**

CBC collects household waste and recycling from 67,000 properties in Charnwood Borough. A fortnightly kerbside comingled recycling collection operates in the borough. This service collects glass, plastic, metal, paper, cardboard and textiles for recycling, alongside fortnightly collections of garden waste and residual waste. (Cole *et al.*, 2012). Currently 49% of household waste collected in the Borough is recycled. The household waste and recycling service is operated under contract by an external waste management contractor. The contract allows changes to be made to operational procedures of the household waste collection service to align with CBC policies which seek to minimise the need for landfill disposal for any of the household waste collected (Cole *et al.*, 2013).

### **5. Research methodology**

CBC views the development of the ZWS as a “significant undertaking” (CBC, 2012b). This vision may influence the work of the Borough for a period up to 12 years. For this reason a thorough and robust methodological process, outlined in Figure 2, was devised and adopted for this research. The research was carried out by the authors working with the LA to procedures set out in CBC’s Constitution which outlines the process for decision making, consultation, overview and scrutiny (CBC, 2008).

#### **5.1 Charnwood Borough Council Zero Waste Strategy development process**

The development process for the ZWS consisted of an initial “brainstorming” session with five CBC waste management officers and the authors. During which two facilitated focus groups were planned, one with 16 members of the community, and the second with a group of eight LA elected members.

The intention was to explore with the focus groups a range of actions; operational practices; policy and charging procedures; and performance targets to include in the ZWS.

Using the output of these discussions, a draft ZWS was written to provide a framework for CBC to follow and implement. Subsequently, the draft CBC ZWS underwent a wider public consultation exercise. This was to identify areas requiring amendment, and capture feedback from a larger sample group than the initial focus groups. Responses from this consultation were reported to CBC and amendments made to the ZWS prior to its adoption.

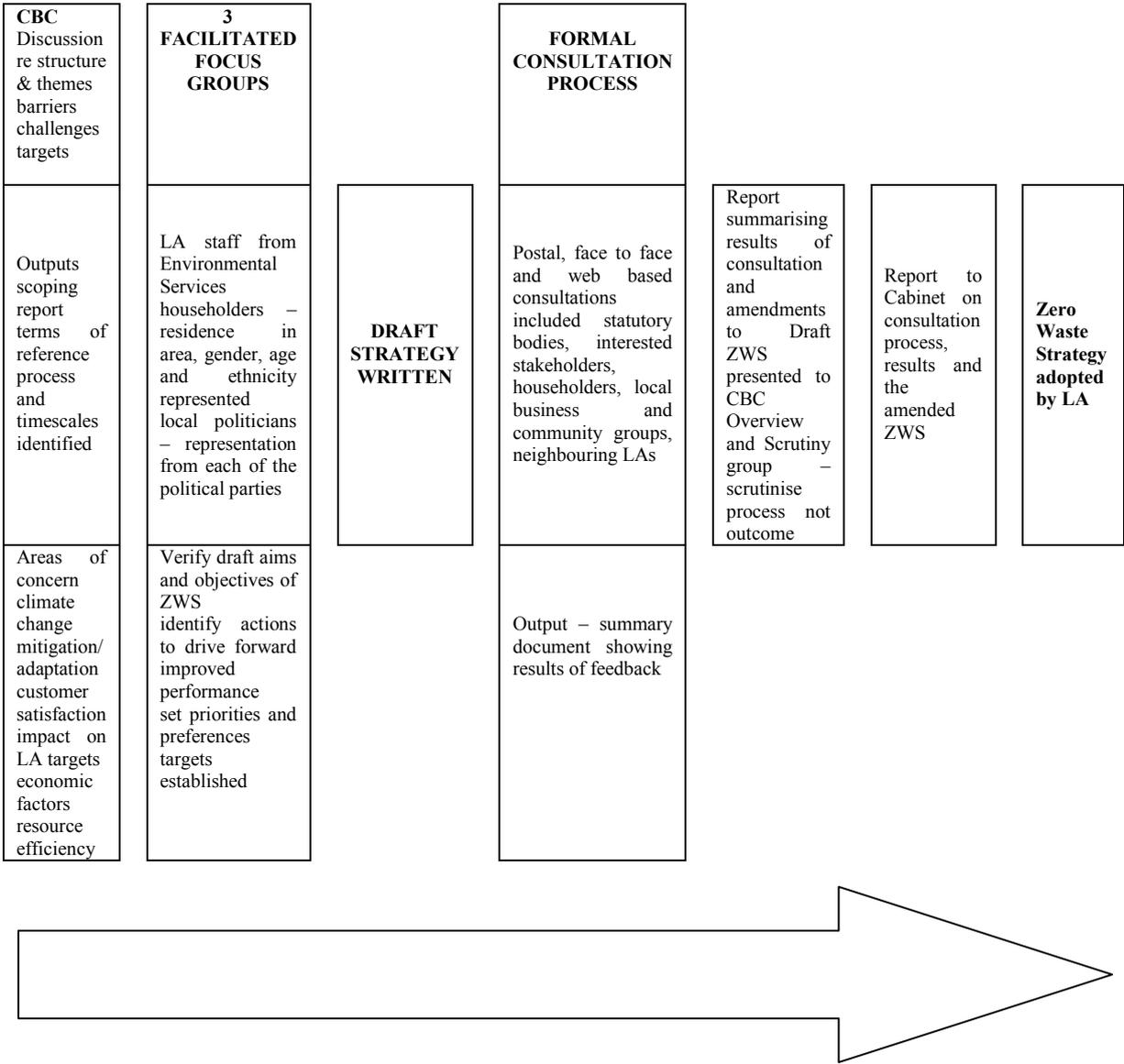


Figure 2 - Process for development of Zero Waste Strategy for Charnwood Borough Council

5.2. Initial scoping exercise

The initial stage of the Strategy development involved a group of five Waste Managers from CBC carrying out a scoping exercise to identify themes and structure to be covered by the ZWS and identify any barriers to the process. This was to establish the aims of the ZWS and the timescale for the development process with the authors, whilst also ensuring it was in line with the LA’s established procedures.

The initial scoping exercise identified themes for the research and development of the ZWS, these include:

- Climate change mitigation.
- Customer satisfaction.
- Impact on LA targets.
- Economic factors.
- Resource efficiency.

Barriers to the development and implementation of a ZWS, were acknowledged, these are:

- Varying commitment of senior management and politicians.
- Absence of training programmes to explain the concept of Zero Waste.
- Embedding Zero Waste in all CBC activities rather than just referring to household waste collections.

Identifying these barriers early in the process enabled these to be challenged during the Strategy development stages. In addition to this, some areas of concern that a ZWS could have an impact upon were identified.

### **5.3 Facilitated Focus Groups**

Following established LA procedure, which requires the use of focus groups following set rules on membership and terms of reference, two facilitated focus groups were formed. This was to ensure the ZWS received input from both members of the community and political support from elected members within CBC. The focus groups were to assist in the development of a ZWS, to identify and prioritise environmental, operational and social demands available to CBC. The focus groups used a mix of quantitative and qualitative research.

A specialist market research company was used to recruit local residents for the first focus group to ensure a demographic selection reflecting the diversity of the Borough. This included getting a wide selection of age ranges, participants with different gender, ethnic backgrounds and from varying locations within the CBC area. The first focus group was attended by 16 members of the community. The participants of the second focus group comprised eight elected members. This was structured in such a way to include representation from each party in the same proportions that reflected the political makeup of CBC.

Many of the participants in both focus groups had an interest in sustainability, not necessarily waste management and the degree of awareness about the issues involved varied widely. The focus group findings were used to inform actions and targets included in the ZWS and supporting policies.

#### **5.3.1 Focus Groups Tasks**

The focus group participants were set a series of four tasks, these were as follows:

1. Completion of a questionnaire comprising the following questions:
  - What is CBC's current recycling target?
  - What is the recycling target for the UK (as a whole)?
  - What are the individual recycling targets for England, Scotland, Wales and Northern Ireland?
  - What percentage of household waste does CBC recycle and compost?

Discussion to identify possible policy options to include in the ZWS.

2. Participants were asked to rate the level of ambition CBC as ambitious, moderate or to remain at today's levels in the following three areas:
  - The recycling rate (as a percentage of household waste collected).
  - The amount of waste sent for landfill disposal.
  - The cost of the waste and recycling collection service.

- Completion of a structured form by scoring the identified options available to the CBC against a series of issues that they may influence to varying degrees. A scoring matrix, Figure 3, was developed to allow focus group participants to score each of the identified options available to CBC against the issues listed above. Participants were asked to complete this task individually, giving each of the options a score between 1 (low impact) and 5 (high impact) depending on the perceived scale of impact of each option on the issues listed. For instance, if they thought that removing the charge currently in operation for the garden waste collection service would have a high impact on customer satisfaction then they would score this 5, if this would have a low impact on CBC’s recycling rate they would score it 1.

Appraisal of Waste Management Options Consultation workshop		Benefits					
		Total (Rank)	Climate mitigation	Customer satisfaction	Impact on targets	Economic factors	Resource efficiency
Options	Garden waste charging policy (remove charge)						
	Bulky waste charging policy (introduce charge)						
	Residual waste (additional capacity) charging policy (introduction of charge)						
	Behavioural change						
	Food waste						
	Rearrange of recycle						
	Influencing treatment options						
	Street cleansing waste						
	Home composting/ food digestion						
	Restrict landfill bin capacity						

Figure 3 - Focus group appraisal scoring sheet

5.3.2 Assessing focus group outputs

Each individual focus group member completed one of the scoring sheets (Figure 3), marking each option for its potential to impact on the listed areas of concern /“benefits”. With each column receiving equal weighting a total score was calculated for each option on each participants scoring sheet. The scores from each individual were then combined to produce an overall score for each option and from this a ranked order produced showing a measure of importance placed on each option by the focus group.

An overall average ranking across both groups, those of elected members and members of the community, can be produced by using the following equation:

$$Overall\ Ranking\ Score = W_e S_e + W_c S_c \tag{1}$$

where:

- $S_e$  = score given by elected members
- $S_c$  = score given by members of the community
- $W_e$  = weighting factor for elected members
- $W_c$  = weighting factor for members of the community

in which  $W_e + W_c = 1.0$

A subsequent overall ranking score was produced for each policy option, with the lowest score becoming the highest priority action. These were then placed into order of priority in an overall listing.

#### **5.4 Public consultation on draft ZWS**

The findings from the focus groups were used to shape the structure and content of the ZWS and build on areas identified at the earlier scoping exercise. A draft ZWS for CBC was compiled; this was subject of further public consultation to establish opinions on its content, targets and actions. A six week public consultation on the draft CBC ZWS took place during October and November 2012.

The consultation took the form of a questionnaire. The authors used a questionnaire following the standard format used by CBC for public consultation. This contained 10 questions. Two questions were related to the age and location of the respondent, seven questions were multiple choice directly related to the content of the ZWS and associated targets, and a further question offered the opportunity to provide free-text comments giving opinions on the current waste and recycling operations of CBC, or related subjects.

The consultation was promoted through a series of public meetings, leaflets, posters, text alerts and the LAs Twitter account and a dedicated webpage on CBC website, which contained the draft strategy, information and a link to the questions. A paper copy was posted to a variety of stakeholders, Government organisations, other LAs, local businesses, professional partners and community groups.

### **6. Results and Analysis**

#### **6.1 Focus Groups**

The results from the activities undertaken in the focus group are presented in this section. These have been combined for analysis to provide a guideline for the structure and content for the draft ZWS.

Results from both focus groups were combined to produce a draft strategy whose structure and content reflected opinions of both groups.

**6.1.1 Questionnaire results** The questions set aimed to test the level of understanding on the recycling performance of CBC, the UK as a whole and the individual nations within the UK and to judge their perceptions of CBC's current performance relative to other regions.

Results showed 85% of participants demonstrated some accuracy about local and UK recycling performance, with 80% of participants also accurately stating CBC's current recycling target. There was wide range of answers about the recycling performance in Scotland, Wales and Northern Ireland, with 30% of participants correctly stating these. However, views were subjective, based on each participant's prior level of knowledge.

#### **6.1.2 Identified policy instruments for inclusion in Zero Waste Strategy**

The focus group discussions to suggest possible policy options for inclusion in the ZWS agreed two ways for CBC to move towards Zero Waste: "recycle and reuse" and "reduce waste produced in households". Within these two categories, a list of policy instruments available to the CBC have been identified, these are:

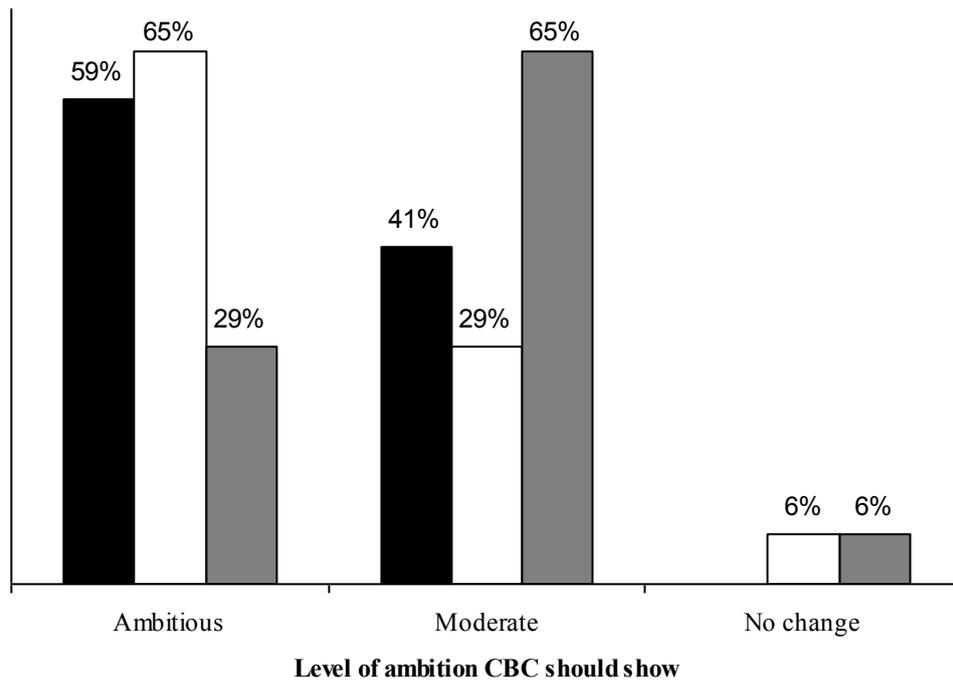
1. Increase the range of recyclate by collecting materials present in residual waste stream that are not currently recycled. This involves evaluating the cost of segregation,

collection and transport. Possibilities exist for increasing recycling of textiles, bulky waste, food waste and WEEE (electrical and electronic items), which have recycling potential high enough to justify the additional resources involved in segregating them from residual waste.

2. Encourage behavioural change by identifying and encouraging non-recycling householders to participate in kerbside recycling schemes that collect common household waste materials.
3. Educate householders on the benefits of using home composting equipment or other treatment methods suitable for home processing of garden and food waste.
4. Restrict HW landfill bin capacity, by decreasing the size of containers provided to households.
5. Seek more sustainable treatment methods for a range of materials present in HW. Working with partners, such as neighbouring LAs and Leicestershire County Council, to make use of alternate treatment processes that have environmental benefits.
6. Introduce a separate food waste collection for anaerobic digestion or composting, and therefore divert this waste from landfill disposal.
7. Remove the current garden waste charge as it is perceived to be a barrier to the use of this service. Removing the charge and providing a free collection service may encourage more householders to use the service, which will in turn result in removing some organic garden waste from landfill disposal.
8. Introduce a charge for excess of residual waste. Provide householders with the ability to have any amount of residual waste removed from their premises by CBC, provided they pay for the service beyond an agreed reasonable amount.
9. Charge for the removal of bulky waste stream to discourage the use of the current CBC free bulky waste collection service, to encourage householders to find alternative ways for reuse and recycling (e.g. second hand sales, charity shops, furniture recyclers etc) (Cole *et al.*,2013).

### **6.1.3. Rating the level of ambition**

The level of ambition that CBC should aim for in the three key areas is shown in Figure 4. This is shown as a percentage of total attendants at both of the focus group sessions.



- CBC's current recycling rate is 49%. What level of ambition should CBC show to improving this?
- What level of ambition should CBC show to reducing waste sent for landfill disposal?
- What level of investment should CBC make with regard to the cost of the waste and recycling collections service?

**Figure 4:** Focus group participants views on the level of ambition CBC should target.

These results show a clear level of ambition amongst participants for the LA to strive for higher recycling rates and reduce the level of waste sent for landfill disposal. Whilst continuing to reduce the costs of the services should remain a priority, it does show some willingness to invest in a service that delivers an improved recycling performance and reduction in waste to landfill.

#### 6.1.4. Completing structured form - Prioritisation of policy options for Zero Waste Strategy

Participants looked at the various policy options available to CBC (listed in Section 6.1.2) and then considered how adopting any of these would impact on waste management across a series of factors identified in the project scoping.

Rankings for each option from both the member's and the local residents' focus group are presented in Table 4, together with an aggregated score from both groups (by assuming  $W_e = W_c = 0.5$ ). The table shows the policies ranked order of priority, with highest priority in position 1.

**Table 4-** Policy instruments prioritised by focus group participants

Policy instruments	Ranking		
	Elected members*	Members of the community*	Aggregated score (Equation 1)
Increase the range of recyclates collected separately	1	2	1.5
Encourage / subsidise home composting	2	6	4
Restrict the size of the landfill bin issued to households	3	4	3.5
Sustainable treatment/disposal of street cleansing waste	4	8	6
Garden waste charging policy	5	7	6
Behavioural change	6	1	3.5
Influencing treatment options	7	3	5
Residual waste (additional capacity) charging policy (introduction of charge)	8	10	9
Introduce a separate food waste collection	9	5	7
Bulky waste charging policy (introduce a charge)	10	9	9.5

\* 1: Highest priority. 10: Lowest priority.

The results show the two focus groups had different priorities. Increasing the range of recyclates was top priority for the elected members and second priority for the members of the community, making it the highest priority for the aggregated rankings. The members of the community saw behavioural change as their top priority; this was sixth in the priorities listed by elected members, but became second priority in the aggregated rankings.

Policies that involved introducing a charge for services were not popular with either focus group. Introducing a charge for bulky waste collections ranked tenth by the elected members and ninth by the members of the community. Implementing a charge for the collection of residual waste above a predetermined quantity was also unpopular. Elected members placed this in eighth position and members of the community gave this the lowest priority of all options.

The introduction of a separate collection service for food waste received mixed support; this was not seen as a priority by either focus group. It was ranked fifth by members of the community, but deemed as a very low priority (ranked ninth) by elected members.

In the overall rankings (Table 4) the low cost options (increase the number of recyclable materials collected, behavioural change, encourage home composting and restrict the size of landfill bins supplied to households) occupied the highest ranked placings. The policies regarding the collection of organic waste, garden waste, food waste and street sweepings were seen as neither high nor low priority and occupied the mid ranking places. Finally, and as mentioned previously, the policies that addressed charging for services were unpopular.

## 7. Results from public consultation

The consultation received 411 responses. It is difficult to quantify a response rate because the questionnaire was available online through CBC’s website with open access in addition to the questionnaires that were posted and completed by respondents visiting roadshows and other events. The number of replies was in line with other consultation exercises carried out by CBC, such as the public consultation on the Core Strategy Consultation in 2012 (CBC, 2012c).

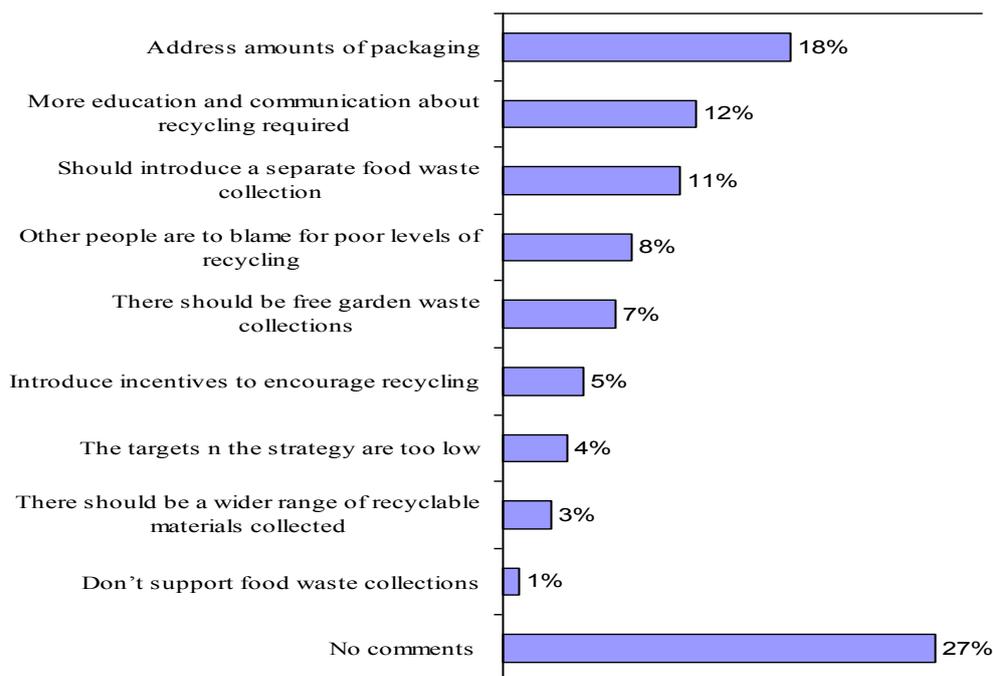
### 7.1. Targets set within the Zero Waste Strategy

Looking specifically at the targets included in the draft ZWS there was a broad agreement with the targets set, as reported below:

- Over 88% agree with a recycling target (62% of waste collected within the Borough by 2024).
- Over 81% agree that households should aim to dispose of less than 335kg of waste per household per year by 2024.
- Over 72% agree that the cost of the waste collection service should be in the lowest 25% of CBC, with some support for increased service costs if required to meet the other two targets.

### 7.2. Public consultation responses to Zero Waste Strategy questions.

Results of the consultation exercise included comments on ZWS and CBC actions to implement it, of which 151 responses included qualitative comments. The most frequently recurring topics were associated with addressing the levels of packaging on consumer items (18%); and increasing education and communication regarding recycling (12%), with 8% stating that “other people (e.g. neighbours, other householders, etc.) were to blame for low levels of recycling”. Support for the introduction of a dedicated food waste collection service was received from 11% of respondents, with only 1% not supporting this action. The comments have been grouped into topics and are shown in Figure 5.



**Figure 5:** Respondents’ qualitative comments received during public consultation.

### 7.3 Amendments to the draft Zero Waste Strategy

The public consultation process showed broad support for the draft ZWS and based on the findings the following recommendations were made:-

- The focus on waste prevention and reuse requires strengthening. As such, respective sections in ZWS were amended.
- Targets in the draft ZWS, whilst set above Government baseline levels, were accepted as achievable for CBC.
- There is widespread support for continuing educational programmes and communication with the public to raise awareness about waste prevention, reuse and recycling.
- CBC should continue to work in partnership with other agencies and stakeholders to influence the parts of the “sustainable waste management cycle” that they do not have control over.
- CBC should explore ways of improving the waste services it offers. However, there is a need to take account of the financial impact of any changes when assessing their viability.

## 8. Discussion

This paper has outlined the development of a ZWS for CBC, providing a narrative of the process undertaken. Findings from two focus groups were used to build on the initial results of a scoping group to form a base for the ZWS. Taking into account the limited sample size of the focus groups, a wider public consultation was used to refine the contents of the CBC ZWS. The refinements include increasing the focus on reuse and waste prevention and exploring improvements that can be made to household waste collection services within the Borough to recycle, reuse or treat more sustainably various sections of the residual waste stream.

The order of priority of options from the focus groups showed a preference for the lower cost options (increase the number of recyclable materials collected, encourage home composting and restrict the size of landfill bins supplied to households) these policies will be among the first to be implemented. These actions have been found to have some success in reducing quantities of household waste, with the limit on the amount of residual waste forcing householders to reduce and recycle (Uzzell and Rätzl, 2009)

The policies regarding the collection of organic waste, garden waste, food waste and street sweepings were neither high nor low priority options in the focus groups. However, food waste makes up as much as 30% of residual household waste (Defra, 2008a; Zero Waste Scotland, 2010). Therefore, the treatment of organic waste, particularly food waste, is an important issue that must be included in the ZWS if CBC is to reach set targets and also meet the Landfill Directive requirements of reducing landfill disposal of biodegradable waste. In addition to this, increasing the range of recyclates collected separately was highest ranked priority for the focus groups and the introduction of a separate food waste collection was popular in the wider public consultation. This would suggest the value of investigating all options for recycling waste that is not currently separated for recycling or organic treatment. The value of collecting food waste should be explored particularly as this has a recognised high potential yield, which is not the case with all items contained within the household waste stream. Other areas to explore are separating other items for recycling such as e waste, and making improvements to the existing bulky waste and textile collections (Cole *et al.*, 2013).

Educating householders to change behaviour patterns by providing information and encouraging compliance of those poor or non-recyclers was an area that was important to the community member's focus group and in the later consultation. It is generally easy to obtain the involvement of the environmentally aware, but the interest of other sections of the public is more challenging (Harder and Woodward, 2007). Public education, or structured and frequently repeated social marketing of desired behaviour to the users of systems is essential (Scheinberg, 2010); whilst changing behaviour remains one of the biggest challenges when making changes to waste collection services (Price, 2001).

Options that involved introducing or increasing a charge, such as for additional waste to be collected or for the collection of bulky waste items, were unpopular; this may serve as an incentive to reduce waste production to avoid the cost of collection (CIWM, 2007).

This research focuses on the actions of an English LA taking an innovative approach to adopt a ZWS. Comparing waste management approaches taken in England with those in Scotland and Wales raises the issue of increased targets, national policy and legislation in the devolved countries against the freedom LAs have in England. With less legislation and lower targets in England, LAs are free to take innovative approaches or alternatively to do the bare minimum at times of financial pressure.

## **9 Conclusion**

The results from this research give a clear indication of actions that can be taken by CBC to devise and implement a ZWS. The continued use of policies, which influence the development of sustainable waste management systems, provide education and raise awareness of environmental issues, and promote positive behavioural changes, will move towards achieving the key principles of Zero Waste. Examining the Lean Movement, possibly the foundation for Zero Waste, Pool et al (2010) found improvements are conditional on adequate organisational arrangements with respect to change management, particularly communications and involvement. This is an area for further research, in particular examining LA strategic successes by monitoring improvements and examining inter-organisational actions.

Many of the options identified during this research complement each other and if used in combination may see large steps taken towards achieving Zero Waste. Zero Waste is difficult to achieve without clear management policies in place and requires long term initiatives. A ZWS should include social and environmental aims alongside WM performance targets and the ability to monitor progress.

To achieve targets set within a ZWS, there is a need to establish a link between all stakeholders to produce a holistic approach to waste management. This would encompass treatment processes chosen to consider the best possible method of resource recovery for different elements of HW streams and deliberate efforts made to reduce waste production. This will require additional efforts, innovation, creative and effective policies, partnership working and support from National Government for LAs to move in the direction of zero waste.

This study illustrates the benefits of LAs and universities working together in partnership based on the principles outlined by Williams (2009). The commentary provided on the

development of this ZWS by an English LA could be utilised to aid other Local Authorities, or other world regions to address the issue of Zero Waste. Subject to legislative differences, the findings could be utilised to structure waste management strategies in a variety of international contexts.

Further study is suggested to establish whether the implementation of ZWS is successful and whether ZWS made a difference to the performance of the LA when compared to similar LAs without a ZWS. Additionally, if any innovative practices were introduced as a result of adopting ZWS, the structure and processes of these could be investigated to show any examples of Best Practice.

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## APPENDIX F – QUESTIONNAIRE



Centre for Innovative and Collaborative  
Construction Engineering

Household waste management - collection policies and services in English Local Authorities.

### Questionnaire

As part of the research project I am undertaking with Loughborough University and Charnwood Borough Council I would greatly appreciate your help in answering a few questions about the waste and recycling collection services operated by your Local Authority. I will be pleased to share the results of the survey with you.

- 1 Are your household waste and recycling collection services operated by an external contractor, or by the Local Authority?
- 2 Can you detail in the table below the frequency of the household waste and recycling services that you operate in your Local Authority area, the type of container that you supply for households and the materials you collect for recycling.

Waste stream	Size and type of container supplied to households	Materials collected	Frequency of collection
Dry recycling			
Garden waste			
Food waste			
Residual waste			
Bulky waste			

- 3 Do you charge for garden waste collections? Yes / No
- 3a If you charge for garden waste collections, how much do you charge?
- 4 Do you charge for the removal of bulky waste items? Yes / No
- 4a If you charge for removing bulky waste items, how much do you charge?
- 4b Do you recover any bulky waste items for reuse? Yes / No
- 5 Is there a University within your Local Authority area?

For further details on either the questionnaire or the research programme please don't hesitate to contact: Christine Cole

Email: [christine.cole@charnwood.gov.uk](mailto:christine.cole@charnwood.gov.uk) [c.cole@lboro.ac.uk](mailto:c.cole@lboro.ac.uk)

Project website : <http://www.lboro.ac.uk/research/cice/current-research-engineers/christine-cole.html>

## APPENDIX G – ZERO WASTE STRATEGY



Zero Waste Strategy  
2012 – 2024



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## Foreword

As individuals and organisations we are becoming increasingly aware of our impact on the environment, and the need to look after precious resources and materials we all depend on in our society. In the developed world, all too often, today's product is viewed as tomorrow's waste. The challenge is change this throwaway culture and treat waste in a more sustainable manner.

The residents of Charnwood have already made huge progress on waste. The amount of household waste requiring collection by the Local Authority has decreased over the last 5 years, and of the waste produced, almost 50% of it is now recycled and composted. This has dramatically cut the amount of waste we have “thrown away” into landfill sites. However, we must continue to improve. We must recognise that everything we use and throw away is a resource which has value, a value that we should try to preserve, capture and use again.

A Zero Waste Borough is not one where we can never throw anything away again, or indeed maximise the amount of waste we recycle, it includes a new approach to reducing the amount of waste we produce, reusing items where possible and treating what waste we do produce as a resource.

Within our community we already see individuals and organisations taking action to prevent waste and use resources more effectively. We are convinced that Charnwood Borough should be leading the way and supporting the efforts of others. We are proud of the efforts that the residents of Charnwood make to recycle and compost large proportions of our waste and hope that together we can meet the aspirations set out in this strategy to exceed national targets.

This strategy document has been put together with the help of elected members and community consultation panels. We thank those that also contributed their thoughts during our further consultation stages to help us develop a better local service that reflects our concern for the wider environment.

Cllr Hilary Fryer

Lead Member for Cleansing and Open Space



## Executive summary

This is a strategy for the management of waste and resources in the Borough of Charnwood. It aims to promote a clear understanding of, and commitment to, the principle of a Zero Waste Borough. It will play an active and leading role in reducing the impact of climate change by treating the waste we manage as a resource, and consequently maximising the amount of waste diverted from landfill. All stakeholders and residents of the Borough can contribute to the overall goal through their individual actions. It will also ensure the Council's commitment to Zero Waste is fully integrated into its strategies, plans and programmes, by influencing and informing policy development and implementation across the Council's activities.

### Background

The Council's existing Zero Waste Strategy ran from 2007 to 2012, and was refreshed in 2009 taking into account the adoption of a new Environmental Services Contract, which covers household waste collections and street cleansing. This contract runs from August 2009 to March 2017.

Since the existing contract was written, there have been a number of changes in waste management – locally, nationally and internationally. A revised EU Waste Framework Directive guiding all waste policies across Europe, a new UK Government with new priorities; an updated Leicestershire Municipal Waste Management Strategy re-affirming ambitions for the county-wide management of waste; and new contracts for waste and recycling collections and the sale of recyclable materials in Charnwood allow greater opportunities for driving the service forward.

### Performance to date

Charnwood Borough Council currently recycles and composts 48.6% (2011/12) of the household waste it collects. This compares against a national average of 43% for the same period.

The council has successfully undertaken a range of waste prevention actions and in recent years the total amount of waste collected from households has reduced slightly. However, research carried out in Leicestershire in 2009 shows that many of the materials collected for recycling are still present in the residual waste (black bin) collections. These materials are therefore unnecessarily destined for landfill. So, while the Council is performing well it is clear that more needs to be done to ensure that recyclable material is appropriately separated for collection and therefore recycling.



### Scope of the new strategy

The new strategy will cover waste produced by the residents of Charnwood, and collected by Charnwood Borough Council. The strategy will summarise the current arrangements for waste management and set out the actions necessary for the Council to move towards the vision of a Zero Waste Borough over the next 12 years. The new strategy will be used to guide future decision making by the council, and successful delivery will require the engagement of all key stakeholders. This includes the support of a wide range of Council services, as well as Leicestershire County Council, as Waste Disposal Authority, Leicestershire Waste Partnership, the contractors for household waste & recycling services, the voluntary and community sector, businesses, schools and householders.

### Key drivers

There are a number of key drivers for the new strategy including the new obligations arising from the European Commission's revised Waste Framework Directive. In addition to this, Charnwood Borough Council operates a popular recycling service achieving high levels of recycling and a continuation of this high performance is expected by local communities and other key stakeholders. However, it is recognised that the next steps required will be very

challenging. Budget constraints, increasing costs of transport and Landfill Tax, and ensuring householders continue to receive a comparable service regardless of their rural or urban location will all present significant challenges.

### Main issues to be addressed by the Zero Waste Strategy

This Zero Waste Strategy is about far more than providing a convenient regular recycling collection; it is about reducing the amount of waste produced and using the most sustainable treatment methods for any waste remaining. It is about providing leadership and engagement on waste management, maximising the economic benefit from Zero Waste and optimising services for the future

In adopting a Zero Waste Strategy, Charnwood Borough Council has shown it has aspirations to make significant improvements in environmental performance. A key part of achieving success with the strategy will be working with a variety of partners, and using a range of methods of communication to encourage and inform different sectors of the community. In this way we can ensure that all stakeholders and residents of the Borough can, through their individual actions contribute towards the overall goal of diverting the maximum amount of waste from landfill.



# 1. Introduction

This is a strategy for the management of waste and resources in the Borough of Charnwood. It aims to promote a clear understanding of, and commitment to, the principle of a Zero Waste Borough. It will play an active and leading role in reducing the impact of climate change by treating the waste we manage as a resource, and consequently maximising the amount of waste diverted from landfill. All stakeholders and residents of the Borough can contribute to the overall goal through their individual actions. It will also ensure the Council's commitment to Zero Waste is fully integrated into its strategies, plans and programmes, by influencing and informing policy development and implementation across the Council's activities.

It builds on Charnwood Borough Council's previous Zero Waste Strategy 2007-2012. This formed the basis of the Environmental Services contract which covers the operational aspects of the household waste collections and street cleansing throughout Charnwood, and expires in 2017.

It is a strategy to steer the Council's actions on waste through to 2024. As there is a possibility of a seven year extension to the Environmental Services contract, it will ensure the continuation of the Council's priorities on Zero Waste. To ensure that any major developments are accounted for, interim formal reviews will take place every three to five years, with the first review to be completed by 2017. The Strategy will not be fully reviewed and updated until 2024, unless there is a significant change in national policy.

There is no legal requirement to produce this strategy but Charnwood Borough Council wishes to ensure that it meets all relevant national and local targets, and reduce the impact of waste management on the environment. The plan therefore identifies policy objectives for waste and resource management, with key objectives and actions of the strategy outlined following engagement with local residents and Members of the Council. This Strategy has been written taking account of the opinions of residents and stakeholders in Charnwood through a consultation process.



### 1.1 What is “Zero Waste”?

Reaching Zero Waste requires ambition and vision, suggesting that waste should be eliminated and viewed instead as a potential resource. Zero Waste means treating waste in a way that has least impact on the environment. This challenges the long held practice of disposal of materials and is a big change to the traditional forms of waste management.

In the UK in 2010, household recycling rates were reaching 70% in some Local Authorities, with a national average of 42%. This shows considerable improvements

in recent years because of concerted efforts by national and local government to encourage individuals, manufacturers and retailers to do more.

Charnwood Borough Council sees the concept of Zero Waste being far more than increasing the amount of recycling we do. The focus lies on waste prevention, thus reducing the amount of waste requiring treatment and treating the waste we do manage as a resource, using landfill disposal only as a last resort, as shown in the waste hierarchy.

### 1.2 The Waste Hierarchy

The Waste Hierarchy is a way of depicting the preferred order for different treatment methods used to deal with waste. These are ranked according to their environmental impact, placing the most preferred option at the top and the least preferred at the bottom, as shown in diagram 1 below.

Waste Prevention (not creating waste in the first place) offers the best outcomes for the environment and is therefore at the top of the priority order. Offering additional environmental benefits associated with reduction in the energy use of manufacture, distribution, collection and processing through all the other options. Preparing



Diagram 1: The Waste Hierarchy



for re-use, recycling, other recovery and disposal, all in descending order of environmental preference are lower in the waste hierarchy than waste prevention, this takes into account the need to safeguard resources for future generations.

### 1.3 The vision for the strategy

In adopting a Zero Waste Strategy, Charnwood Borough Council will play an active and leading role in promoting sustainable resource management at a local level. Charnwood Borough Council recognises that it has limited control on

the waste cycle, being able to influence rather than control some aspects of waste generation and treatment. Therefore, this strategy is about an attitude towards the prevention and sustainable management of waste, and encouraging and educating others to join us in this philosophy. The Council aims to be at the forefront of new ideas and to challenge the way we currently deal with waste. It will reduce the impact of climate change by treating the waste we manage as a resource, and consequently maximising the amount of waste diverted from landfill.

### 1.4 Aims and objectives of the strategy

***The aims of this Zero Waste Strategy are to:***

1. Provide a strategic framework within which waste will be managed in Charnwood, with the vision of becoming a Zero Waste Borough
2. Set ambitious annual targets, long-term priorities and short-term actions to drive forward improved performance
3. Be innovative in achieving its ambitions and fulfill the expectations of Charnwood residents

***The objectives are to:***

1. Use education, appropriate facilities and waste minimisation initiatives to encourage the use of waste as a resource
2. Use education, contract management, contract development, and enforcement to ensure the standards of street cleanliness remain high
3. Use contract management and procurement to secure funding, and to review service delivery costs and the potential for maximising income to ensure financial efficiency
4. Make effective and appropriate choices of waste management initiatives, taking account of local opportunities and total system environmental costs
5. Manage contracts using a series of Key Performance Indicators and reward/penalty systems.

## 2. Context

### 2.1 Why is waste a problem?

For many people the problem of waste is restricted to what they can put into their bins and when, and how often, they will be emptied. It might also relate to a waste treatment site, a landfill site or incinerator close to their home, but the impact of waste is greater than merely this end of life viewpoint. Increasingly, consideration is being given to the environmental impact of waste, the overuse of resources and the problems these will cause today and in the future.

Although attitudes to waste are changing, 32.5 million tonnes of municipal waste was still collected in the UK in 2009, of which 53,000 tonnes was from Charnwood residents. The Office of National Statistics predicts an increase in the population of Charnwood of 16.4% by 2020. This will almost certainly mean an increase in the amount of waste that Charnwood Borough Council will be collecting for treatment.

Recent years have seen a reduction in the generation of waste in the UK, partly due to the global economic downturn, and partly due to increased awareness by business and the public, and more recycling. Households and businesses are becoming more thoughtful about purchasing and replacing items unnecessarily and are therefore producing less waste. This is not always a conscious decision and can be a consequence of the economic situation. In times of austerity there is often lower concern for the environment, although this is not borne out by recent evidence which shows public concern for the environment remaining high despite the economic challenges people face. What is clear is that constant commitment is needed by councils, business and householders alike to maintain awareness about the value of actions to improve the environment in order to meet demanding targets.



## 2.2 Strategic context

Since the last Strategy was written in 2007, there have been a number of changes in waste management, both locally and nationally. A new government with new priorities, including a Waste Policy Review in 2011; an updated Leicestershire Municipal Waste Management Strategy, 2011 which reaffirms ambitions for the county-wide management of waste; and new contracts for the collection of recycling and waste, and the sale of recyclable materials in Charnwood, allowing greater opportunities for driving the service forward.

This section outlines the context within which the Zero Waste Strategy should be considered, illustrating the European, national, regional and local influences that have to be considered in this strategy.

## 2.3 The European context

The European Union (EU) has established a number of Directives that impact on waste policies throughout Europe, guaranteeing environmental protection and supporting economic growth through resource efficiency.

The following EU Directives have strongly influenced national waste management policy and have led to the introduction of several new pieces of national legislation.

### 2.3.1 Waste Framework Directive

The Waste Framework Directive is the primary European legislation for the management of waste, providing the overarching structure for waste policy and legislation across member states. It was revised in 2008, and has been implemented in England through the Waste (England and Wales) Regulations 2011. The revised Waste Framework Directive (rWFD) introduces the first EU wide recycling targets. By 2020 Member States must reuse or recycle 50% of household waste (this includes composting of organic wastes).

The rWFD places the Waste Hierarchy as a core principal. The Waste Hierarchy depicts the preferred order of solutions for the treatment of waste, placing the most preferred option at the top of the Hierarchy and the least preferred at the bottom.

### 2.3.2 Landfill Directive

The Landfill Directive sets targets for reducing the amount of biodegradable municipal waste (BMW) going into landfill and the pre-treatment of wastes before landfilling. This is to reduce the volume of waste and reduce the environmental impacts of disposal.

The targets in the Landfill Directive are set against a 1995 baseline and are to reduce landfill disposal of biodegradable waste to 50% of 1995 levels by 2013 and further reduce to 35% of 1995 levels by 2020.

Prior to the rWFD the Landfill Directive was the main driver for national policy and this saw all Local Authorities introduce separate household collections for recyclable materials. Many also set up collections for garden and food waste.

### 2.3.3 Roadmap for a Resource Efficient Europe

Although not a binding policy, the European Commission's recent Roadmap for a Resource Efficient Europe is an important strategic document. It looks ahead to resource security and resource efficiency in Europe to 2050. It provides further important context for this Zero Waste Strategy as it indicates the challenge Europe faces to manage its resources better, encouraging the growth of 'green jobs' by capturing resources, and managing more of them within Europe in a global climate of potential resource insecurity.

## 2.4 The national context

The UK Government uses the structure set by EU policy and associated Directives to provide a national framework for the regulation of waste. The devolved Governments of Scotland, Wales and Northern Ireland set their own priorities and legislation.

### 2.4.1 Waste Strategy for England 2007

The Waste Strategy for England 2007 recognised the need to produce less waste in the first place, provide a more joined up approach to the treatment of waste and

move towards long term sustainability, treating waste as a resource. To encourage Local Authorities to work towards these aims the Waste Strategy set a series of national targets for recycling (including reuse and composting) of household waste, the last of these is to reach 50% recycling of household waste by 2020.

### 2.4.2 Review of Waste Policy in England 2011

A review of Waste Policy in England was carried out by Defra (the Department for Environment Food and Rural Affairs) in 2011. This will affect the way waste is managed at a local level. The review looked at all aspects of waste policy and waste management in England, with the aim of ensuring that the right steps are being taken to move towards a 'zero waste economy'. The key outcomes of the review were to:

- Continue with the commitment to the waste hierarchy, with a strong focus on waste prevention
- Make it easier to recycle
- Reward and recognise those who do the right thing
- Improve the quality of local service delivery through the Recycling and Waste Services Commitment
- Work to reduce food waste, aiming to send none to landfill
- Encourage communities to address waste issues



- Improve collection of waste from smaller businesses
- Continue with the Courtauld Commitment (a voluntary agreement between major retailers and manufacturers, initially to reduce the growth in use of packaging materials) and to deliver a Packaging Directive
- Support energy from waste for genuine residual waste
- Review landfill restrictions on wood waste, textiles and biodegradable waste
- Abolish the Landfill Allowance Trading Scheme (LATS) at the end of 2012/13, as the rising Landfill Tax is a more effective driver
- Explore the measurement of waste in carbon terms rather than weight, as a more accurate measure of environmental impact

In the UK, most of the incentives to find more sustainable methods of waste management have encouraged local authorities to contribute to meeting targets set by the European Union in order to divert waste from landfill. Whilst this has encouraged higher recycling rates, it hasn't yet tackled the more significant issue of waste prevention.

The important challenge of waste prevention has to be addressed by Government as part of the revised Waste Framework Directive. Defra will be producing a national Waste Prevention Plan for England and this has to be in place by the end of 2013. This Zero Waste Strategy seeks to anticipate this and put in place more actions on waste

prevention, but this will be reviewed in the light of the Government's plan if necessary.

### 2.5 Regional Context

Charnwood Borough Council recognises the importance of working in partnership with its neighbouring Local Authorities to influence waste management locally.

#### 2.5.1 Leicestershire Waste Partnership

The Leicestershire Waste Partnership involves the seven District and Borough councils in Leicestershire (the Waste Collection Authorities), Leicester City Council (a Unitary Authority with responsibility for both collection and disposal of waste), with Leicestershire County Council, (the Waste Disposal Authority joining as an associate partner. The Partnership carries out a number of joint projects, particularly relating to waste prevention and communications.

The Leicestershire Waste Partnership was the highest performing two-tier Local Authority waste partnership in England in 2011/12 for recycling and composting of household waste, with 56.2% of household waste recycled and composted. This is higher than the national target of 50% recycling by 2020; therefore, an ambitious target of recycling 58% of Local Authority Collected Waste by 2017 has been set by the Partnership. The Leicestershire Waste Partnership has collectively agreed a Joint Municipal Waste Management Strategy for Leicestershire, which was updated in 2011.

### 2.5.2 Joint Municipal Waste Management Strategy for Leicestershire, 2011

This strategy sets a vision for waste management in Leicestershire, along with a number of county-wide objectives and actions for waste management. The objectives include:

- Manage materials in accordance with the waste hierarchy, except where costs are prohibitive, or where the environmental consequences can be demonstrated to be negative
- Deliver quality services, offering value for money in the long and short-term
- Ensure flexible services to allow for technological developments and new legal requirements
- Research and develop coordinated services and infrastructure for waste collection, treatment, transfer and disposal
- Reduce and manage residual waste within the County, and to manage other waste in the nearest appropriate facility
- Consider management of commercial and industrial waste where this contributes to the well-being of Leicestershire residents
- Lobby and work with a range of partners, in particular on waste prevention
- Work with the community on environmental education, and encourage waste prevention, re-use and recycling
- Promote the economic and employment opportunities of sustainable waste management

- Local Authorities to set an example by following the waste hierarchy with their own waste, and using buying power to encourage sustainable resource use
- Seek to reduce carbon emissions

The Charnwood Zero Waste Strategy complements and enhances the underlying principles of the Joint Municipal Waste Management Strategy for Leicestershire.

## 2.6 Local Context

### 2.6.1 How waste is managed

The responsibility for collection and disposal of household waste management in Charnwood is split between Charnwood Borough Council (the Waste Collection Authority), and Leicestershire County Council (Waste Disposal Authority). This means that the collection of household waste and recycling is the responsibility of Charnwood Borough Council and the provision of treatment facilities for residual household waste is the responsibility of Leicestershire County Council. However, both authorities are partners in the Leicestershire Waste Partnership and work together to ensure waste is treated in accordance with the Waste Hierarchy and the most sustainable treatments available are used. Charnwood Borough Council for its part will do what it can to influence and facilitate the provision of sustainable treatment facilities within a reasonable distance.

Charnwood Borough Council operates an excellent and popular recycling service achieving high levels of recycling and a



continuation of this high performance is expected by local communities and other key stakeholders. However, it is recognised that the next steps required will be very challenging. Budget constraints, increasing costs of transport and Landfill Tax, and ensuring householders receive a comparable service regardless of their rural or urban location will all present significant challenges.

Charnwood's Zero Waste Strategy is written to support the Borough Council's Corporate Plan, Local Development Framework and Climate Change Strategy and is reflected in many other services the council provides.

### 2.6.2 Charnwood Borough Council Corporate Plan

Charnwood Borough Council adopted a refreshed Corporate Plan in 2012; this outlined the ambitions of the Council, and made specific reference to waste and the need for a Zero Waste Strategy. It proposes to "ensure the Borough maintains a leading role in local efforts to reduce the impacts of climate change... by increasing the amount of waste diverted from landfill." The actions in order to do this include exploring options for new recycling schemes which can be implemented Borough wide and continuing to explore further initiatives to divert waste from landfill.

### 2.6.3 Climate Change Strategy

The impacts of a changing climate mean that Charnwood will experience warmer and wetter winters, hotter and drier summers and more extreme weather events like

flooding and heat waves. The greenhouse gas emissions caused by the past hundred years of industrialization have meant that there is not way to avoid these impacts – we can only adapt.

The Council's Climate Change Strategy seeks to not only reduce the carbon emissions arising from everyday life in Charnwood, but also adapt services, public estates and development.

### 2.6.4 Charnwood Borough Council Zero Waste Strategy 2007 – 2012

Charnwood's Zero Waste Strategy was adopted in December 2006, and implemented from 2007 to 2012. It aimed to minimise the number of things we throw away; re-use, recycle and compost at least 50% of waste; and treat all remaining waste to maximise the amount of value recovered. The achievements against the previous strategy are outlined in section 3.4.

### 2.6.5 Waste Collection Policy

Charnwood Borough Council ensures the delivery of a high-quality domestic waste collection service through a Waste Collection Policy. This was refreshed and approved by Cabinet in March 2011 and can be seen in Appendix 1.

Issues such as the use of wheeled bins and alternate weekly collections are largely considered best practice. Current areas of debate are charging for waste collections, or offering incentives for recycling. These may be areas of the Waste Collection

Policy that are amended during the lifetime of this strategy to ensure Charnwood embraces best practice and complies with new legislation.

### 2.6.6 Enforcement

Charnwood Borough Council has a strong Waste Collection Policy in place. This provides a framework for the delivery of the operational service. Together with an ongoing educational and awareness campaign, it is hoped that the need to resort to using regulatory powers in an enforcement role will be reduced. However, there will be times when it is necessary to use these powers in the interest of the environment and all residents of the Borough.



## 3. Current services

### 3.1 Demographic profile of Charnwood Borough

Charnwood Borough Council is responsible for the collection of household waste and recycling from 69,000 households. Charnwood is a largely rural Borough; the main urban centres in Charnwood are Loughborough, Shepshed, Syston, Birstall and Thurmaston. The Office of National Statistics predicts a 16.4% increase in the population of Charnwood Borough by 2020, and an associated increase in the number of households. This will increase the amount of waste Charnwood Borough Council will be required to collect from households.

Loughborough University has approx 14,000 fulltime and 3000 part time students; this means that a significant number of residents in Charnwood are students, based in the area for a relatively short period of time. This presents particular communication challenges to Charnwood Borough Council, with a continuous programme of education required to provide students with information about the recycling and waste collection services to ensure they are used correctly.

### 3.2 The service

As the Waste Collection Authority, Charnwood is able to determine the features of collections, such as frequency, size and type of containers, materials collected for recycling, and the option to collect organic waste separately. Over time, the household waste and recycling collection service operated by Charnwood Borough Council has evolved to increase the proportion of household waste that is recycled, re-used or composted, and to reduce the cost of the service, as outlined in Table 1 opposite.

The kerbside recycling service in Charnwood now accepts a wide variety of materials: paper, cardboard, glass bottles and jars, food and drink cans, plastics, foil, food and drink cartons, aerosols and batteries. Some bulky household waste is reused through Sofa, a local furniture reuse project, and textiles and bric-a-brac are donated to the charity Mind.

In addition to the kerbside recycling service, a range of recycling opportunities exist at dedicated local sites across the Borough where householders can deposit a range of recyclable materials, and the Recycling and Household Waste Sites operated by Leicestershire County Council.

Table 1: The history of Charnwood Borough Council's waste and recycling collection service

Year	Amendment to waste collection service	Annual cost of waste collection service per property (£)
<b>Baseline (1994)</b>	Residual waste collected weekly in black sacks No recycling collections Chargeable collection of bulky household items	
<b>2004</b>	Introduction of alternate weekly collections of residual waste in black wheeled bins, and recycling in red and green sacks and a green box	
<b>2004</b>	Opt-in chargeable fortnightly garden waste collections introduced in a brown wheeled bin	£54
<b>2008</b>	Addition of mixed plastics and drinks cartons to the recyclable materials collected	£54
<b>2009</b>	Purple bags replace red and green sacks to simplify collections Green box used for separate collection of glass Textile and bric a brac collections using a white sack supplied by Mind Free bulky waste collections	£46
<b>2011</b>	Introduction of green wheeled bin for all recyclable materials to replace purple sacks and green box White sack for textiles and bric a brac is retained Free bulky collections continue Battery collections introduced using dedicated bag.	£36

### 3.3 Education and awareness

This high recycling rate has been achieved through a variety of different actions including:

- Raising awareness with a comprehensive communications plan
- Increasing the work carried out with the student population
- Recycling Amnesty to maximise recycling and reuse from student house clearances
- Waste education in schools across the Borough
- SWITCH project (Saving Waste in the Charnwood Home) to encourage waste minimisation in households. The project provided a wide range of communication materials, advice on waste prevention and a variety of subsidised home composting and food digestion equipment.



3.4 Performance against previous strategy

The previous Zero Waste Strategy set a number of targets to drive performance toward the overarching aim of recycling and composting 50% of waste.

The previous strategy set a number of targets, which have been translated into the primary focus for monitoring the Environmental Services contract. These use the key performance indicators set out in table 2 below. They look at the performance of the Local Authority and contractor together to achieve high levels of recycling and composting, whilst reducing the

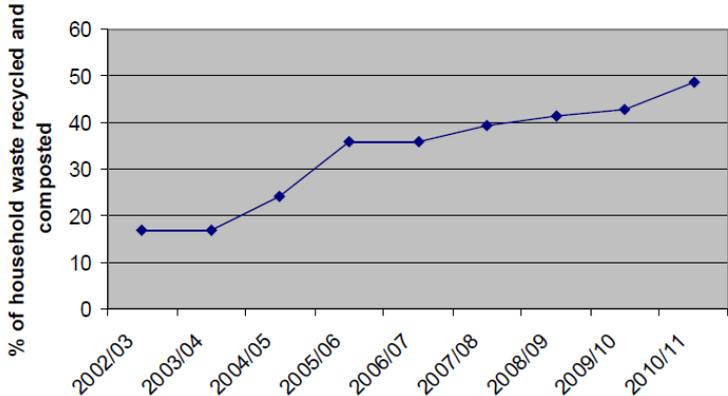
amount of waste sent for landfill disposal, and also reaching and maintaining high levels of customer satisfaction.

National waste strategies and policies over recent years have concentrated on the recycling and composting achievements of Local Authorities. Charnwood Borough Council has seen the amount of household waste it collects for recycling and composting rise from 16% in 2002/3 to a figure of 46.8%, as demonstrated in chart 1 overleaf. This falls just short of reaching the target in the current Zero Waste Strategy of 50%, but still compares favourably to the national average of 42% for the same period.

Table 2: KPIs used to monitor the Environmental Services contract

Key Performance Indicator	Target 2011/12	2011/12 figures (unaudited)
Recycling and composting (as a percentage of total household waste collected)	50%	48.6%
Reduce the amount of residual waste collected per household	415kg/hh	413kg/hh
Customer satisfaction with the waste and recycling collection services	90%	93%

Chart 1: Recycling and composting performance since 2002/03



However, this percentage could be much higher if the recyclable materials currently thrown away as non-recyclable waste (residual waste) were actually separated out. Analysis of residual household waste, in black bins, destined for landfill disposal has shown that only 78% of the recyclable materials collected in Charnwood are actually separated by residents for recycling. The Zero Waste Strategy seeks to address this by including waste reduction and recycling targets alongside continued communication, to raise awareness and encourage behaviour change.

Whilst achieving high levels of recycling is important, waste reduction has a higher place in the waste hierarchy and is to be encouraged before recycling activities. The amount of residual waste (waste that is not reused, recycled or composted, or “black bin waste”) collected in Charnwood was 413kg per household in 2011/12. This is compared to the national average of 575kg per household. A continued reduction in this figure in Charnwood will see progress against targets to further reduce the amount of waste collected and take account of the Waste Hierarchy.

Many councils achieving similar or higher recycling rates than Charnwood are doing so by providing a garden waste collection without an additional charge to users to boost composting levels. This policy is generally accepted to increase the total amount of household waste collected and therefore works against waste minimisation measures. Charnwood Borough Council

and Leicestershire County Council do, however, offer alternative treatment methods for garden waste including the provision of home composting equipment at reasonable rates, believing this is a far more sustainable method for treating this waste.

### 3.5 Customer satisfaction

Customer satisfaction levels with the household waste and recycling collections in Charnwood are monitored through a quarterly survey carried out by a market research company on behalf of the contractor. These show high levels of satisfaction with both the household waste collections and street cleansing services. This is partly due to the range of services offered, but also to the quality of the operational aspects of the service.

The surveys have shown an increase in customer satisfaction from 74% in 2008/09 to 90% in 2010/11. This strategy will show Charnwood’s commitment to high levels of service in its waste management operations, and aims to maximise the levels of customer satisfaction with the service.



## 4. Improving performance

Whilst there are many challenges in finding the most sustainable waste management strategy, Charnwood Borough Council has been very successful in responding to these challenges. It delivers waste and recycling services that in most respects meet the aspirations of the local community and have been accorded high satisfaction ratings. Although Local Authorities themselves have little direct control over major issues that affect waste and recycling (such as packaging design), they do have a range of tools at their disposal to meet the next set of challenges as we strive for Zero Waste.

These are:-

- Waste collection services offered to householders
- Education and awareness activities, including waste prevention messages to householders, businesses and council staff
- Minimising council produced waste and managing what is produced in line with Best Practice
- Embedding Zero Waste into all council activities
- Using sustainable procurement methods, and purchasing items with a recycled content whenever possible
- Planning policy and climate change strategy
- Demonstrating clear leadership on Zero Waste that enables others to follow and gain benefits

#### 4.1 Good practice

Whilst Charnwood Borough Council has made, and continues to make concerted efforts to assist residents with the re-use and recycling of products, they have little control over the products and packaging available to consumers. Manufacturers and retailers are responsible for the products available to consumers, and so should take responsibility for the future of the product and packaging, be that through re-use, recycling or disposal.

The Waste and Resources Action Programme (WRAP) are carrying out work to encourage manufacturers and retailers to use more sustainable packaging. This includes The Courtauld Commitment, which is a voluntary agreement between major retailers and manufacturers, initially to reduce the growth in use of packaging materials with follow on targets to reduce this year on year. Courtauld II goes even further, including carbon targets to improve the environmental impact of packaging. Additionally, several pieces of EU legislation have been introduced to ensure producers and retailers recycle a proportion of the goods they place on the market at the end of their useful life and these are directed at specific products, such as batteries, electronic and electrical equipment.

Charnwood Borough Council seeks to examine areas of good practice and

partnership arrangements in order to learn from others and to maximise the effectiveness of the operational aspect of the waste collection service. This will include taking maximum benefit from national organisations such as CIWM (the Chartered Institute of Wastes Management), LARAC (Local Authority Recycling Advisory Committee), WRAP and other high performing Local Authorities, as well as regional and local organisations and local community and residents groups.

The Environmental Services contract has enabled Charnwood Borough Council, the contractor and Loughborough University to work together in a partnership, directing the research of a doctoral student. The research carried out will inform Charnwood on areas of best practice across Europe and within the UK. This will enable sustainable areas of good practice to be identified and adopted locally in the household waste management operations and has enabled the preparation of this document.



## 5. Consultation

### 5.1 Consultation workshops on the development of the Strategy

In developing this Strategy, the Council decided to test its thinking and outline plans in order to help shape this document. TWO consultation workshops were organised – one for Members of the Council and one for members of the local community. Members of the community were chosen using a specialist market research company with the aim of getting a representative group that reflected the diversity of the Borough.

The workshops received presentations and information from officers of the Council, and were able to debate, ask questions and challenge assumptions. The process was facilitated by an independent waste and resources expert who was also able to respond to questions and clarify any issues of concern.

These workshops identified and prioritised a range of areas of service delivery and policy (referred to as 'actions') to meet aspirations for a Zero Waste Borough.

The panels were given information on a set of criteria to help them to make informed decisions about prioritisation.

These criteria were:

- Climate change
- Resource efficiency
- Economic factors
- Impact on targets
- Customer satisfaction.

The outcome was a considered discussion in both workshops, the results of which are embodied in this Strategy.

### 5.2 Communication on the draft strategy

The Council conducts regular consultation of the level of satisfaction with the services it provides as part the Corporate Plan. This survey shows that residents value an efficient and effective waste and recycling collection service and consider this has positive impacts on the environment.

Positive customer feedback is therefore significant in measuring how well the service is received. The waste and recycling service has seen continued improvements in satisfaction in recent years, reflecting the effort the Council has made to provide a high quality service across the Borough.

This Strategy will form the cornerstone for measuring this key corporate indicator and as such a comprehensive and robust consultation process was undertaken to seek comments from a wide range of stakeholders including:

- Area Forums e.g. Loughborough area forums
- Key partners e.g. the County Council
- Statutory bodies e.g. Environment Agency, Department of Environment, Food and Rural Affairs etc
- Town and Parish Councils

## 6. Priorities for the Zero Waste Strategy

The Zero Waste Strategy will continue to be a key foundation stone of the Environmental Services Contract. It will enhance the contract as it goes into either an extension in line with the agreed framework, or out to tender with other waste management companies.

The Zero Waste Strategy aims to provide a strategic framework within which waste will be managed in Charnwood, with the vision of becoming a Zero Waste Borough and through the Annual Action Plans it will put this vision into place. The targets, long-term priorities and short-term actions identified within the strategy will seek to drive forward improved performance.

The Strategy will meet, and in some cases exceed the requirements of central government and the Leicestershire Municipal Waste Management Strategy, be innovative in achieving its ambitions, and fulfill the expectations of Charnwood residents.

### 6.1 Outcomes of consultation workshops on the development of the strategy

The two workshops held to consult Members of the Council and members of the local community on the shaping of the draft Strategy document heard a wide range of views. Following a debate and questions, participants were asked for views on target setting, service outcomes and on priority areas for action.

A ranking system was then used to prioritise the actions that consultees felt were most important.

The results showed that the main priorities for further action were increasing the range of materials recycled, and developing behaviour change. The full ranking of actions is detailed below:

1. Range of recyclable materials
2. Behavioural change
3. Home composting/food digestion
4. Restrict landfill bin capacity
5. Influencing treatment options
6. Food waste
7. Garden waste charging policy (remove charge)
8. Street cleaning waste
9. Residual waste (additional capacity) charging policy (introduce charge)
10. Bulky waste charging policy (introduce charge).

In terms of setting targets and indicating a relative order of magnitude, participants clearly indicated:

A clear level of ambition for the Council to strive for higher recycling rates and lower amounts of waste to landfill.



That continuing to reduce the costs of the service and seek best value should remain a priority with only a modest appetite for seeking to be amongst the absolute lowest cost authorities, on the basis that the community values the good service on recycling that it already receives.

That there is very little appetite for maintaining the status quo in terms of service outcome, mirroring the appetite to be more ambitious.

The full report of the independent facilitator of the consultation workshops is provided as Appendix 2.

## 6.2 Measuring the strategy – setting targets

The Environmental Services contract contains a series of targets for monitoring the performance of the service, including:

- Reducing the amount of residual waste collected to 400kg per household by 2017
- Increasing the household recycling and composting rates to 54% by 2017 and achieving year on year improvements
- Maintaining customer satisfaction with the waste and recycling services above 90%.

It is proposed to include these targets in the Zero Waste Strategy and to extend them further to cover the period up until 2024. The strategy will be regularly reviewed and the targets will be extended if they prove not to be challenging enough.

Following the consultation workshops, targets were set for this strategy. The can be found in the box below.

### Zero Waste Strategy Targets 2012 – 24

#### TARGET 1:

Recycling and composting target of 62%

#### TARGET 2:

Reduction in the amount of waste sent for disposal without treatment to 335kg per household

#### TARGET 3:

Cost of service to reflect the ambition of targets 1 and 2, to maintain a service that provides best value, and compares well with the top 25% of English Local Authorities

These targets are in line with current best practice and are figures we believe to be achievable. However, they are subject to regular review over the lifetime of the strategy and will take into account legislative changes and new and innovative working practices.

The ongoing review of the household waste and recycling service will seek to make improvements and introduce new and innovative systems as they become affordable or technologically available and to stretch the achievements of the Borough Council in order to meet targets set out in this strategy.

### 6.3 How to meet the targets

The Council has a range of activities available to ensure we meet the targets set in this Strategy. They are a combination of improvements to existing activities (such as ease of recycling and improving recycling from street cleaning), continuing educational programmes with the public to raise awareness about waste prevention, reuse and recycling and good management practices (such as the customer service approach). They include the following key activities, which will be expanded upon in a separate Action Plan:

- Provide a quality, reliable and efficient recycling and waste collection service
- Provide information and support for waste prevention activities
- Promote reuse activities
- Make it easier for householders to recycle
- Increase 'recycling on the go', i.e. recycling when you are out and about by providing litter bins where recyclable items can be collected separately
- Recycle street cleansing waste
- Promote recycling and litter prevention through Love Where You Live
- Investigate funding opportunities to support food waste collections
- Improve customer satisfaction with service quality
- Work with partners to jointly deliver waste projects and communication programmes that promote waste reduction, reuse and recycling projects
- Use groups to educate, develop networks around services, facilitate volunteering, increase participation in local decision-making on waste
- Ensure residents are kept informed about what happens to their waste, including publishing details of the end destination of recycling on our website
- Consult fully, listen to and work with householders, provide information and make it easier for householders to reduce, reuse and recycle their waste
- Investigate the use of financial incentives/rewards to residents for producing less waste, using the grant funding scheme promised by government
- Work in partnership with other agencies and stakeholders to influence the parts of the "sustainable waste management cycle" that we do not have control over and encouraging waste prevention, reuse and recycling in preference to waste disposal
- Work with Leicestershire County Council, the Waste Disposal Authority to support the most sustainable treatment method for genuine residual waste.



## 7. Resourcing the strategy

In adopting a Zero Waste Strategy, Charnwood Borough Council has shown it has aspirations to make significant improvements in environmental performance. Throughout the time period covered by the strategy resources will be estimated and identified through an Action Plan. The delivery of this Action Plan will depend on a range of factors such as viability, impact on performance and the level of resources required to deliver effective implementation.

A key part of achieving success with the strategy will be communication to encourage and inform different sectors of the community. It is recognised that to provide the variety of key messages to a diverse range of communities, different methods of communication are required. The Environmental Services contract currently makes available marketing resources. These are used to communicate national waste related initiatives, such as Love Food, Hate Waste and Compost Awareness week, as well as raising awareness of local services to permanent residents, and the more transient student population in the Borough.

By supporting locally based reuse schemes (such as SOFA) through the donation of goods collected through bulky household waste collections, Charnwood Borough Council is recognising the many benefits of these schemes to the local community. These organisations work with locally disadvantaged families, provide employment and training opportunities and also provide environmental benefits.

An annual Action Plan will be put in place to monitor ongoing work towards the aims

of this Strategy, and it will sit alongside the Environmental Services communications plan. The two plans will complement each other in the delivery of the Strategy, and will be jointly delivered by the Environmental Services team and the waste collection contractor.

### 7.1 Working in partnership

Charnwood Borough Council recognises that partner organisations are important to the success of the Strategy. It is keen to encourage new ideas and initiatives from partners that can contribute to the overall aims of the Zero Waste Strategy. In doing so, this may attract additional external resources into Charnwood to help make the strategy more affordable. Charnwood Borough Council will also seek grant funding, where available, to support and fund Zero Waste projects.

Charnwood Borough Council will continue to work actively with the community, voluntary sector, Loughborough University, private sector partners including Serco, Viridor and other organisations. It will also support the Leicestershire Waste Partnership and Leicestershire County Council in the delivery of County wide waste initiatives project.

The Environmental Services contract, detailing the operational aspects of household waste and recycling collections in the Borough, reflects the policies and initiatives in the Zero Waste Strategy, setting targets for the contractor to help drive up recycling rates in the Borough through both the marketing and communications work, but also by seeking service improvements that work towards the Zero Waste concept.



