The Collection, Treatment and Disposal of Municipal Solid Waste arisings in London: Key Recommendations to ensure Compliance with European Commission Directive led Drivers and Targets

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Ernest John Sharp

Abstract

Waste Strategy 2000 (Waste Strategy for England and Wales) laid out a fairly conservative agenda for the future of waste management in England as it responded to the developing EU Legislative drive for sustainable practice. A careful analysis of the Strategy, in around 2001, whereby likely future delivery was compared to EU requirements revealed that the UK (being disaggregated into 4 separate strategies) was unlikely to meet targets, in particular the Landfill Directive. The production of the Strategy Unit report Waste Not Want Not (2002) signalled up the requirement for a rapid increase in the rate of adoption of more sustainable practice. Waste Strategy 2007 took forward the need for more sustainable practice to meet targets in a cost effective manner.

This research agenda approaches the topic from considering the action taken by the Mayor of London and the 33 London Borough waste management authorities to comply with the European Directives on waste management. Firstly, starting with an extensive literature review to ascertain current practice, and based on rigorous methods of methodology the research investigated the techniques utilised by the municipal waste collection authorities to overcome the barriers to achieving compliance. This research revealed a significant increase in resource recovery from the municipal solid waste arising in London combined with a more than corresponding decrease in biodegradable waste being disposed in landfill. Secondly the assistance produced by Government Departments e.g. DEFRA was closely studied to evaluate the effectiveness and value for money of the projects and campaigns instigated as a result of Government intervention. Data gathered from the collection, treatment and disposal areas and case studies from several different types of waste management projects indicate that London waste management is in compliance with the requisite legislation and is on target to achieve the aims and objectives of the European Commission Framework Directive and the Waste Strategy. Thirdly, the annual increase in the population of London has encouraged a requirement for innovation in waste and resource management. The innovation has been assisted by the need for additional resource management facilities, an improvement in planning procedure and financial incentive

This research offers a unique insight into the developing agenda within London. Original data sets have led to the identification of barriers and success factors for best practice to meet European Commission Directive led Drivers and Targets.

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The Collection, Treatment and Disposal of Municipal Solid Waste Arising in London: Key Recommendations to ensure compliance with European Commission Directive led Drivers and Targets

1. Introduction

Recognition of the need for a more sustainable approach to the management of waste, both municipal and commercial, has grown at International, European, National and local levels in recent years (Waste Strategy, DETR 2000). United Kingdom policy, driven by EU Directives, has shifted from almost total reliance on depositing waste in landfill sites to raising levels of recycling, composting, recovery and renewable energy (DEFRA, 2007).

Under the Framework Directive on Waste 75/442/EEC of 15th July 1975, as amended by Directive 91/692/EEC, there is a requirement for a Statutory National Waste Strategy for the UK. The enactment is laid out in Section 44A of the 1990 Environmental Protection Act (as amended by Section 92 of the 1995 Environment Act). Schedule 3A of the 1990 Act (Schedule 12 of the 1995 Act) set out the objectives of the waste strategy (75/443/EEC).

This research addresses the Collection, Treatment and Disposal of Municipal Solid Waste arising in London to ensure compliance with European Commission Directive led drivers and targets and seeks innovation that may manage municipal waste arising to the year 2020.

- Analyses of the past will show the progression from the 1970s when environmental pollution in London led to the demand for change (EPA 74, LWRA 1985).
- Analyses of the present will explain issues surrounding the municipal solid waste management in London today.
- Predictions for the future will describe some of the innovations, treatment and methods that are being propounded for consideration as viable solutions after feasibility studies of their suitability for future waste management through organisations such as the Government Science and Innovation ten-year Framework (2004/2014) Waste Strategy Fund.

1.1 Key Directives

Key European Union Directives and UK legislation affecting waste management in the United Kingdom are to be found in the following sections.

Key Directives

• Directive on Waste (Waste Framework Directive)	1975	75/442/EEC
• Directive on Hazardous Waste Shipment	1984	84/631/EEC
• Directive on Batteries and Accumulators	1991	91/157/EEC
• Directive on Waste (Amendment)	1991	91/692/EEC
• Directive on Waste (Framework Directive)	1991	91/156/EEC
• Directive on Hazardous Waste	1991	91/689/EEC
• Regulation on Waste Shipments	1993	259/93/EEC
• Directive on Packaging and Packaging Waste	1994	94/62/EC
• Directive on Integrated Pollution Prevention and Control	1996	96/61/EC
• Directive on the Landfill of Waste	1999	1999/31/EC
• Directive on the Incineration of Waste	2000	2000/76/EC
• Directive on End of Life Vehicles (ELV)	2000	2000/96/EC
• Directive on Waste Electrical & Electronic Equipment (WEEE)	2000	2000/53/EC
• Thematic Strategy on Waste Prevention and Recycling	2006	2006/12/EC

Legislation driven by the need for change in the management and control of solid waste and environmental pollution.

- Control of Pollution Act 1974 (CoPA 74)
- EU Waste Framework Directive 1991 (91/156/EEC)
- London/counties re-organisation (1965)
- The Framework Directive on Waste (75/442/EEC)
- Waste Strategy 2000 (WS 2000)
- Devolution, Scotland (1999), Wales (1998) and Northern Ireland (2006)
- Waste Strategy Review 2006 (WSR 2006)
- EU Thematic Strategy Review on the prevention and recycling of Waste (2006)
- Waste Strategy for England (2007)

The Waste Framework Directive (75/442/EEC) (OJ 1975 L 194/47) was originally adopted in 1975 and was substantially amended in 1991 (91/156/EEC), (OJ 1991L 78/32) (91/692/EEC) and again in 1996 (96/350/EC) by Commission Decision (OJ 1996 L 135/32). The Directive's objective is to ensure that waste is recovered or disposed of in ways that protect the environment and human health.

The Waste Framework Directive has been implemented in the UK through national legislation.

- The Environmental Protection Act 1990
- The Control of Pollution (amendment) Act 1989
- The Waste Management Licensing Regulations 1994 (as amended)
- The Controlled Waste (Registration of Carriers and seizure of Vehicles) regulations 1995
- The Waste Management (England and Wales) Regulations 2006 amends the infraction and introduces the EU Animal By-Products Regulation ((EC) No. 1774/2002).

1.2 Sustainable Development

The European Commission has produced a number of sustainable strategies including Sustainable Development, Sustainable Consumption and Production and Sustainable Waste Management.

Sustainable Waste Management is embodied in the 'Framework Directive on Waste' (75/442/EEC as amended by Directive 91/692/EEC) and requires Member States to draw up waste management plans for the improvement and sustainability of waste management with the overriding requirement 'the protection of human health'. The UK Government's implementation of the requirements of the Directives was to produce Waste Strategy 2000. (DETR 2000) and Waste Strategy for England 2007 (DEFRA 2007).

1.3 Definition of waste: The European Union definition

Municipal Waste is defined in Article 2b of the European Commission Framework Directive 1999/31/EC, as:

"Waste from households, as well as other waste which because of its nature and composition, is similar to wastes from households (FDW 99) (91/156/EEC) (91/692/EEC) (96/350/EC).

The Organisation for Economic Co-operation and Development (OECD) 'Fact Book' 2006 gives the following definition:

"Waste from households, including bulky waste, similar waste from commerce and trade, office buildings, institutions and small businesses, yard and garden waste, street sweepings, the contents of litter containers and market cleansing waste, excluding sewage and municipal construction and demolition waste".

1.3.1 The United Kingdom interpretation:

'Waste from households and all other waste similar to household waste under the control of the local authority', be they waste disposal, waste collection or unitary authorities' (DEFRA, 2004).

The definition of waste in Article 1 of the amended European Commission Framework Directive on Waste 91/156/EEC (Directive Waste (SI No.1056) was incorporated into UK law by the Waste Management Licensing Regulations 1994 (WMLR 1994) (table 1.4).

1.3.2 Definition of Municipal Solid Waste (MSW)

Directive 91/156/EEC version:
The definition states that "waste" shall mean any substance or object in the categories set out in Annex 1 which the holder discards or intends or is required to discard. (ECJ). Discard' needed to be clarified and Department of the Environment circular 11/94 (2) attempted to do this.

Any substance that constitutes a scrap material or an effluent or other unwanted surplus substance arising from the application of any process or otherwise spoiled. It does not include explosives as designated in (1875 c.17) Explosive Act 1875.

Anything which is discarded or otherwise dealt with as if it were waste shall be presumed to be waste.

1.3.3 Controlled Waste

"Controlled" waste (Table 1.1): means household, industrial and commercial waste or any such waste.

i) Household waste: waste from domestic property.

ii) Commercial waste: waste from premises used for trade or business or for the purpose of sport, recreation or entertainment.

iii) Industrial waste: waste from a factory (as stated in the Factories Act 1991) or from premises used to supply the public with gas, water, electricity or sewage services (EPA 1990 s75 ss4).

Table 1.1: Type of wastes included in 'Controlled' waste category

Paper and Card	Electrical and Electronic Equipment	Metal
End-of-life Vehicles	Putrescible footwear waste	Plastic
Vegetable Oil	Textiles	Soil
Furniture		Glass
Inert Construction and Demolition Waste		Mineral Oil

The composition of household waste is found in table 1.2

Table 1.2: Composition of household waste

- Garden waste 20%
- Paper and board 18%
- Kitchen waste 17%
- General household sweepings 9%
- Glass 7%
- Wood furniture 5%
- Scrap metal/white goods 5%
- Dense plastic 4%
- Soil 3%
- Plastic film 3%
- Textiles 3%
- Metal cans and foil 3%
- Disposable Nappies 2%

(Parfitt 2002).

1.4 The Environment Agency

The Environment Agency (EA) is the leading public body for protecting and improving the environment in England and Wales. Its task is to make sure everyone in today's society looks after our land and water so that tomorrow's generations inherit a cleaner, healthier world.

A new initiative to encourage the waste management industry landfill operators and waste treatment plants to improve their environmental performance was announced on 9th. August 2006.

The plan sets out the environmental and wider impacts of the waste management sector and identifies ten objectives for the industry and the Environment Agency for the next ten years. It explains how the sector is performing environmentally and pinpoints main areas for improvement. Some of the areas outlined are voluntary and others are part of existing regulations. They will be reviewed annually to chart the progress being made (EA 1995).

The objectives for industry and the Environment Agency: part of the Agency's ten year plan.

The ten objectives are:

- Lessen the impacts of climate change by reducing greenhouse gas emissions
- Reduce the consumption of raw materials by promoting waste as a resource
- Improve and protect the environment by working to reduce the number of pollution incidents
- Take steps to tackle waste crime and illegal operators
- Improve data on waste production and management
- Enhance habitats around waste management sites
- Work to reduce risk-based regulatory and environmental management systems
- Improve relationships between the Environment Agency, industry and the wider community
- Ensure there is a sustainable and competent waste management industry and regulator
- Improve health and safety by reducing accidents and injuries
- Ensure that facilities utilised for waste management, treatment and disposal are regulated and enforced by the Environment Agency

The Environment Agency has already published sector plans.

1.5 Waste Strategy 2000

A draft waste strategy for England and Wales was published by The Department of the Environment, Transport and the Regions (1999) following the launch of "A better quality of life: a strategy for sustainable development for the UK", by the Office of the Deputy Prime Minister (May 1999). The theme running through the strategy was sustainable waste management into the 21st Century and the challenges that lie ahead with a plan of action for the next five years. The plan set out the barriers to attaining the vision and the tools necessary to achieve the aims and objectives (DETR 1999). The Waste Strategy 2000 (WS2000) (DETR), published in two parts, as a blueprint for how waste would be managed for the next 20 years.

Part.1: Waste Strategy Part 1 set out the UK Government's vision.

The Government's vision of sustainable wastes management in England and Wales for the next 20 years, a strategic overview of waste policy; its aims and objectives. It outlined the scale of the tasks required to carry out the aims and the tools that may be necessary to meet the challenge and gave details of the actions that stakeholders needed to take in the following 5 years. It set targets to maximise the recovery and re-use of recyclable waste material and financial deterrents to minimise waste to landfill.

Part.2: Part 2 is set out to complement Part 1

It provided data on the nature and quantity of waste production and more detailed background to the policies in part1. Some of the progress since the publication of Making Waste Work in 1995 was described, more detailed background to policies described in part 1. Set out arrangements for specific waste streams and described the existing facilities for managing waste in England and Wales.

The Strategy (DETR 2000) stated "over 100 million tonnes of waste from households, commerce and industry arise annually and the tonnage is increasing every year. Household waste is a relatively small part of this waste and at the time of publication, 9% was recycled and 8% was used in energy recovery" (DETR 2000). Through the requirement to comply with the European Union Directives (99/31/EC) and the disadvantages of landfill

of waste, the Government and the national Assembly set targets to increase the recycling of municipal waste.

Actions were needed to achieve the aims and objectives of the strategy.

- Setting up Waste and Resources Action Programme (WRAP)
- Setting local authority recycling targets
- Increasing funding to local authorities
- Waste minimisation recycling fund
- New opportunities fund (NOF)
- Landfill Allowance Scheme (LAS)
- Private Finance Initiative (PFI)
- Enforcement of the Waste Hierarchy and Waste Minimisation
- Economic and Regulatory Framework and associated tools

Tools to be used (DEFRA 2007)

1 The Waste Hierarchy
2 The Proximity Principle
3 Sustainability
4 The 'Producer Pays' Responsibility
5 Duty of Care
6 Landfill Tax Escalator
7 Best Value Performance Indicators
8 Landfill Allowance and allowance Trading Scheme (LATS)

1. Waste Hierarchy

The Waste Hierarchy is a principle tenet with the order of priority:- minimisation at the apex and waste to landfill disposal at the nadir (figure 1.1)

Figure 1.1 Waste Hierarchy

All waste should be treated as a resource, an available asset. The primary objective of the hierarchy is to stop the over-production of goods and packaging and the indiscriminate disposal of recoverable material. The Waste Minimisation Act 1998, led to many changes (Phillips, et al 2005).

2. The Proximity Principle

The proximity principle requires that the production, treatment, transport and disposal of waste be utilised as near to the point of origin as possible, e.g. The Mayor of London's strategy aims for London to be 80% proximity efficient by 2020.

3. Sustainability

Improvements in the management of waste material for the protection of human health and the betterment of the living environment must be sustainable to safeguard future generations.

4. Producer responsibility

Producers, Retailers and Consumers in all parts of society must share responsibility for the safe, environmental management of waste resources (DEFRA 2007).

5. Duty of Care

The Environmental (Duty of Care) Regulations, 1991 (amended 2003) cover all 'controlled' waste at all stages; import, carriage, storage, treatment, disposal and brokerage from the 'producer' to the point of final disposal.

6. Landfill Tax Escalator

The Landfill Tax is a government levy on all municipal biodegradable waste disposed by landfill. The standard rate of tax will increase by £8 per year from 2008 until at least 2010/2011, from £24 (2007) to £48 in 2010. (DEFRA 2007). To minimise the possibility of incurring a penalty fine there are a number of barriers to overcome.

1 Low investment mainly because the least expensive option was landfill disposal
2 Lack of public awareness and perception of waste management facilities

3 Economic regulatory framework offered few incentives to reduce waste or change methods
4 Lack of clear responsibility
5 Delays in planning permission (both through finance and NIMBY)
6 Availability of landfill capacity meant there was no need to invest in superstructures and the
7 Complexity involved in acquiring them.
8 Waste has not been an area of policy priority
9 Delivery structure complex with responsibility split between several Government departments
10 Policy – DEFRA, (DTI-defunct 2007)
11 Funding – HMT, ODPM, DEFRA
12 Regulatory responsibility – Environment Agency and Local Authorities
13 The Audit Commission perceived a barrier between collection and disposal authorities (AC, Waste Management guidance)
14 Length of time to obtain planning permission
15 Risk permission refused due to public opposition
16 Inconsistency in planning permissions

Other barriers involving the Economic and Financial Factors play a major part in decision making and may lead to innovation being abandoned or delayed.

- Access to capital funding
- Available funding/subsidies
- Cost of current system and other options
- Best Available Technique Not Entailing Excessive Cost (BATNEEC)
- Cheapest Available Technique Narrowly Avoiding Prosecution (CATNAP)
- Local and regional budget limitations
- Economic tools employed influencing the cost of waste management
- Pricing system for waste services
- Secondary materials market
- The fragmentation between waste collection and waste disposal services
- Local Unacceptable Land Use (LULU)

- A changing legislative environment coupled with uncertainty over waste growth and future
- waste composition

1.6 Waste not, Want not

A review of the Waste Strategy was due in 2005. The Government in pursuit of its approach to Sustainable Waste Management, tasked the Strategy Unit to produce a report to establish a new model of sustainable development that is far more efficient in its use of natural resources than the current model. As a result the Strategy Unit produced the report 'Waste not, Want not'. (SU 2002). Some key elements are:

- England has a growing waste mountain
- The way England manages it's waste harms the environment and squanders resources
- Action is needed now to reduce waste growth and recycle more
- The Strategy Unit was asked by Government to direct it's work to achieving the Landfill Directive
- Providing a robust and long-term economic and regulatory framework
- Investment in new facilities and measures to boost progress to sustainable waste management
- Additional funding accompanied by radical reform of delivery structures

1.6.1 Department for Environment, Food and Rural Affairs (DEFRA)

The budget 2003 announced a new delivery programme on sustainable waste management for England to be managed by the Department of the Environment Food and Rural Affairs. (DETR 2001).

1.6.2 Waste and Resources Action Programme (WRAP).

The Waste Resources and Action Programme (WRAP), was created by government to work with industry, the public sector and the wider community to bring about positive change in the management of waste in the UK by increasing recycling. Set up as a not-for-profit company in 2000, WRAP is funded by Government money from DEFRA, DTI and

the devolved administrations of Scotland, Wales and Northern Ireland. The aims of WRAP are:

- To create stable and efficient markets for recyclable materials and products
- To remove barriers to waste minimisation, re-use and recycling
- To set up new programmes to reduce waste and increase recycling and
- By assisting existing programmes to progress
- To help local authorities divert biodegradable waste from landfill

In addition to the Strategy Unit recommendations, Defra formulated further action on wider wastes.

- Regulations on inert and agricultural wastes
- Higher recovery and recycling targets for packaging waste
- End of Life Vehicle regulations
- Implementation of the Waste Electronic and Electrical Equipment Directive
- Implement the Waste Oil Directive
- Review Waste Permitting to lessen the burden on regulators and regulated
- Introduce the Waste and Emissions Trading Bill (WET 2003)

1.6.3 Waste Implementation Programme (WIP 2003)

The Waste Implementation Programme responds to a package of strategic measures recommended by the Strategic Unit report Waste not, Want not, (2002). The remit of the Strategy Unit was to consider action to be taken by the UK to meet the targets under Article Five of the EU Directive. DEFRA set up the Waste Implementation Programme (WIP) in 2003. The aim of WIP is to divert increasing volumes of biodegradable waste away from landfill and move the treatment of waste up the waste hierarchy ladder, as required by Article 5 of the EU Landfill Directive. A series of work stream activities generated by the eight work streams combined to actively promote other forms of waste management over landfill.

A major objective of the Waste Implementation Programme is to move Municipal Solid Waste up the waste hierarchy and away from landfill.

The work streams are:

1. Local authority funding
2. Local authority support
3. Data
4. Research
5. New technologies
6. Waste minimisation
7. Recycling (focus on organics)
8. Waste awareness

Other objectives of the Waste Implementation plan for local authority support included funding and financial management, data, research and new technologies and to encourage waste minimisation and awareness to improve recycling.

The objectives of the Waste Implementation Programme work streams are:

1 Local Authority Funding:

- Identify barriers to improve support
- Develop support products and services
- Work alongside other organisations to improve support and make it more accessible

2 Local Authority Support:

- Managing the funds
- Advise on the design of, and implement, the Waste Management Performance Reward Grant
- Delivery of waste PFI projects
- Management of local PSI targets

3 Data:

- Technical and innovative fund
- Demonstrator programme
- Waste technology support
- Waste technology data centre

4 Research:

- Data integrity project

- Central database
- An effective mechanism to monitor local authority and other delivery plan targets

5 New Technologies:

- Advisory group and support management
- Research review project
- Research information access system

6 Waste Minimisation:

- An organised market development System
- An advisory service to local authorities on recycling and organics

7 Recycling (focus on organics):

- A targeted home composting programme
- Development of re-usable nappy services
- A major retailers initiative
- A waste minimisation innovation fund

8 Waste Awareness:

- A national programme of underpinning messages (to raise awareness)
- A support package
- A range of issue specific initiatives

1.6.4 Waste Infrastructure Development Programme (WIDP 2006).

A programme, part of the Waste Implementation Programme WIDP, was to give extra help to local authorities to reduce the amount of waste going to landfill. The WIDP targeted waste that cannot be recycled or composted. Support was provided to local authorities with project scoping, procurement strategies, technology choice, planning, community engagement, public consultation, through to negotiation delivery of the project and the operation phase. WIDP aimed to complement and expand on existing work and resources to meet Landfill Directive targets.

1.6.5 Local Authority Support Unit (LASU)

The aim of Local Authority Support Unit, (LASU), is to provide support in a number of areas including:

- Procurement
- Planning
- Provider/market appetite
- Waste Composition Analysis
- Land Use Planning
- Estates
- Bulky Goods, and Civic Amenity Sites

1.6.6 The Waste and Resources Research & Development (R&D) Strategy (DEFRA, 2003).

The Waste and Resources R & D Strategy focuses on waste covered by the Waste Framework Directive (91/156/EEC) and its 'Daughter' Directives, including agriculture and extraction industry waste.

The aim of the research programme is to deliver a sound base for better-informed policy development, implementation, monitoring and evaluation for sustainable management at both national and local levels, which incorporates an effective mechanism for the access to, and dissemination of, research results.

1.6.6.1 The Waste and Resources Research and Advisory Group (WRRAG).

Recognising the lack of cohesion between research bodies and the dearth of timely and accurate information was a barrier to effective policy development and funding, DEFRA Waste Research Team (WRT) set up an advisory group, The Waste and Resources Research Advisory Group (WRRAG), to assist in the team's development of a strategy for a three-year research and development programme. The Research and Development Strategy (R&D) has now been published in 2003. A major objective of the programme was the dissemination of the acquired information as widely as possible. To this end a web site has been opened. Working in co-operation with similar advisory groups, for example,

the Environment Agency, the Research Council and WRAP, the group will examine existing barriers and use the waste research and resources fund to carry out the programme. There are eight themes in the Research and Development Programme.

1. Systems for resource recovery
2. Residual Sustainable resource consumption and management
3. Waste management
4. Market development and intervention
5. Social dimensions
6. Environment and health (risk management and impact assessment)
7. Economics
8. Decision support tools

1.6.7 Business Resource Efficiency and Waste programme (BREW)

The Government is funding a series of delivery programmes that help business reduce waste at every stage of the business cycle and manage resources more efficiently, returning landfill tax to business through free advice and support. BREW programme vision, the overall objective would be to have more profitable businesses through minimised waste and more efficient use of materials; waste and energy, with reports from councils on hard outputs e.g. reduced CO2 emissions or landfill.

1.7 Waste Strategy for England 2007, a review of the aims of the strategy.

The result of Waste Strategy Review 2006, was the production by DEFRA of the Waste Strategy for England 2007, (DEFRA, 2007) on the 1st. May 2007.

1.7.1 The aims of Waste Strategy for England.

The aim of the strategy is to reduce consumption of natural resources towards 'One Planet Living' and to minimise waste by strict adherence to the 'Waste Hierarchy'.

Eight aims set out in Waste Strategy 2007 (DEFRA 2007)

1. A new strategy of the game
2. Getting the rules right: prices
3. Getting the rules of the game right: effective regulations

4. Increasing resource efficiency: targets, materials, products and sectors
5. Stimulating investment in waste collection and treatment
6. Getting local and regional governance right
7. A shared responsibility
8. Implementation and measuring success

1.7.2 Waste Strategy 2007 Key Objectives and Targets.

The Government key objectives are:

1. More emphasis on prevention and re-use
2. Exceed landfill directive diversion targets
3. Divert non-municipal waste from landfill
4. Secure investment in superstructure
5. Increase recycling of resources and recovery of energy.

1.7.2.1 The Waste Framework Directive 1975 (and amending directives) and the Directive on the Landfill of Waste 1999/31/EC.

The Waste Framework Directive 1975 (and amending directives) and the Directive on the landfill of waste 1999/31/EC, listed categories of waste disposal operations and recovery operations. They also set down mandatory targets for the management MSW, biodegradable municipal waste to landfill and recycling targets. The targets have been amended by the Waste Strategy for England (Defra) 2007 (table 1.3)

Table 1.3: 2005 baseline and targets for 2005, 2010, 2015, and 2020

	2005	2010	2015	2020
Household waste after reuse and composting (million tonnes)	18.6mt	15.8mt	14.3mt	12.2mt
(percentage reduction from 22.2m in 2000)	(16%)	(29%)	(35%)	(45%)
equivalent per person figures	370 kg	310 kg	270 kg	225 kg
(percentage reduction from 450 kg per head in 2000)	(18%)	(32%)	(40%)	(50%)
Household reuse, recycling and composting	27%	49%	45%	50%
Municipal waste recovery – (recycling, composting & energy recovery	38%	53%	67%	75%

Directive targets for biodegradable municipal waste disposal to landfill in England, for the years 2010, 2013 and 2020 (table 1.4).

Table 1.4: Landfill allowance targets, 2010, 2013 and 2020

Target year	Target in directive	Amount of limit
2010	75% of that produced in 1975	11.2 million tonnes
2013	50% of that produced in 1995	7.4 million tonnes
2020	35% of that produced in 1995	5.2 million tonnes

1.7.3 Key proposals for action

Proposals for action to increase resource recovery and re-use of recyclate

The 2007 Strategy are:

- Incentivise efforts to reduce, re-use, recycle waste and to recover energy from waste
- To reform regulations to drive the reduction of waste and diversion from landfill while reducing costs.
- Target action on materials, products and sectors with the greatest scope for improving environment and economic outcomes
- Stimulate investment in collection, recycling and recovery infrastructure and markets
- Improve natural, regional and local governance.

1.7.3.1 Measures contributing to waste prevention designed to influence behaviour at various stages of the life cycle and impact of the waste hierarchy (Table 1.5).

Table 1.5: Measures to improve and enforce government objectives

Measure	How it can contribute
Landfill Allowance Trading Scheme (LATS)	Provides an incentive for councils to encourage waste prevention in their area to reduce amount of waste needing to be diverted from landfill and reduce costs of treatment
Allowing councils to incentivise recycling including through household financial incentives	For waste that can not easily be re-used or recycled this provides an incentive for the householder to reduce waste
Performance indicators for councils	Indicators that focus on waste prevention provide an incentive for councils to address this issue, including in local agreements
Landfill Tax Escalator	For waste that can not easily be re-use, recycled or recovered this provides an incentive for businesses to reduce waste
Restriction on Landfill	For waste where restriction could have most effect on cost, this provides an incentive for waste prevention
Material or sector-based voluntary agreement	Can include specific agreement on waste reduction (as with the Courtauld Commitment on packaging and food waste); agreements on recycling provide indirect incentives on waste prevention for waste that is relatively expensive to recycle
Implementation of EU producer responsibility Directive	For waste that is relatively expensive to recycle, recycling requirement will encourage waste prevention
Government waste management and procurement targets	By including targets for waste prevention; recycling targets provide indirect stimulus to waste prevention for waste that is relatively expensive to recycle, recycled content requirements stimulate recycling markets
New packaging target after 2008	These could include specific targets on waste prevention; higher targets for recycling would indirectly encourage prevention
Guidance and awareness measures, including through more visible recycling facilities in public places, activities within schools and use of the voluntary sector	These will encourage waste prevention, including through stressing resulting economic gains and through behaviour change

1.7.4 Incentives

Actions and incentives to promote the waste hierarchy:

- Increasing the landfill tax escalator by £8 each year, at least till 2010/11, to £48 per tonne by 2010
- Give opportunity to local authorities to offer financial incentives to householders for waste
- reduction and recycling
- Enhance Capital Allowances for secondary recovered fuel (SRF)

1.8 Devolution, Scotland, (1999), Wales, (1998), and Northern Ireland (2006)

Devolution by Central Government led to the constitutions of the Scottish parliament and the National Assemblies of Wales and Northern Ireland. The devolved Authorities have re-organised waste management in the part of the United Kingdom under their control introducing their National Strategy and Plan for waste management in compliance with legislation.

1.8.1 Scotland

The keystone in the implementation of the strategy is the National Waste Management Plan. The Plan was prepared by the Scottish Executive (SE) and the Scottish Environmental Protection Agency (SEPA), in consultation with the Convention of Scottish Local Authorities (CSLA), the waste industry and the community sector. The duty of co-ordinating the plan was delegated to the Scottish Environmental Protection Agency (SEPA) by the Scottish Executive (1999) and the Waste Strategy for Scotland was produced.

1.8.2 Northern Ireland

The Northern Ireland Waste Management Strategy (NIWMS) is the overall responsibility of the Department of the Environment (DoE). The control and management of the services are in the jurisdiction of the Environmental and Heritage Service (EHS). The strategy, which focuses on key policy areas, contains a High-level Implementation Action Plan

(HIAP) for initiating, developing and sustaining the strategy for each of the policy areas. The Waste Management Action Plan produced by the Environmental Policy Group (EPG) is working with Waste Resources and Action Programme (WRAP 2001) in creating markets for recycled materials.

1.8.3 Wales

The National Waste Strategy for Wales, (NWSW) -"Wise about Waste" (2002).
Wales has 22 Unitary Authorities (UA) governed by the Welsh Assembly. The Assembly set out the Welsh Waste Strategy (WAWS) 'Wise about Waste'. Three Regional Plans (RP) have been prepared in line with the National Waste Plan (NWP) (Technical advice note No.21 – waste) to provide a framework for establishing waste management infrastructure needs for all waste streams.

1.9 Waste Management in England

The estimated total of all wastes arising by sector in England in 2005 is given in table 1.6.

Table 1.6 the estimated total of all wastes arising by sector in England in 2005.

	Percentage	Thousand Tonnes
Agriculture	1.0	2720
Mining & Quarrying	30.0	81600
Sewage Sludge	1.0	2720
Dredged materials	3.0	8160
Household	9.0	24480
Commercial	11.0	29920
Construction and demolition	32.0	87040
Industrial	13.0	35360
Total	100.0	272,000

1.9.1 The structure of municipal waste management in England.

The Government decided on regional autonomy in England and through the Government Office for the Regions (GOR) nominated nine regions classified into geographical areas. Each Region Assembly is responsible for the Development Agencies (DA) with the power to oversee planning and development and to ensure compliance with Government and EU legislation and DEFRA five strategies and Public Service Agreements (PSA) (2005), the London Region is exceptional to the norm.

1.9.2 The disposition of Local Authorities in England with municipal waste management duties.

There are 410 Local Authorities in England, and around 9,000 Parish Councils. The Unitary Authorities (UAs) carry out most local Government functions, in the remaining areas functions are split between 34 Counties and 238 Districts.

- Unitary Authorities (UA) are responsible for the collection, treatment and disposal of municipal solid waste (MSW).
- Joint Waste Disposal Authorities (JWDA), the collection and/or treatment is operated by the district Councils and the treatment and/or disposal by the County Council (treatment is by agreement between the two authorities).
- The exception to this is the Greater London metropolitan region where the Waste Collection Authorities (WCA) are Borough Councils (LBC).

England and the Regions, (table 1.7) shows the municipal solid waste (MSW) arising from 2000/01 to 2005/06 in the nine regions and the 5.08% reduction in London's tonnage over this period.

Table 1.7: Municipal waste arising (1000 tonnes)

	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	% change
North East	1,452	1,527	1,657	1,636	1,581	1,537	5.85
North West	4,125	4,138	4,344	4,380	4,304	4,159	0.83
Yorkshire - Humber	2,932	3,013	3,000	2,931	3,026	2,908	-0.83
East Midlands	2,290	2,409	2,449	2,445	2,525	2,428	6.03
West Midlands	2,820	2,985	3,046	3,031	3,116	3,014	4.66
East Region	2,921	2,999	3,012	3,031	3,071	3,014	3.19
South East	4,344	4,477	4,538	4,529	4,631	4 ,540	4.50
South West	2,675	2,830	2,901	2,867	2,994	2,993	9.64
London	4,438	4,438	4,446	4,342	4,370	4,213	-5.08
England	28,057	28,905	29,394	29,114	26,619	28,745	2.45

England and the Regions, (table 1.8) show the household waste (HW) arising from 2000/01 to 2005/06 in the nine regions, the figures indicate 1.88% reduction in household waste tonnage arising in London over this period (table 1.8). Sources of municipal waste arising in England for 2000/01-2005/06 are provided in table 1.9.

Table 1.8: Household waste arising (1000 tonnes)

	200/01	2001/02	2002/03	2003/04	2004/05	2005/06	%change
North East	1,251	11,307	1.361	1.362	1,330	1,288	2.94
North West	3,836	3,846	3,945	3,866	3,767	3,818	0.46
Yorkshire - Humber	2,472	2,484	2,521	2.463	2,548	2,508	1.44
East Midlands	2,120	2,196	2,230	2,235	2,273	2,190	3.31
West Midlands	2,607	2,658	2,690	2,646	2,681	2,655	1.86
East Region	2,742	2,811	2,820	2,756	2,873	2,847	3.84
South East	4,157	4,216	4,257	4,195	4,265	4,195	0.91
South West	2,503	2,598	2,630	2,593	2,624	2,626	4.92
London	3,390	3,408	3,379	3,331	3,297	3,326	1.88
England	25.079	25.524	25,832	25,448	25,658	256454	1.50

Table 1.9: Sources of municipal waste arising in England from 2000/01 to 2005/06.

Household waste from	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06
Regular household collection	16,665	16,683	16,528	16,066	15,470	14,616
Other household sources	1,381	1,277	1,351	1,244	1,205	1,314
Civic amenity sites	4,234	4,367	4,213	3,616	3,198	2,726
Household recycling	2,809	3,197	3,740	4,521	5,785	6,796
Total household	25,079	25,524	25,832	25,448	25,658	25,454
Non-household sources (excluding Recycling)	2,432	2,656	2,730	2,650	2,795	2,289
	636	724	832	1,106	1,167	1,1003
Total municipal waste	28,057	28,905	29,394	29,114	29,619	28,745

1.10 Municipal Solid Waste Management in London.

The population of London was around 7 million in the 1960s there came a period when much of the manufacturing industry and dock work began to move out of London. The population went down to the low 6 million mark, in 2006 it reached 7.4 million with around 3.1 million household and is estimated it will rise to 8.2 million by 2021 (DETR 1999) (Enviros 2000). Solid waste (MSW) arising in London. Table 1.10 shows the transportation distances to landfill for different haulage methods.

Table 1.10: Amount (1000) tonnes % of total distance transported (km)

	Tonnes arising	Percentage of total	Miles transported
Incinerated	400	13	
Transferred to road haulage for landfill	1,130	36	10 – 15
Transferred to river haulage for landfill	700	22	20 – 30
Transferred to rail haulage for landfill	650	21	55 – 65
Taken direct to landfill	250	8	Up to 15
Total	3,130	100	30 average

Estimated tonnage of all waste arising in London in 1985 was 13.6 million tonnes (table 1.11).

Table 1.11: All waste arising in London in 1985

Inert Waste	8,150,000 tonnes
Commercial and Demolition waste	3,040,000 tonnes
Household waste/ Civic Amenity site	2,420,000 tonnes
Total	13,610,000 tonnes

Waste from London was disposed to landfill in eight counties in the South East Region and London in 1985, in the following proportions (Table 1.12)*includes waste incinerated at the Edmonton solid waste incinerator plant (ESWIP).

Table 1.12: The destination of London's waste in 1985

County	Total amount ('000 tonnes)	Percentage of total
Bedfordshire	225	1.7%
Berkshire	285	2.2%
Buckinghamshire	780	5.7%
Essex	3,442	25.1%
Hertfordshire	1,990	14.6%
Kent	1,989	14.6%
London	3,895*	28.6%
Oxfordshire	205	1.5%
Surrey	811	6.0%
Total	13,612	100%

1.10.1 Methods used for the Disposal of Municipal Solid Waste from London.

The municipal solid waste (MSW) arising in London that is currently destined for landfill outside London, utilising the 3 options of road, rail and river, transport, possibly the most urgent problem is the river transported waste. Approximately 27% are transported to Essex Landfill sites by barge down the River Thames, to Rainham, Mucking and Pitsea. 27% by containerised rail to Appleford (Oxon), Calvert (Bucks), Stewartby (Beds) and 46% by road transport.

1.10.2 Time for change

The enactment of the Environmental Protection Act 1974 (EPA 1974) and the Waste Framework Directive 1975, introduced many legal requirements. However, the pattern of London's waste disposal in 1985 (tables 1.11 & 1.12 above), changed very little over the following 20 years. The main exception is the South East London Combined Heat and Power Incinerator (SELCHP) in Lewisham that is accepting MSW from the boroughs of Lewisham, Greenwich, Bromley and the City of Westminster. Opened in 1994, it is capable of handling 420,000 tonnes per year. Table 1.32 indicates the contracted tonnage for 2007/08. Contracted input of residual municipal solid waste (RMSW) to South East London Combined Heat and Power Plant (SELCHP) 2007/08 (Table 1.13).

Table 1.13: the overall tonnage arising in 2005/06.

City of Westminster	150,000 tonnes	330,000 cu m
London Borough of Lewisham	105,000 tonnes	231,000 cu m
London Borough of Greenwich	105.000 tonnes	231,000 cu m
London Borough of Bromley	40,000 tonnes	88,000 cu m

1.11 London Waste Arisings and Growth

The overall tonnage of waste arising in London in the year 2005/06 was over 18 million tonnes, 24% is municipal waste collected by the 33 London waste collection authorities (WCA), including litter, trade waste and waste handled at civic amenity sites (table 1.30). Of this 24%, recycling and composting accounts for 25 % and incineration 21%, the remainder goes to landfill. Commercial and Industrial waste tends to grow with London's gross domestic product (GDP), currently 5% per annum. It accounts for 15% of the UK. GDP. Estimates suggest it will go on increasing by 5.5% per year (ENVIROS, 2003) (table 1.14).

Table 1.14: Waste arising in London (million tonnes) 1985 to 2004/05

Million tonnes	1985	1998/99	2002/03*	2004/05
Municipal waste	3.13	3.4	4.4	4.4
Household waste	2.42	3.05	3.2	3.3
Construction and Demolition waste	8.15	14.2	7.3	6.6
Commercial and industrial waste	7.5	9.9	7.5	7.1
Total	13.6	27.5	19.2	18.1

*Change in definition of MSW and accounting

1.11.1 London Municipal Waste Arising 2005/06

Household and municipal waste tonnage collected, treated and disposed by the municipal authorities in London in the year 2005/06 is in (table 1.15)

Table 1.15: London MSW tonnes managed in 2005/06

Authority	Type	H/H	H/H other	CA sites	H/H recycle	Total H/H	Non-H/H	Non-H/H recycle	Total MSW
Bexley	Unit	47,377	2,311	8,609	41,587	99,883	30,667	4,221	134,313
Tower Hamlet	Unit	61,773	8,954	1,233	7,130	79.070	23,693	63	102,826
City London	Unit	2,239	1,720	-	832	4,792	39,353	168	44,313
Westminster	unit	41,720	19,231	-	13,911	74,862	110,804	3,293	188,595
ELWA	JWDA	257,858	59,600	37,029	63,001	417,488	65,417	9,290	492,195
NLWA	JWDA	531,460	41,344	33,612	160,213	766,692	172,113	12,075	950,796
Southwark	Unit	72,374	17,349	1,060	16,039	106,822	29,136	2,167	138,124
Lewisham	Unit	81,024	19,448	1,171	13,712	115,365	25,496	649	141,510
Greenwich	Unit	63,639	13,279	4,459	22,119	103,497	6,606	1,101	111,204
Sutton	Unit	47,665	2,837	11,577	23,965	86,080	10,870	3,076	100,027
Merton	Unit	40,535	4,633	11,456	16,453	73,076	21,779	1,288	96,143
Kingston	Unit	40,810	2,556	5,907	17,025	66,299	1,185	11,671	79,155
Croydon	Unit	82,457	12,157	21,794	22,364	138,772	38,572	9,436	186,780
Bromley	Unit	84,702	6,766	18,185	41,168	150,821	24,204	60	175,086
WLWA	JWDA	406,571	63,840	84,375	155,756	710,541	82,932	15,069	808,542
WRWA	JWDA	250,000	638	9,468	72,081	332,187	125,518	2,390	462,095
Total						3,326,184			4.924,918

Source: Capital Waste Facts 2007

1.11.2 London Municipal Solid Waste Facts

Statistical information on London's municipal solid waste arising in the 2005/6 and 2006/7 period, municipal solid waste is a quarter of all waste arising in London, 4.4 million tonnes per year, 19% is incinerated, 25% Recycled and the remainder goes to landfill. There are 39 civic amenity sites in London, mostly with recycling facilities and over 2,700 'bring' sites. The production of the definition of municipal waste (Ch.1) accounts for the sudden increase in data on MSW tonnage arising, the 25% non-household waste tonnage had rarely been included e.g. Green waste, gully emptying, parks waste, 12 authorities have a separate biological waste collection system.

All the waste authorities have a duty under the Household Waste Recycling Act 2003 (HWR) to collect at least 2 items of clean material for recycling. The WCA have the choice of several options to comply with the Act and to achieve the legislative recycling

targets. An analysis of a comprehensive "Door-stepping" survey (Read 1999) enables the authority to arrive at a method that is compatible with the wishes of the majority of householders in the authority area. The doorstep collection of clean recyclable material may utilise the 'box' method i.e. one or more coloured boxes to keep the recyclate separate from the 'dustbin waste, a coloured plastic sack or wheeled bin for all or each item of material, generally recognising black for non-recyclable waste. See section 3.3, case study No.3, (Williams 2005;Robinson, Read 2005;Lyas, Shaw & van Vugt 2005). The possible structure subject to predicted forecast is in table.1.16.

Table 1.16: Waste arising in London predicted to 2020, (1,000 tonnes)

Type	2010	2013	2015	2020
Anaerobic digestion	54	271	257	402
Back/fill Cover	113	115	117	107
Composting	460	609	895	1,257
Conventional incineration	1,051	1,051	1,051	1,051
Gasification/Pyrolysis	194	906	861	1,347
Landfill	4,612	3,275	3,947	2,469
Mechanical biological treatment	382	1,624	1,542	2,413
Recycling	12,895	13,434	14,245	14,383
Residues	-351	-908	-932	-1,374
Re-use	621	642	655	625
Total	20.001	21,020	21,737	22,681

1.12 The Governance of London.

The Greater London Authority is a region of England. London has a population of 7.5 (24/8/2006) million inhabitants in 32 London Boroughs and the Corporation of London. Greater London covers an area of 1596 square kilometres, it has 3.3 million households: 6.1% detached, 19.3% semi-detached, 26.2% terraced, 33% purpose built flats and 15% converted, 1% other housing. The population is increasing by 20,000 people every year and is estimated to reach 8.1 million by 2016 (ONS 2001).

The Greater London Authority (GLA) Act 1999 designed to provide a citywide government for London established the Mayor of London and an elected Assembly in 2000. The Mayor of London is responsible for strategic planning in London and is required to produce a 'Plan for London' (GLA 1999) and by law, must produce a series of strategies for London (2002). One of these strategies is for the direction of municipal waste management, 'Rethinking Rubbish in London. The Mayor is responsible for strategic planning in London (GOL 1/2000).

The Mayor is responsible for planning:

- Produce strategies to promote economic and social development and the environment
- Improvement of Greater London Act (GLA1999).
- Chapter 29 sections 41 - 44 explains the conditions for establishing a 'Spatial Development Strategy' (SDS)
- The London Plan as set out in the government guidance note (circular 1/2000)
- Sections 353 –361 sets the obligation for a Municipal Waste Management Strategy (MWMS),
- An 'Action Plan' to include proposals and policies for the recovery, treatment and disposal of municipal solid waste (MSW) originating in London.
- The Act gives the Mayor power to issue direction to waste collection authorities (WCA) and to waste disposal authorities (WDAs) in pursuit of the municipal waste management strategy
- Under section 49 (4) of the Environment Protection Act 1990 collection authorities have a duty to produce a waste recycling plan (WRP), they are now required to send a draft copy to the Mayor for approval before publication.

The Mayor is responsible for waste and has produced "The Mayor of London's Draft Waste Plan Policy".

Draft London Waste Plan Policy:

- 85% Regional self-sufficiency by 2020
- To exceed national targets of 33% municipal waste recycling/composting by 2015
- 45% municipal waste recycling/compost by 2020
- 70% commercial/industrial waste recycle by 2020
- 95% Re-use of construction/demolition waste by 2020

- 98% re-use of construction/demolition waste by 2020

Pressure for alterations to the London Plan arose through matters affecting policy laid down in the mayor's Waste Strategy and Plan through Directives and additional powers delegated to the Mayor.

1.13 Waste Modelling for London (2006)

A waste modelling project was commissioned and a summary report was delivered by Mouchel Parkman and Cranfield University's Integrated Waste Management Centre (2005). The project produced land and facility requirements for the alternative options examined with cost implications. As a result of the examinations of the alternative options, mechanical biological treatment (MBT) with recovered solid fuel ranked among the best options. Of the 68% biodegradable waste content of household waste (GSU 2002), the mayor's plan envisages 66% disposed by MBT, 22% by pyrolysis/gasification and other new technology.

London has 750 sites that are used to manage or recycle waste, 'Waste Modelling Options Report suggests 332 facilities may be required to deal competently with London's increased waste arising. Table 1.39 displays the 33 authorities in their Joint Disposal area or as a Unitary Authority with the estimated population as at 2004 (estimated population 2007, 7.5 M).

The Enviros Stakeholder Report for London Waste Action estimated that for London to comply with the recycling targets and the biological waste to landfill allowance, it would need to divert 3.4 million tonnes of biological waste by 2020. This is equal to 5.4 million tonnes of unsorted municipal waste; this estimation is based on the assumption that 62.5% of municipal waste is biodegradable.

1.14 Greater London Region

The Mayor of London in his *Spatial Development Strategy*, 'The London Plan' has designated the London Borough Councils into a five Sub-Region Development Framework: North, South, East, West and Central. The allocation of boroughs is shown in (table 1.19).

1 London Sub-Region Development Authorities (table 1.19).

Composition of the 5 London Sub-Region Development Authorities (LSRDA) (Table 1.19). The 33 collection authorities are autonomous in the method they adopt for storage, collection, treatment, and transport. The unitary authorities (UA) are also responsible for disposal arrangements disposal. The Joint waste disposal authorities (JWDA) deliver their waste to the waste disposal authority (WDA). The Mayor's proposal is to sector the waste disposal in London into five sub-regions; the four Joint Waste Disposal Authorities, North, East, West and Central, the six Southern boroughs will form the South sub-Region. The estimated population is in table 1.19.

Table 1.19: Composition of the 5 London Sub-Region Development Authorities (LSRDA):

North Sub-Region:	Barnett; Enfield; Haringey; Waltham Forest
Central Sub-Region:	Camden; City of Westminster; Islington; Kensington & Chelsea; Lambeth; Southwark and Wandsworth
South London Sub-Region:	Bromley; Croydon; Kingston upon Thames; Richmond upon Thames; Merton and Sutton
West London Sub-Region:	Brent; Ealing; Hammersmith & Fulham; Harrow; Hillingdon; and Hounslow
East London:	City of London; Hackney; Tower Hamlets; Newham; Havering; Barking & Dagenham; Redbridge; Lewisham; Greenwich and Bexley

All 33 authorities (table 1.20) are responsible for waste collection (WCA). Unitary authorities (UA) are responsible for their municipal waste disposal.

Table 1.20: The estimated population and status in London, August 2007

North London Waste Authority (JWDA)		estimated population (2007)
1)	Barnett	338,671
2)	Camden	238,518
3)	Enfield	282,335
4)	Hackney	210,069
5)	Haringey	224,846
6)	Islington	183,128
7)	Waltham Forest	223,480
East London Waste Authority (JWDA)		
1)	Barking and Dagenham	165,952
2)	Havering	226,276
3)	Newham	249,427
4)	Redbridge	254,800
West London Waste Authority (JWDA)		
1)	Brent	270,798
2)	Ealing	304,816
3)	Harrow	214,411
4)	Hillingdon	255,159
5)	Hounslow	212,358
6)	Richmond	194,619
Western Riverside Waste Authority (JWDA)		
1)	Hammersmith and Fulham	188,093
2)	Kensington and Chelsea	214,420
3)	Lambeth	271,273
4)	Wandsworth	288,371
Unitary Authorities		
1)	Corporation of London	7,523
2)	Bexley	221,740
3)	Bromley	304,656
4)	Croydon	347,577
5)	Greenwich	235,470
6)	Lewisham	244,970
7)	Kingston-upon –Thames	157,354
8)	Merton	198,231
9)	Southwark	257,837
10)	Sutton	177,401
11)	Tower Hamlets	219,967
12)	Westminster	267,310
		Total: 7,500,000

1.15 Best Value

A joint consultation document was produced by the DETR and the Audit Commission (AC) in September 1999 for Performance Indicators for 2000/01 (See table 1.21). From April 2000 Best Value Performance Indicators (BVPIs) was the main yardstick against which best value authorities' performance will be judged. The Audit Commission has a duty to set Authority Performance Indicators, Audit Commission Performance Indicators (ACPIs), it will be retaining some of these along with the BVPIs. The performance indicators cover the full range of key local services and the following table 1.21 sets out the approximate numbers involved.

The Comprehensive Performance Assessment (CPA) measured by the Audit Commission (AC) indicate that 8 collection authorities have 4 stars; 16 have 3 stars, 6 have 2 stars and the 3 worst performing have 1 star, e.g. Bexley 4*. Hillingdon 1*. New national performance indicators will be operational from 2009.

Table 1.21: The Best Value Performance Indicators relevant to municipal waste management

BVPI and ACPI pertaining to waste management	
(new national BVPIs in 2008)	
BV82	Tonnage of municipal waste arising: a percentage recycled b percentage composted c percentage used to recover heat, power and other energy sources d percentage to landfill
BV83	Waste transported kilometres per tonne of waste collected
BV84	Kg of household waste collected per head as a percentage of Kg collected in previous year
BV85	Cost per Kilometre of keeping any relevant highway or relevant rod clear of litter and refuse
BV86	Cost of waste collection per household
BV87	Cost of waste disposal per tonne for municipal waste
BV88	Number of collections missed per 100,000 collections of household waste
BV89	percentage of people satisfied with cleanliness standards
BV90	percentage of people expressing satisfaction with recycling facilities, household waste collection and civic amenity sites
BV91	percentage of population served by a kerbside collection of recyclables or within a kilometre of a recycling centre
J1	The percentage of highways that are of a high or acceptable standard of cleanliness
	Proposal for Audit Commission Performance Indicators (ACPI) to be retained:
D1 (ii)	Does the authority promote home composting by making available composting Equipment to all relevant dwellings
J2	The average time taken to remove fly-tipping
BV92	Local Transport Plan

1.16 The Waste and Emissions Trading Act (2003)

The Waste and Emissions Trading Act 2003 (WET Act 2003) established a regime governing the amount of biodegradable municipal waste sent to landfills by waste disposal authorities (WDAs). The Government will impose a penalty fine (£150) for each tonne exceeding the allocation given to the offending authority under the Landfill Allowance Scheme (LAS). The United Kingdom National Targets for Biological Municipal Waste (BMW) to Landfill (table 1.22) are the national target allowances (LAS) and (Table 1.53) show the trading in permits (LATS) in the year 2005/06.

1.16.1 Landfill Allowance Trading Scheme (LATS)

An important element in the WIP philosophy is the Landfill Allowance Scheme (LAS) and the serious threat of failure to attain the requisite target of biodegradable waste to landfill and the financial penalty for missing the target. The Landfill Allowance Scheme (LAS, DEFRA 2005) is the allocation and targets set by Article Five, Framework Directive for the disposal of municipal biodegradable waste to landfill.

The Landfill Allowance Trading Scheme (LATS) was launched in England on 1st. April 2005 to help waste disposal authorities (WDAs) to reduce the amount of biodegradable municipal waste (BMW) sent to landfill. Tradable landfill allowances are a flexible economic instrument that will bring new ways of working for many local authorities. The Waste and Emissions Trading Act 2003, (WETA 2003) places a duty on Waste Disposal Authorities (WDAs) to reduce the amount of biodegradable waste disposed of to landfill. Each disposal authority has been allocated an allowance, if they do not require all their allowance they may (a) save the surplus to the following year or (b) sell the permit to another disposal authority who will be exceeding their allowance. An authority who does not hold enough allowances to cover the amount of BMW it intends to landfill would need either to increase its rate of diversion, purchase additional allowances or borrow forward up to 5% of its following year's allocation. One unit is worth one tonne, the penalty for exceeding one's allocation is £150 per tonne, and permits may be traded on the open market. All the disposal authorities will endeavour to keep within their allocation and hope to have spare capacity to trade off. The Landfill Allowance Trading Scheme (England) Regulations 2004, determined the proportion of certain waste types that are deemed to be

biodegradable. An electronic register will record all transactions and an electronic planning tool (M-BEAM) to enable individual local authorities to develop and cost their strategies. The Environment Agency (EA) will monitor the amount of biodegradable municipal waste (BMW) sent to landfill. In England the deemed percentage of the biodegradable component of collected municipal waste is 68%, to be kept under review by the Agency. In Wales the deemed percentage is 61%. The UK allowance is shown in Table 1.22.

Table 1.22: The combined UK allowance of Biodegradable Municipal Waste to Landfill (BMW) in tonnes

	England	Wales	Scotland	Northern Ireland	Total
2006	15,196,000	1,035,000	1,800,000	669,885	18,700,885
2007	14,530,000	970,000	1,500,000	655,544	17,655,544
2008	13,642,000	905,000	1,440,000	641,235	16,628,235
2009	12,532,000	840,000	1,380,000	626,925	15,378,925
2010	11,200,000	710,000	1,320,000	473,925	13,703,925
2011	9,953,333	630,000	1.173,333	469,937	12,226,603
2012	8,706,667	550,000	1,026,667	465,950	10,749,284
2013	7,460,000	470,000	880,000	315,950	9,125,950
2014	7,140,000	450,000	842,857	302,409	8,735,266
2015	6,820,000	430,000	805,714	288,868	8,344,582
2016	6,500,000	410,000	768,571	275,327	7,953,898
2017	6,180,000	390.000	731,472	261,768	7,563,197
2018	5,860,000	370,000	694,286	284,245	7,172,531
2019	5,540,000	350,000	657,143	234,704	6,781,847
2020	5,220,000	330,000	620,000	221,164	6,391,164

1.16.2 Action taken by collection and disposal authorities to comply with the legislation on biodegradable municipal solid waste to landfill.

The Mayor of London considers AWC unsuitable in a conurbation i.e. London. To comply with the Waste Framework Directive and the resulting UK legislation, to attain their targets for recycling and to keep within their Landfill disposal allocation for biodegradable waste, municipal waste collection and disposal authorities have made many changes. Additional

boxes, bins or sacks have been distributed to enable the separate kerbside collection (Read 1999) of clean recyclable material and green waste. Alternative weekly collection (AWC) is in practice in many authorities.

At least two types of clean materials must be separated from the 'dustbin' waste; this has led to many authorities installing Material Resource Facilities (MRFs). The growth in the separate collection of garden, food and green waste has encouraged the installation of composting and Mechanical Biological Treatment (MBT) and Residual Waste Derived Fuel (RWDF) facilities. These activities have gone some way to counteract the continued increase in waste arising and to reduce the tonnage of biological waste going to landfill. An example of the need for action to be taken is shown in (table 1.23) with tonnage figures from joint waste disposal authorities for the three years 2003/04 to 2005/06.

Table 1.23: Municipal waste tonnage disposed to landfill by London Joint Waste Disposal Authorities (JWDA), 2002/03 to 2005/06 and recycling percentages for 2004 and 2005.

	Household Waste (tonnes per year)			Municipal Solid Waste			Recycled %	
	2003/04	2004/05	2005/06	2003/04	2004/05	2005/06	2004	2005
NLWA	767,445	698,721	766,692	944,440	826,002	950,796	18.28	18.0
WLWA	627,916	683,758	719,541	812,620	811,839	808,542	20.06	27.0
WRWA	326,591	395,931	332,187	488,985	484,921	462,095	17.6	24.0
ELWA	483,572	440,982	417,488	549,072	501,690	492,195	12.47	18.0
Total	2,205,542	2,119,392	2,226,845	1,945,121	2,614,452	2,713,628	17.40	21.7
Greater London	3,331,140	3,124,000	3,326,189	4,343,398	4,376,000	4.212,516		

London's allocation and allowances of biodegradable municipal solid waste (BMSW) to landfill 2005/06 to 2020 (table1.24). Landfill allowance allocations (LAS) of the maximum tonnage of biodegradable municipal solid waste permitted to be disposed in landfill sites on the given date for each London disposal authority. Biodegradable municipal waste exceeding the allocated shown against the base year (1995) from 200/06 to 2020.

Table 1.24: London municipal waste collection authorities (WCA) allowance for biodegradable municipal solid waste (BMSW) to landfill, from base year 1995 to 2020.

Local Authority Name	Base Year Figure 1995	2005/06 allocation	2006/07 allocation	2007/08 allocation	2008/09 allocation	Target 2010 BMW[5]	2010/11 allocation	2011/12 allocation	Target 2013 BMW[5]	2013/14 allocation	Target 2020 BMW[5]
Bexley LB	58,448	58,064	57,487	56,719	55,759	54,606	48,528	42,450	36,372	34,811	25,450
Bromley LB	118,012	113,868	107,651	99,363	89,002	76,569	68,046	59,523	51,000	48,813	35,687
Croydon LB	123,632	118,839	111,649	102,062	90,079	75,700	67,274	58,848	50,421	48,259	35,282
East London WDA	308,833	299,129	284,573	265,165	240,905	211,793	188,218	164,644	141,069	135,018	98,711
Greenwich LB	35,515	37,285	39,940	43,480	47,905	53,214	47,291	41,368	35,445	33,924	24,802
Kingston-on-Thames	46,871	45,327	43,010	39,922	36,062	31,430	27,931	24,433	20,934	20,036	14,648
Lewisham LB	12,456	16,184	21,776	29,231	38,550	49,733	44,197	38,661	33,126	31,705	23,179
London Corporation	47,271	45,247	42,210	38,162	33,102	27,029	24,021	21,012	18,003	17,231	12,598
Merton LB	58,676	56,701	53,739	49,790	44,854	38,930	34,597	30,263	25,930	24,818	18,144
North London WDA	307,815	312,933	320,610	330,847	343,642	358,996	319,037	279,077	239,117	228,860	167,318
Southwark LB	61,969	60,886	59,262	57,096	54,389	51,141	45,448	39,756	34,063	32,602	23,835
Sutton LB	50,985	49,453	47,155	44,091	40,261	35,665	31,695	27,725	23,756	22,737	16,623
Tower Hamlets LB	66,801	64,008	59,819	54,233	47,250	38,871	34,544	30,218	25,891	24,780	18,117
Western Riverside WDA	323,619	311,126	292,388	267,403	236,172	198,694	176,578	154,461	132,344	126,667	92,606
West London WDA	524,917	505,370	476,050	436,957	388,090	329,450	292,779	256,108	219,437	210,024	153,547
Westminster CC	61,627	64,258	68,205	73,467	80,044	87,938	78,149	68,361	58,573	56,060	40,985
Total	2,207,447	2,158,678	2,085,525	1,987,987	1,866,065	1,719,759	1,528,333	1,336,908	1,145,482	1,096,346	801,530

1.17 Methods utilised by London Collection Authorities (WCA).

The pattern of household waste collection has changed very little from the methods described above (1.16.2). The major changes in the current methods of collection has been brought about by legislation, Landfill Tax Escalator (LTE), Landfill Allowance Scheme (LAS), Landfill Allowance Trading Scheme (LATS), the Waste and Recycling Act 2003, Waste Strategy 2000 and shortage of landfill capacity.

Refuse for collection may be from within the curtilage of the residence, but for improved performance containers are mainly sited on the periphery of the heraditament adjacent to vehicle access. Most WCAs use wheeled Euro-bins augmented by plastic sacks where the use of a wheeled bin is not practicable. Wheeled bin sizes in litres: 110, 180, 240, 1100, larger containers in cubic metres: 10, 12, 14, 16, 20 and 30 m^3.

The 33 collection authorities use compression/compaction ram loading vehicles, predominantly with bin lift hoist, for household waste collection, discharging into a bulk transfer or treatment depot (see 1.16.3). Some Sutton and Merton vehicles discharge at the Beddington Lane Waste Facility (BLWF - landfill, recycling and composting).

Caged-bodied (for bagged waste) or refuse collection vehicles are used for kerbside collection, a dedicated recycling vehicle allows segregation at pick-up point and ensure a better quality material.

Assembling the information gathered from the 33 London municipal waste collection authorities (WCA) it was possible to produce a list of actions taken where feasible by London's waste collection authorities:

- All 33 WCA operated a kerbside collection system for dry recyclate
- 17 used the box system
- 13 used coloured plastic sack system
- 16 used wheeled containers (1100ltr) green or brown
- They have all carried-out a door-stepping investigation on recycling;
- Encourage home composting and 'real' Nappy' services
- White good collection, ranging from free to £40 per item
- Garden/green waste service, from free to £1/£3 per bag for collection
- Publicity schemes through the local media and council publications
- Bring sites (e.g. bottle banks) ranged from 25 sites in Kensington and Chelsea to 260 sites in Sutton
- All have schemes; partial schemes or plans for recycling in multi-story occupied premises
- 15 kitchen waste collection schemes are planned or operating
- 15 collect trade waste and recyclate from trade premises (SMEs)
- All require proof of borough residency for free use of their civic amenity site,

- Charges are made to non-resident e.g. £3 per visit or article
- Bulky waste collection varies considerably from free collection to £10 per item
- 240 litre wheeled container has been the accepted method for storage and collection
- Black polythene bags are used where accommodation, access or topography rules out wheeled bins

1.17.1 Localised barriers

The choice of optional methods for the storage, collection, transport, treatment and disposal of municipal solid waste (MSW) in London are governed by many differing localised factors. There is no one ideal blueprint that may be adopted universally.

Barriers that require attention locally (not in order of priority), can include a range of options.

- Local Authority policy
- Red-line route restrictions
- Traffic congestion and one-way routes
- Servicing of small and medium enterprises (SMEs)
- Multi-storied premises
- Hours of working
- Highway vehicle parking
- Distance to disposal point
- Type of storage facility and container
- Access to storage point and/or container
- Availability of disposal point
- Suitability of container and its proper use
- Supervision – direct labour (DLO) or private contractor
- Human behaviour – apathy
- Separate collection of dry recyclate
- Separate collection of kitchen waste/ garden waste
- Lack of co-operation
- Possible poor management/supervision
- Lack of technical and legislative knowledge
- Awareness

1.17.2 Barriers encountered in the collection of household solid waste in London.

The central London boroughs encounter problems peculiar to dense urban housing, older converted premises, ancient convoluted roads and alleyways, premises with little or no room for waste storage. Traffic, both vehicular and pedestrian, not conducive to waste collection operations and with highway and other (e.g. nuisance) legislation imposing restrictions Local policy or measures taken to improve performance may cause problems.

- Issuing smaller bins in an effort to increase recycling
- Not removing overflow by the dustbin
- Charging non-residents for the use of the civic amenity site (CAS)
- Charging for the collection of garden waste
- Not accepting all recyclable waste
- Encouraging fly-tipping by charging for bulky items
- Threatening normally law-abiding residents with penal fines – causing resentment
- The intense media coverage has still not overcome the problem of awareness
- Biased or inappropriate media coverage

1.17.3 Kitchen Waste Collection

Waste and Resources Action Programme research has shown that about one third of all food bought is thrown away, this has been estimated at 19% of all UK household waste (WRAP 2007b). After an exhaustive campaign (Purton 2007) which examined the difficulties in attracting participants the conclusion and recommendations for a range of actions.

Kitchen waste collection in the London Borough of Hackney, (Purton 2007)

- A sustained communication campaign
- Consistent advice on how to participate
- Rapid replacement of bins and/or liners
- Regular performance monitoring (weighing)
- Ensure available treatment capacity
- Maintain a high-quality standard
- Continuous door-stepping to increase participation

- With systematic and imaginative campaigning

WRAP is supporting up to 20 trials in local areas of food waste collection; research report the best performing schemes in recent studies will still only convert 26% of household food waste into recycling.

An environmental Impact Study (Evans 2006) claims that a kitchen waste collection followed by composting, costs (BV84 and BV86) are less than the alternative methods and has a smaller global warming potential. A report by WRAP advises that the collection of kitchen waste should be collected weekly.

1.17.4 Doorstepping

A Best Practice Guidance report produced on 'Door-stepping', by Waste Watch (WW) for the Greater London Authority (Read et al 2004). Several London authorities took an active part in the exercise this included: Hounslow, Kensington and Chelsea, and Western Riverside (JWDA). A study of the results from six London Waste Collection Authorities (WCAs) Door-stepping projects produced the following 'on-average'.

Percentage, Average Results

- Contact attempts 73%
- Contact rate 60% (of these
- Unaware of recycling service 16%
- Can't be bothered 29%
- Poor communications 25%
- Convenience of service 10%
- Poor service 15%
- No container – box/sack/bin 12.5%
- Council's responsibility 3%
- Negative comments 20%
- Happy with the service 60%

The average increase in recyclate collected of 10% was not immediately sustained in every case. These projects have been carried out over the past few years and in every instance the recycling rate is now higher. All conclusions emphasise the importance of continuous

monitoring, data collection and publicity; the most successful authorities have employed Recycling Wardens. A report from WRAP on the result of interviewing 2,400 people in February 2007 was compared with the last survey by WRAP in 2004. It appears that 8.5 million more people have been converted to regular recycling, with 61% claiming to be committed recyclers. 94% accepted that recycling is important and 85% said they recycle all that can be recycled (up from 65% in 2004). Those who will admit to not recycling fell from 13% in 2004 to 5% in 2007 (Goodwin 2007).

The London Borough of Sutton, a Unitary Authority, commissioned Enviros to produce a Municipal Waste Management Strategy as required under the Best Value Review (2003) "that will enable Sutton to comply with existing and emerging legislation". The 61 page document was published in 2004, discussed the current waste management position in the borough and the effect of the introduction of Statutory Performance Standards (SPS) (2003) on Recycling and Composting. Another objective was to elucidate the possible problem arising from the European Union Waste Framework Directives, 75/442/EEC and the Landfill Directive, 1999/31/EC. An objective was to ascertain what part the Landfill Allowance Trading Scheme (LATS) would need to be used in the period up to the year 2020. This scenario, the barriers and options are probably a fair reflection of the situation facing all 33 of the London municipal waste collection authorities. Targets are in (Table 1.28).

Table 1.28: Targets for municipal waste recycling

National Targets	2005	2010	2015
Recycling and Composting Household Waste	25%	30%	33%
Recovery of Municipal Waste	40%	45%	67%

Statutory Performance Standards for recycling and composting were introduced under The Best Value Framework. The Performance Standards for Sutton are provided in table 1.29. Table 1.30 shows the Mayor of London's targets for the recycling of MSW.

Table 1.29: Sutton Performance Standards

Best Value Standard Performance	2003/04 (%)	2005/06 (%)
Recycling and Composting Household Waste	35	36
Actual Performance	19	27.86

Table 1.30: The Mayor of London's Targets for Municipal Solid Waste Recycling

	2010	2015
Recycling and Composting ---- Municipal Waste	50%	605

To achieve the targets set in the Waste Strategy 2000, Sutton must increase recycling, composting and recovery, the targets are shown in table 1.31.

Table 1.31:Targets required by Sutton to meet Best Value and Waste Strategy 2000

		2005/06	2009/10	2015/16
Municipal waste arising	Tonnes	101,400	109,700	123,600
Household waste arising	Tonnes	92,100	99,700	112,300
Household recycling and composting	Target (%) Target Tonnes	36% 33.200	36% 35,900	36% 40,400
MSW recovery (including energy)	Target (%) Target Tonnes	40% 40,500	45% 49,400	67% 82,800

The Sutton review set out some specific recommendations on the Waste Management Service (shown in Box 1).

Box 1: Service Recommendations

- Make the use of wheeled bins standard across the borough and discourage black sacks
- To stop the collection of textiles at kerbside and encourage the use of Neighbourhood recycling centres
- To extend the garden waste collection (now achieved)
- To develop a new composting plant at Beddington Lane (now constructed)
- To trial a kerbside glass collection
- To undertake a waste stream analysis
- To provide a recycling service to flats and schools
- To work with residents and address waste minimisation
- To investigate provision of recycling services for commercial customers
- To improve Resource Recycling Centres

1.18 Recycling results 2005/06 and targets for 2007/08

The combined recycling and composting results of the London municipal waste collection authorities and the joint waste disposal authorities for 200/06 with the targets for 2005/06 and 2007/08 are provided in Table 1.32.

Table 1.32: London Borough recycling results – 2005/06

Authority	Recycling	Compost	Total %	Target 2005/06	Target 2007/08
Barking & Dagenham	12.18	4.42	16.6	18	20
Barnett	17.98	9.49	27.47	27	27
Bexley	21.5	16.21	37.71	30	30
Brent	10.89	9.12	20.01	18	20
Bromley	22.79	4.46	27.25	21	21
Camden	22.24	4.9	27.14	30	30
City of London	18.1	0	18.1	18	20
City of Westminster	17.9	0.5	18.29	18	20
Croydon	12.99	3.18	16.17	30	30
Ealing	15.36	3.92	19.28	30	30
East London Waste A	11.21	4.04	15.25	18	20
Enfield	16.92	10.37	27.29	27	27
Greenwich	18.16	3.5	21.66	18	20
Hackney	11.84	4.37	16.21	18	20
Hammersmith & Fulham	21	0.49	21.49	24	24
Haringey	16.08	3.15	19.23	18	2o
Harrow	13.66	13.04	26.7	24	24
Havering	11.85	5.96	17.81	27	27
Hillingdon	16.3	11.4	27.7	21	21
Hounslow	15.74	3.51	19.25	30	30
Islington	15.7	2.59	18.29	18	20
Kensington & Chelsea	19.29	0.65	19.94	30	30
Kingston upon Thames	17.41	6.56	23.97	30	30
Lambeth	18.96	3.19	22.15	21	21
Lewisham	11.96	0,24	12.2	18	20
Merton	19.35	3.24	22.59	27	27
Newham	8.63	1.5	10.13	18	20
North London Waste A.	15.27	5.62	20.89	18	20
Redbridge	12.79	4.55	17.34	21	21
Richmond upon Thames	21.06	7.53	28.59	30	30
Southwark	11.55	3.41	14.96	18	20
Sutton	20.21	8.86	29.07	30	30
Tower hamlets	8.85	0	8.85	18	20
Waltham Forest	13.44	8.41	21.85	18	20
Wandsworth	20.63	0.33	20.96	24	24
Western Riverside W.A.	20.2	1.83	22.03	24	24
				22.39	22.378

1.19 Treatment of Municipal Solid Waste (MSW)

Approximately 25% of Parfitt's analysis (2002) of municipal solid waste (MSW) is non-household waste, i.e. not bin waste. Treatment of these materials is dependent on the method of disposal; primary segregation will enhance the value of the material, assist the handling and storage and its marketability. The use of a material resource/recovery facility (MRF) would be beneficial (with co-mingled collection) to achieving the requisite standard for suggested treatment. The following treatment to maximise resource recovery may be used.

- Green waste/garden waste/board — aerobic digestion for compost
- Paper and board — re-use as newsprint or kraft/wall board
- Kitchen waste — compost/residual/derived/fuel/soil-conditioner
- Glass — re-use as bottles/new glass/aggregate
- Wood furniture — re-furbish/re-use/wallboard/mulch
- Scrap metal/ white goods — re-furbish/re-use/smelters
- Dense plastic — garden/furniture/carpets/new bottles/etc
- Plastic film — re-mould/plastic sacks
- Textile — re-use/shoddy/waste rags/fibre recovery
- Metal cans/foil — re-use as virgin material
- Disposable Nappies — change to recyclable nappies
- Non-reusable carbon waste (residual) — energy recovery/RDF

1.19.1 Municipal Solid Waste handling and treatment in London

Many Material Recovery Facilities (MRF) have been installed either by the local authority or under a PFI scheme, the latter are generally larger and/or more sophisticated, composting plants and mechanical biological treatment (BMT) are being constructed/planned/operated in or adjacent to the Capital. The incinerators at Edmonton in North London (800,000t) and SELCHP in South London (400,000t) are producing electricity from 19% of London's municipal waste, a third incinerator at Belvedere in South East London is in the planning acquisition stage will handle up to 600,000 tonnes per annum. It is hoped to achieve a target of 30% of MSW through composting/soil conditioner plants and MBT. Although current landfill sites have limited capacity, under

the South East Area Development Plan, there will be some landfill space available for non-recyclable waste from the London area.

1.19.2 New and Existing Resource Facilities in and around London

To ascertain the capacity of facilities available for handling and treatment of London's municipal solid waste a survey was carried out in 2002 by SLR Consultants for the Greater London Authority found there were:

- 2,700 'Bring 'sites
- 60 composting sites
- incinerators for municipal solid waste (19%)

A further recycling and recovery facilities site investigation in London was commissioned by the GLA in 2005 and "Waste Modelling for London".

To ascertain:

- Existing waste site capacity
- New site assessment
- Future capacity requirements

Following the publication of "Waste Modelling for London and "Assessment of Pergamentum Assumptions", the site investigation showed the current and proposed municipal solid waste transfer, treatment and disposal facilities for managing London's waste.

Treatment sites currently operating and planned, includes those operated by private companies, private and public partnerships and publicly authorities:

- K. Grundon Ltd. has a composting Plant in Slough, West London, working with and accepting compostable waste from Ealing LB Council.
- North London Waste Authority (NLWA) have a Composting facility and a clinical waste incinerator; and are building a material resource facility (MRF) at Edmonton Ecopark.
- There is a compost plant at Beddington Lane Landfill site, Sutton South West London
- There are compost and charcoal facilities in Croydon LB south London.

- The South East London Combined Heat and Power Plant (SELCHP) incinerator in Lewisham, South East London, accepts residual municipal waste from Lewisham, Greenwich, City of Westminster and occasionally some waste from Bexley and Bromley Boroughs. There is a recycling centre and recycling transfer station adjacent to the incinerator, recyclate is transferred to Grosvenor Recycling Facility (GRF) in Bexley.
- Proposed incinerator (CHP) in Belvedere, Bexley LB, South East London (520,000t/y) will accept and sort prior to incineration and power production waste from City of London, Tower Hamlets, Western Riverside Waste Disposal Authority (WRWA) four London Boroughs. WRWA River Transfer Station (RTS) in Wandsworth contains a Civic Amenity Site/ Resource Separation and Transfer station.
- Grosvenor (Ltd) Recycling Plant in Bexley, South East London has recently installed a plastic Recycling unit, the plant accepts recyleable material from many London Authorities.
- Cleanaway (Veolia) operate a Resource Recovery Facility (RRF) in the London Borough of Greenwich.
- They also accept East London waste at a Material Resource Facility in Rainham, Essex
- There is a combined heat and power plant (CHP) and refinery to convert 45m litres of tallow and used cooking oil to biofuel operating in Silvertown, Tower Hamlets, East London (RRF 2005).
- East London Waste Authority: Compost Plant and MRF, Cleanaway, Rainham.
- Mechanical Biological Treatment and Bio-MRF at Frog Island, Essex operated by Shanks (Env. Ltd.), fuel from the MBT plant to be used for energy recovery at Ford's motor work, CHP, Dagenham East London.
- MRF and MBT to be constructed at Jenkins Lane, Barking, East London. See ELWA (Shanks 2006) MBTs in East London will be 'Ecodeco' System and Biocubi® & Intelligent Transfer station (ITS) 170,000t/year.
- Envirocom Ltd. Are working with London REMADE to obtain a site in London to build a £25m WEEE recycling plant and WRAP are looking to allocated funds for a plastic recycling plant in London.

1.19.3 Treatment and Road Transport to Landfill

A Joint Waste Disposal Authority (JWDA), East London Waste Authority (ELWA) approach to an effective strategy to divert Biological municipal waste (BMW) from landfill incorporates 2 Biological and Materials Recycling Facilities (Mechanical Biological Treatment (MBT) and Bio-MRF) which receive mixed waste. The waste is separated into recyclable streams and a stabilised organics, plastics and paper faction designed to be used as a Refuse Derived Fuel (RDF) in an industrial process.

ELWA is responsible for the disposal of 535,000 tonnes of municipal solid waste (MSW) per year from four London Boroughs: Barking and Dagenham, Havering, Newham and Redbridge. About 60% is household waste, 30/40% from civic amenity (CA) sites and some trade (C&I) waste.

The contract for the project was Integrated Waste Management (IWM) and Private Finance Initiative (PFI) (OBC) (£47m). ELWA Ltd, a Special Purpose Vehicle (SPV) was set up with the successful contractor as Shanks, East London. A tonnage levy is apportioned across the 4 boroughs and the contractor is penalised if the recycling targets are not met.

The project was PFI funded and ELWA were awarded £47 million. ELWA Ltd raised £138 million of project financing with ABN Amro and NIB acting as lead funders. Capital expenditure was over £100 million and operating expenditure costs for first year are in the order of £25 million. The Frog Island project is now in operation Bio-Material Resources Facilities are planned for Newham and Redbridge (2006 WIP).

1.19.4 Treatment and disposal method in London

Western Riverside Waste Authority (WRWA)

A Joint Waste Disposal Authority it was Established in 1986 to undertake the waste disposal functions prescribed by the Local Government Act1985 and the Waste Regulations and Disposal (Authorities) Order 1985.

The Authority manages the waste for the Riverside Waste Partnership (RWP), the four boroughs of Wandsworth, Fulham, Lambeth and the Royal Borough of Kensington & Chelsea. A long-term contract ensures the recyclable are extracted, and containerised residual waste going down the River Thames to Cory's Landfill Site at Mucking in Essex.

Approximately 6,000 tonnes from Western Riverside Transfer station (WRTS) and 5,000 tonnes per week from Cringle dock Transfer station (CDTS). It is planned for this waste to be treated in the Belvedere Combined Heat and Power Plant (BCHPP) when the plant has been commissioned in 2010/11.

1.19.5 Treatment and disposal

South East London Combined Heat and Power Plant (SELCHP 2004). A consortium of Lewisham and Greenwich LB, Onyx Environmental, London Energy and John Laing (PFI) and Public-Private Partnership (PPP), organised the construction of the Energy Recovery Facility (ERF) which opened in 1994 with the capacity to treat 420,000 tonnes of waste per year. The plant, a 'Martin' design, operates well within the EU Directive limit for emissions. The Facility treats the residue waste from Lewisham (105,000t/y}, Greenwich (105,000t/y), Westminster I15,000t/y), and Bromley (40,000t/y) and as required from L. B. of Bexley.

North London 's *Energy-from-Waste' Power Plant* (NLEWPP) (2005); London Waste Limited is a 50/50 joint venture, between the North London Waste Authority, (NLWA) is A Joint Waste Disposal Authority, and SITA (GB) Ltd. North. Constructed to handle 800,000 tonnes of waste per year, the plant produces electricity from the 500,000 tonnes of residual waste. The waste is from seven London Boroughs; Barnet, Camden, Enfield, Haringey, Hackney, Islington and Waltham Forest. The plant generates electricity to the National Grid; the emissions are equal to the cleanest plants operating in Europe and the Bottom ash (140,000 tpa) is utilised in the building industry by Ballast-Phoenix.

1.19.5.1 West London Waste Authority (WLWA)

A Joint Waste Disposal Authority (JWDA), West Waste utilise road and rail transport to landfill sites.

In West London at the Grundon Environment Complex there is a Materials Resource Facility (MRF), a Clinical Waste Incineration Plant (CWIP) and, under construction, an Energy from Waste Power Plant (EFWPP) (80/150,000t available to WLWA) and an MEB Compost Plant. Capacity will be available for waste and/or recyclate from West London Waste Authority (WLWA) boroughs (Grundon 2005).

Municipal Solid Waste (MSW) residue from the London Boroughs of Brent, Ealing, Harrow, Hillingdon, Hounslow and Richmond-upon-Thames is transported containerised by rail from Transport Avenue, Brentford, Hendon and Hillingdon Rail Transfer Stations (RTS); to landfill sites at Appleford in Oxfordshire, Calvert in Buckinghamshire and Stewartby in Bedfordshire. Waste is taken by road to Waterford and Brogborough Landfill sites in Bedfordshire/Hertfordshire.

Municipal solid waste from South and South East London by Bulk Road transport. Waste from the South and South West boroughs, Kingston, Merton, Croydon are road transported to Borough Green and Offam landfill sites in Kent; Sutton waste is treated at Beddington lane Landfill and Resource Recovery Centre.

Chapter 2 Methodology

2.1 Method

Waste management in London is a multi-disciplinary subject entailing environmental, social, regulatory and economic aspects as well as technical aspects. To achieve the aims and objectives of this research will require the use of several acknowledged methods (Bell 2005). Because of the complex nature of London's waste management, when all the data has been collected, analysed and the findings evaluated, the task is not finished (Lomax 2002). There must be continuous review, evaluation and improvement to the practice (Denscombe 1998); "It implies a continuous process of research" (Brown and McIntyre 1981).

Case studies are appropriate (see section 2.3.2) along with surveys and questionnaires to ascertain the attitude and behaviour pattern of participants in the multifarious requirements of the collection, treatment, transport and disposal of waste management and control in a large metropolitan conurbation.

The researcher was engaged at a range of levels with each case study generated. In every case the researcher "work shadowed" the team from the local authority/consultancy. In a significant number of cases the researcher was active in a range of activities to generate original data.

At the end of the research period 30 case studies had been generated. For brevity some 10 were selected as being the most informative and included in the thesis.

2.2 Aim

The development of a range of recommendations based upon the expert opinion and cost effective United Kingdom Best Practice, for the adoption of enhanced Collection, Treatment and Disposal of Municipal Solid Waste in London to ensure compliance with European Commission Directive led Drivers and Targets.

2.3 Objectives

1. Determine present and proposed future Municipal Solid Waste Collection, Treatment and Disposal Practice in London across:
    - 33 Waste Planning Authorities
    - 33 Waste Collection Authorities and
    - 16 Waste Disposal Authorities

2. To critically evaluate data from high, medium and low performing Waste Collection Authorities in London to determine the extent of adoption of best practice for collection, in the light of recently developed DEFRA guidance from the Waste Implementation Programme (WIP).

3. To critically evaluate data from high, medium and low performing Waste Disposal Authorities in London, to determine the extent of the adoption of best practice for the treatment of Municipal Solid Waste. Particularly in the light of recently developed DEFRA guidance from the Waste Implementation Programme (WIP) and the Waste and Resources Research Advisory Group (WRRAG).

4. To critically evaluate data from high, medium and low performing Waste Disposal Authorities to determine the extent of the adoption of best practice for disposal in the light of recently developed DEFRA guidance from the Waste Implementation Programme (WIP) in particular New Technologies Research.

5. To elucidate the barriers and success factors for the adoption of enhanced practice for Municipal Solid Waste stemming from changes to planning guidance in London.

6. The development of a range of recommendations based upon expert opinion, for enhanced cost effective Collection, Treatment and Disposal of Municipal Solid Waste in London in the light of Waste Implementation Programme (WIP) research and in response to European Commission Drivers and Targets.

2.4 Examples of data gathering techniques used

2.4.1 Questionnaires

A questionnaire was produced for structured interviews with Senior Professionals in Environment Education and Management; private and public sectors; Local and National Government control and enforcement Officers; Consultants actively researching proposed projects and on surveys and plans in Municipal Waste Management. (Read, et al, 1997, Morris, et al, 1998).

A written questionnaire was sent to the 33 London Cleansing Managers, followed up by a personal approach where clarification was required.

2.4.2 Surveys

London Borough of Richmond upon Thames - Trade Waste Survey

The London Borough of Richmond upon Thames trade waste service currently has 2109 customers. There have been some recent changes to Trade Waste, mainly an increase in charges and over 300 customers have left to use a new service provider. It is planned in the near future to provide a recycling service for trade customers, with the objective to increase service satisfaction to local businesses and improve resource management. A survey was carried out of all the customers in 2003. The survey included questions relating to the provision of a recycling service. This was done to raise awareness of proposed new services and also to indicate which type of service traders may opt for. This method has been widely used in the London area. Planned Surveys by interview to predict trends in waste management are very productive (Read, et al, 1999, Phillips, et al, 2000).

Leaflet distribution; on-line questionnaires; public consultation and stakeholder meetings used to carry out surveys in the Greater London Area. The waste management surveys aimed to find what the barriers are to sustainable waste management and what action was necessary to overcome them. An example is using the theory of planned behaviour in determining recycling behaviour (Barr and Gilg, 2005, Fox, 1984, Bainbridge, 2003).

2.4.3 Narrative and Inquiry Stories

The 'narrative and inquiry story' approach to researching projects has been used by Gray (1998); Godsmundottir called it "a meaning-making process (Godsmundottir 1996). Gray further wrote that narrative allows experience to be related to the interviewer who requires skill in the ability to structure the interview data and analyse it into a beginning, middle and end (Gray 1998).

Bell (2005) suggests that it is appropriate to move from one method to another providing the researcher has an understanding of the major advantages of each approach (Bell 2005).

Talking to Senior Managers, Contract Negotiators and Public/Private Partners, London Borough Environmental Officers and Cleansing Managers; attending meetings, seminars and stakeholder consultations have produced much information on the current and proposed future of London's municipal waste (Morris, et al. 1998; Phillips, et al, 2000).

2.4.4 The Experimental Style

The Experimental Style is used to plan experiments, which deal with measurable phenomena and conclusions may be drawn. (Bell, 2005) This method may need to involve many people and will certainly entail much time and cost. Example; the analysis of waste from households (Household Waste). Samples of between 500 kg and 1,000 kg from each of the Acorn A to F household area (6) were collected 4 time in one year, summer, autumn, winter and spring, 24 individual samples. They were then sorted, classified and weighed into a minimum of 10 different category of material (Phillips et al 1999). Factors of import when analysing the data include:

- The method of storage – plastic or metal bins, wheeled bins, sack paper/plastic
- Size of the storage container
- Period of collections – weekly, fortnightly, etc.
- Type of refuse collection vehicle – e.g. compaction
- Method used for sorting – classification
- Method of weighing
- Kind of labour and equipment used

2.5 Scrutiny Review

Due to the increasing cost of waste disposal, a North London Borough Council held a Scrutiny Review of Waste Management in the Borough. Following recommendations from the review included box-kerbside system, recycling from multi-storied premises, brown and green bin issue and development of the CA site. Along with this an experimental kitchen waste collection service was instigated. The aim of this was to increase the recycling rate from 13.2% (2003/04) to 25.2% in 2005/06, (achieved 2005/06, 26.7%). The London Borough of Bexley achieved 37.7% recycling in 2005/06 (DEFRA) with an extensive advertising campaign running to March 2006. Continuous monitoring and control is assisted by four peripatetic Recycling Wardens who liaise with the residents introducing new and improved services. The recycling rate for 2006/07 is 41.3%.

The London Borough of Barnet (113,000 houses and 17,000 flats) started a kerbside collection of recyclate in 2001, in April 2004 a trial compulsory scheme, 22,000 houses, was introduced using EPA 1990, part 2 section 46. Continuous monitoring produced 193 non-participants; visits and warning letters reduced this to 8.

Table 2.1: Effects of the pilot scheme

	In pilot area		Outside pilot area	
April to Sept 2004	+18.44%	+ 308.58 tonnes	+13.30%	+534,26 tonnes
Oct. to March 2004	+14.745	264,43 tonnes	+13.56%	578.99 tonnes
2004/05	+16.53	573.01 tonnes	+13.43%	+1113.25 tonnes
March to Dec 2005	+28.96%	+3,292 tonnes	2005/06	31%

2.6 Summary of Methods

Utilising action research, new approaches and changes to procedures will be examined and compared with those used previously to ascertain the best environmental option (BPEO) and best value (BV) emanating from legislative changes, with the object of recommending good practice.

Action research requires specific knowledge of a specific problem or situation to make changes to the rules and procedure. This approach may give rise to challenges from adherents to tried and tested procedures currently in practice.

Case studies will be used to demonstrate the outcome of change in methods to management of municipal solid waste in London.

Surveys include the "door stepping" technique and 'kerb side collection' to improve recycling from householders, employing a social and behavioural science approach applicable to the aims of the waste hierarchy and the demographic profile of London, (Fox, 1984; Bainbridge, 2003). Case Study has its critics who draw attention to a number of problems and/or disadvantages, such as, selective reporting or generalisation and possible difficulty with cross-checking, (Bassey: 1982).

Survey by questionnaire will be used to obtain current and proposed methods of municipal solid waste: collection treatment, transport and disposal from the 33 waste management authorities in London. This information will be augmented by data and statistics from DEFRA, DTI, CNEA, GLA, the WRAP and WIP programmes. In Survey Research each survey is unique and the solution for one survey may not work with a different survey (Aldridge and Levine 2001).

Experimental method will study the historical records and knowledge against current data and information gathered by survey and research. Drawbacks to the Experimental Method include the acquisition of the data, which will include the authenticity/accuracy of the data, the time from operation to the despatch and receipt to the production of a useful analysis.

In the Grounded Theory Approach to qualitative analysis, theory will be developed inductively from the data. Being a cyclical process it can serve a strong basis for further investigation, theory can be built up as the data is collected. Punch suggests that 'saturation' is reached when no new element is in the data, Miles and Hubermann suggest saturation does not actually occur, the process is ongoing.

Computer-assisted coding and data retrieval is quite complex and requires more subtle procedures and analytical skill (Glaser, 1992). The origin of the data could be suspect.

Narrative and Inquiry stories will mainly emanate from personal discussion with erudite and knowledgeable professionals from the waste management industry and London's municipal waste management sector in particular. They may be time-consuming and the researcher must have the ability to interpret the narrative information imparted from the narrator in his own words (Gray, 1998).

2.7 Ethics

The research will be carried-out within the code of ethics laid down by the School of Applied Sciences, of The University of Northampton.

Much of the information in the research is in the public domain either now or in the near future.

A written questionnaire with a guarantee of anonymity and an oral explanation of the aims and objectives of the use of the information was circulated to possible participants. Any interview with competent and senior professionals in environmental pollution prevention and control and waste management, including academia, private and public organisations, will be on a one-to-one personal basis. Specific quotes or opinions may be used but, only with the express permission of the participant. The information will be summarised maintaining anonymity

By the nature of the research no participant will be compromised into an area of risk. Visits to waste management facilities and sites by the researcher will only be undertaken as a member of an organised group or in the company of the site manager when the company risk assessment policy will apply.

Working from home, all data will be stored either on the personal computer or in a secure cabinet in the study and will be destroyed when the final outcome of the research is known. (Denscombe 1998)

2.8 Health and Safety

The thesis will entail reading, writing and PC compilation, attending meetings and seminar, and personal conversations with knowledgeable colleagues, acquaintances and waste management practitioners. Some site visits will be necessary.

2.8.1 Risk Assessment:

Where site and facilities visits made, they will be arranged with the company or authorities permission. For health and safety site specific instructions will be strictly adhered to in accordance with standard practice. The site will not be entered without contacting the appropriate site official o arrival and on departure. The researcher will be accompanied at all time whilst at the facility and will conform with all requests made by the escorts, who will be aware of the company or authority risk assessment criteria.

Most of the literature search and PC compilation will be carried out at the candidate's Home address and they are aware of the risks attached to this. Although 'The Workplace (Health and Safety) Regulations 1992' do not apply to persons working at home, the researcher will apply the relevant conditions to the working environment; space heating, ventilation. Seating, windows, emergency exit and equipment maintenance.

The main risk appears to be Musculoskeletal Disorder caused by poor working habits, repetitive tasks and to uncomfortable working positions. The researcher will be aware of the warning signs for this disorder and for post traumatic-stress (PST)/Post traumatic Stress Disorder (PTSD).

Where Personal Protective Equipment (PPE) is required it will be utilised:

High-visibility jacket	Disposable gloves
Hard helmet	Mobile phone
Industrial gloves	Safety footwear
Eye protection	Dust mask

Chapter 3 Results

3.1.1 Data Sources for methods

Data on which this research is based was derived from:

- Being part of surveys carried out in the London boroughs by either internal staff or by consultants engaged by the borough authority;
- Working with consultants through WRAP or DEFRA funding;
- Questionnaires carried out by personal contact or Emails;
- Questionnaires carried out on behalf of government organisations;
- Attendance at meetings and seminars relevant to the research subject;
- Discussions with professional municipal solid waste managers operating within local authorities, private industry and government departments;
- Information and advice from senior academics and developers of innovative waste treatment technologies;
- Examination of relevant publications and internet information;
- Review of the relevance and implications of new legislation and amendments to current legislation;

3.1.2 Research Objectives:

To ascertain the position of the 33 London authorities in their compliance with the legislation (See section 2.3.1 Objectives).

1. The collection authorities
    - The current position
    - Action taken by collection the authorities for the diversion of waste from landfill
    - Action taken to attain recycling targets (section 2.3.2).

2. The disposal authorities
    - The current position
    - Action taken to divert waste from landfill
    - Action taken to maximise resource utilisation. (See section 2.3.3).

3.1.3 Data on the position of the 33 London MSW collection authorities 2006/07.

The current position of the 33 municipal waste collection Authorities in 2006/2007 is shown in Table 3.1 and Table 3.2. The tables denote the status 'Unitary', an authority, having responsibility for the collection and disposal of waste or 'Collection', an authority with responsibility for waste collection but in whose area waste disposal is a function of a Waste Disposal Authority (WDA).

The tables also show the population, the annual arising of waste per head of population and the percentage of dry recyclate recovered from the household waste table 3.1 (See section 2.3.3)

Table 3.1: Inner London Collection Results 2006/07 - London collection authorities' performance quartile and numerical ranking

Authority	Authority type	Residual h/h waste tonnes	2005 population (ONS)	Residual. h/h waste /head kg	Q	Rank	Dry recyclate %	Q	Rank
Camden	Collect	54,500	226,100	241	1	1	22.38	2	5
City of London	Unitary	3,767	9.200	409	4	9	28.10	1	1
Lambeth	Collect	154,238	269,100	361	4	18	20.54	3	7
Lewisham	Unitary	98,097	247,500	396	4	8	15.49	4	10
Southwark	Unitary	89.717	257.700	348	3	5	14.28	4	11
Wandsworth	Collect	117,921	281,400	365	4	7	22.60	2	4
Greenwich	Unitary	79,821	228,100	350	4	7	21.28	2	6
Kensington & Chelsea	Collect	98,485	196,200	310	1	13	23.58	1	2
Hammersmith & Fulham	Collect	88,115	179,900	257	1	2	22.74	1	3
Hackney	Collect	65,919	207,700	317	2	3	14.00	4	12
Tower Hamlets	Unitary	74,565	213,200	360	3	6	11.64	4	13
Islington	Collect	60,522	182,600	331	2	4	18.85	3	
	Unitary	65,135	244,400	267	1	2	19.57	3	8
Best-max				241			28.10		
Top quartile				317			22.60		
Median				348			20.54		
Bottom quartile				350			15.49		

London collection authority's performance, quartile and numerical ranking showing the population (ONS 2005), tonnes of residual household waste collected and kilograms per head of population with the recycling percentage attained in 2006/07 (table 3.2).

Table 3.2: London collection authority's performance

Authority	type	Residual H/H waste (t)	2005 Population (ONS)	Residual H/H waste per head (kg)	Qtr.	Rank	Dry Recycle % (82a)	Rank
Barking and Dagenham	Coll	68,131	164,500	414	4	29	15.15	24
Barnet LB	Coll	100,398	329,700	305	1	7	17.92	20
Bexley LB	Uni	67,089	220,300	305	2	8	22.21	8
Brent LB	Coll	87,154	270,100	323	2	12	11.25	33
Bromley LB	Uni	103,850	301,900	344	3	18	25.96	2
Camden LB	Coll	54,500	226,100	241	1	1	22.38	7
City of London	Uni	3,767	9,200	409	4	27	28.10	1
Croydon LB	Uni	111,243	342,700	325	2	14	14.63	26
Eating LB	Coll	91,569	301,800	303	1	6	17.97	19
Enfield LB	Coll	87,416	280,500	312	2	9	19.36	14
Greenwich LB	Uni	79,821	228,100	350	3	21	21.28	10
Hackney LB	Coll	65,919	207,700	317	2	10	14.00	28
Hammersmith & Fulham	Coll	88,115	179,900	458.	2	11	22.74	5
Haringey LB	Coll	57,711	224,500	257	1	2	19.35	15
Harrow LB	Coll	75,833	214,000	354	4	22	14.70	25
Havering LB	Coll	93,228	226,200	412	4	28	13.48	30
Hillingdon LB	Coll	89,746	252,400	356	4	23	18.56	17
Hounslow LB	Coll	85,323	212,500	402	4	26	5.70	22
Islington LB	Coll	60,522	182,600	331	3	15	18.85	16
Lambeth LB	Coll	154,238	269,100	351.6	4	18	20.54	12
Lewisham LB	Uni	98,097	247,500	396	4	25	15.49	23
Merton LB	Uni	56,421	194,700	290	1	4	21.33	9
Newham LB	Coll	95,440	246,200	388	4	24	11.76	31
Redbridge LB	Coll	85,171	251,500	339	3	17	13.63	29
Richmond upon Thames	Coll	54,657	186,300	293	1	5	22.78	4
Kensington and Chelsea	Coll	94,485	196,200	310.1	1	13	23.58	3
Kingston upon Thames	Uni	51,727	153,000	338	3	16	18.37	18
Southwark LB	Uni	89,717	257,700	348	3	19	14.28	27
Sutton LB	Uni	57,601	177,700	324	2	13	20.81	11
Tower Hamlets LB	Uni	74,565	213,200	350	3	20	11.64	32
Waltham Forest LB	Coll	72,293	224,100	323	2	11	17.23	21
Wandsworth LB	Coll	117,921	281,400	365.7		7	22.60	6
Westminster City Council	Uni	65,135	244,400	267	1	3	19.57	13
Best – max				241			28.10	
Top quartile				305			21.33	
Median				331			18.56	
Bottom quartile				354			14.70	

3.2 Removing the barriers to the improvement of resource recovery

Major obstacles to increasing the collection of recyclate are the barriers of awareness and incentive, action is needed to overcome these barriers. Methods used by collection authorities are shown below:

1 Waste awareness and education campaigns

2 Questionnaires

3 Kerbside collection

4 Incentives

5 Action for treatment by unitary authorities

6 Action taken for disposal by unitary authorities (see 2.3 section 2.3.5).

3.2.1 Door stepping

Door stepping is a method to address the barriers by knocking at households and aquainting residents of the services available and the need to recover recyclable material from their waste. Examples for comparison are shown in table 3.4.

Table 3.4: Examples of door stepping target group in a London Borough

Campaign	Target Group	Selection Method
Royal Borough of Kensington and Chelsea Roadshow (2004)	20,000 single occupancy households as opposed to flats	Census data and then crew selection to reflect those are with the highest proportion of these households

Costs per household for the Boroughs of Kensington and Chelsea, and the Western Riverside project are provided in table 3.5.

Table 3.5: Cost per household of the Royal Borough of Kensington and Chelsea and the Western Riverside project

Campaign	H/holds visited	Cost per h/hold	Number of door steppers	Man hours per week	H/holds hit per day	Variation
Rethink Rubbish Western Riverside	80,000 over 2 month	£1.62	20 (35 hours per week)	700	100	20 full time door steppers. Awareness raising and promotional campaign
	36,000 over 12 weeks	£2.57	8 (30 hours per week)	240	75	Including pre-door stepping participation monitoring. Residents were asked 25 question survey
RBKC Roadshow 11 (2000)	36,000 over 3 months	£1.69	6 (average 20 hours per week)	120	120	20 question survey team worked 2 hours every evening, and 9 hours on Saturdays (affects hit rate)

Working hours and contact rates from the Western Riverside Waste Authority and Royal Borough of Kensington and Chelsea are given in Table 3.6.

Table 3.6: Working hours and contract rates in Kensington and Chelsea

Campaign	Urban	Working Hours	Average Contact Rate
Rethink Rubbish Western Riverside	Urban	11am to 7pm Monday to Friday and every other Saturday 10am to 4pm	30%
RBKC Roadshow (2000)	Urban	6pm to 8pm Monday to Friday, and 10am to 6pm on Saturdays	25% (day time contact rate 8 – 14%)
RBKC Roadshow (2004)	Urban	5pm to 8pm Monday to Friday, and 10am to 6pm on Saturdays	20% (day time contact rate 8 – 14%)

Management of the projects carried out in Kensington and Chelsea and in the London Borough of Hounslow are shown in Table 3.7.

Table 3.7: Management of the London projects

Campaign	Project management door stepping cost/ratio	Project Manager	Project Co-ordinator	Support role
Hounslow Doorstepping Project	63:35	1 day per week	Full time (35 hours per week). Line-management of door stepping team, data analysis,	None
Royal Borough of Kensington & Chelsea Roadshow	40:60	1 day per week	20 hours per week. One of the door steppers acted as a Supervisor	None
Royal Borough of Kensington & Chelsea Roadshow	60:40	2 days per week	Full time (35 hours per week). co-ordination and Delivery, answering complaints	Each team had a Supervisor

3.3 Case study 1 - London borough of Southwark

London Borough of Southwark Door knocking 2006 Waste Collection.

3.3.1 Introduction

An inner London Borough, centrally located on the south side of the River Thames, immediately opposite the cities of London and Westminster, Southwark reflects the complex socio-economic profile of the three metropolitan boroughs from which it was formed in 1965 – Bermondsey, Southwark and Camberwell.

Southwark has a rising population, over 10,000 additional residents estimated between 2001 and 2006. The current estimated population is 257,000 and is expected to reach 285,000 by 2011.

Southwark is a Unitary Authority (UA) responsible for the collection, treatment and disposal of around 138,000 tonnes of municipal solid waste (MSW) each year.

3.3.2 Data

The figures for the management of collection, treatment and disposal of municipal solid waste arising in Southwark in the period 2006/07 are shown in Table 3.8.

Table 3.8: Data for municipal waste arising in Southwark

Residual municipal solid waste to SELCHP incinerator	32,238 tonnes
Biodegradable municipal solid waste to landfill	46,201 tonnes
LATS allowance of municipal solid waste to landfill (2006/07)	59,262 tonnes
Residual household waste collected	110,033tonnes
Household waste per head of population	348 kg
Household waste recycled	25,345 tonnes
Household waste tonnage recycled (percentage)	18.64%
Waste tonnage composted	2,939 tonnes
Tonnage composted (percentage)	4.28%
Municipal solid waste arising	138,483 tonnes
Total municipal solid waste recovered	28,450 tonnes
Municipal solid waste recycled (percentage)	25%
Residual municipal solid waste to landfill	77,000 tonnes

Residual waste for disposal is sent to:

1) Landfill – 54,436 tonnes by road using bulk haulage vehicles from Manor Place RRF to Pit No2, Sandy Lane Landfill Site, South Ockenden, Essex.
2) Energy from waste (EfW) – 32,238 tonnes to South East London Combined Heat and Power Plant (SELCHP), Lindemann Way, Deptford, South East London.
3) Recyclate – various e.g. Greenwich MRF/ Grosvenor Material Resource Facility in Erith.

3.3.3 Landfill Allowance Allocations

Southwark Council's allocation of allowances under the LATS is shown in Figure 3.1. These allowances will require a decreasing portion of the Council's residual waste to be landfilled directly. The three key years for the council are the target years, namely 2009/10, 2012/13, and 2019.20. The annual decrease is shown in Figure 3.1.

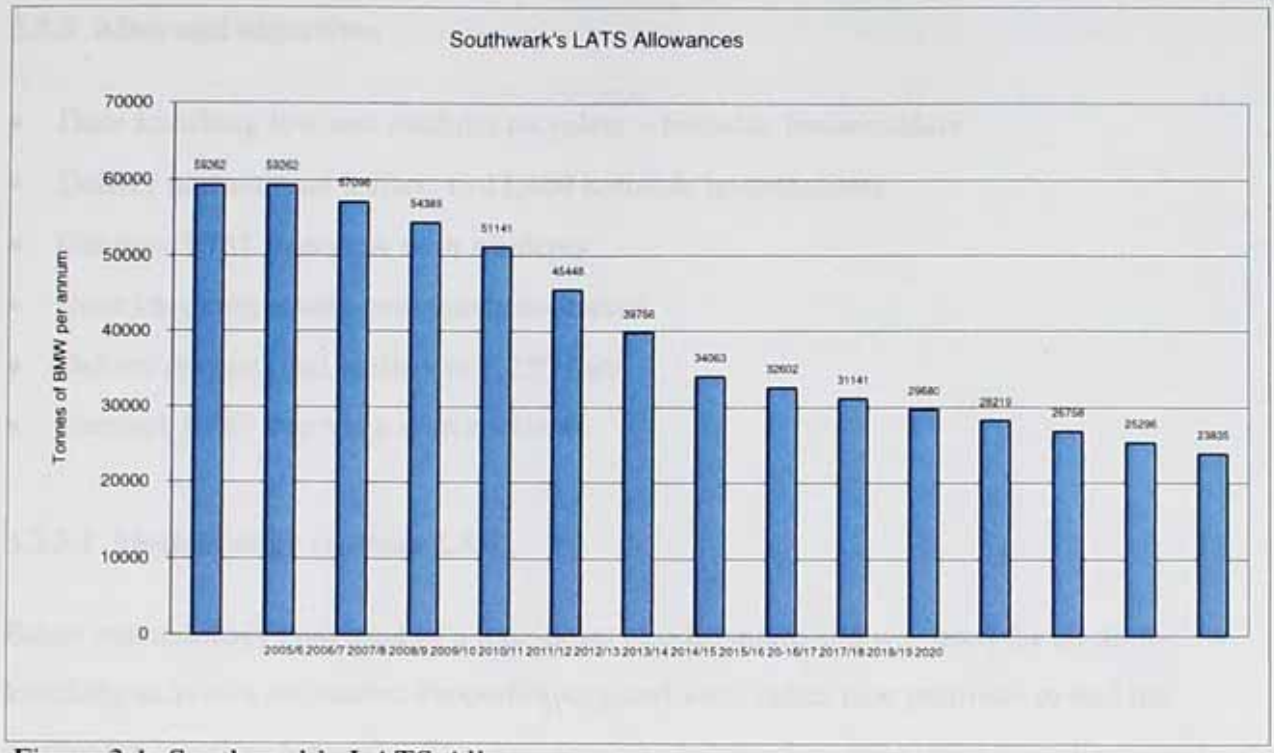


Figure 3.1: Southwark's LATS Allowances

3.3.4 Options to achieve the targets

- Reducing the amount of BMW collected
- Increasing recycling or composting
- Treating waste in an energy recovery process, for example Mechanical and Biological Treatment.

Business Eco conducted a borough wide participation rate survey (PRS) on all properties eligible for the kerbside collection recycling service. The data was used to deliver targeted door knocking to individual households in the Borough.

The waste and recycling behavioural change campaign was spread over seven weeks between the 4th February and the 19th march 2006. Data used was that previously collected by Business Eco to target specific properties and involved 11,460 properties; included in the campaign were 6.750 properties on estates.

3.3.5 Aims and objectives

- Door knocking low and medium recyclers – kerbside householders
- Deliver promotional leaflets to 11,460 kerbside householders
- Conduct 3,781 interview with residents
- Door knocking estates previously contacted
- Deliver promotional leaflets to 6,750 flats
- Conduct 1,687 interview with residents

3.3.5.1 Methodology (section 2.3.6).

Estate methodology consisted of a nine-point questionnaire and was used for all door-knocking activities on estates. Properties targeted were either new premises or had the service for less than 6 months. The questionnaire focussed on promoting the scheme and demonstrating how it operated. The following figures 3.2 to 3.13 demonstrate the results of the door-stepping questionnaire. Reasons for not recycling (Figures 3.2 and 3.4).

3.3.6 Reasons for not recycling

Reason given for not recycling range from 'don't know about the service' to 'don't know why I do not recycle', the reasons are shown in Figures 3.2 and 3.4.

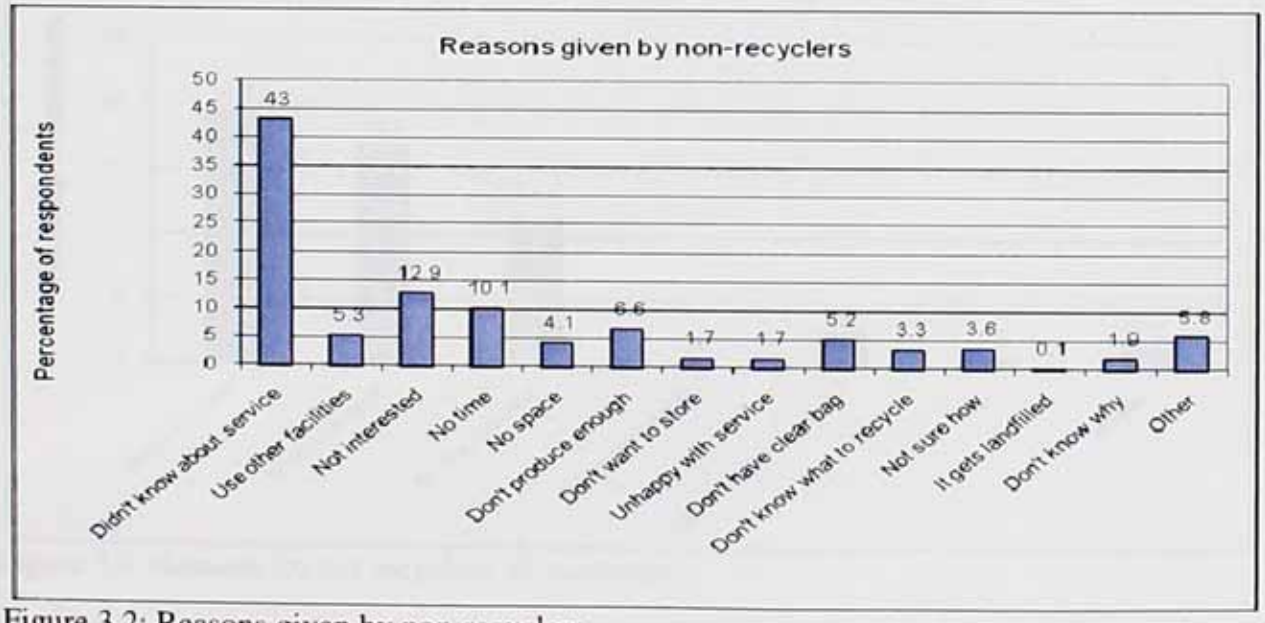


Figure 3.2: Reasons given by non-recyclers

The answers to 'how many materials are you recycling? Nine different materials are listed in Figure 3.3, generally separated by the people who do recycle (Figure 3.3).

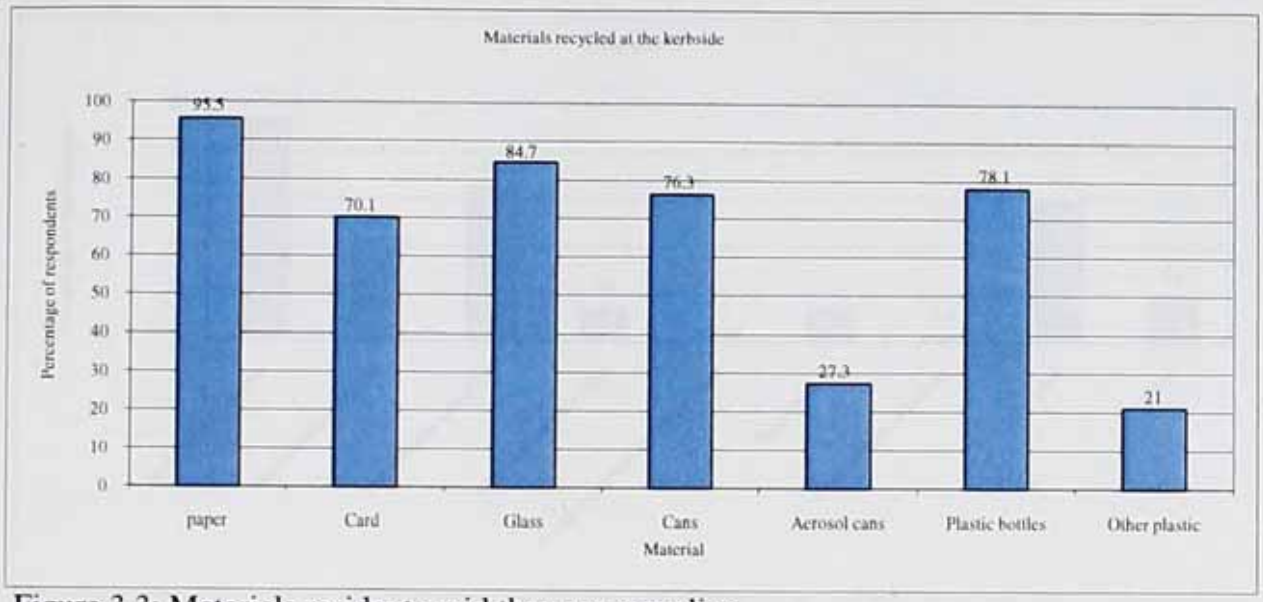


Figure 3.3: Materials residents said they are recycling

Reasons given by residents who do not recycle all the materials that are accepted is shown in figure 3.4. This demonstrates one of the main barriers to be overcome, apathy and the need to emphasise the importance of resource recovery (Figure 3.4).

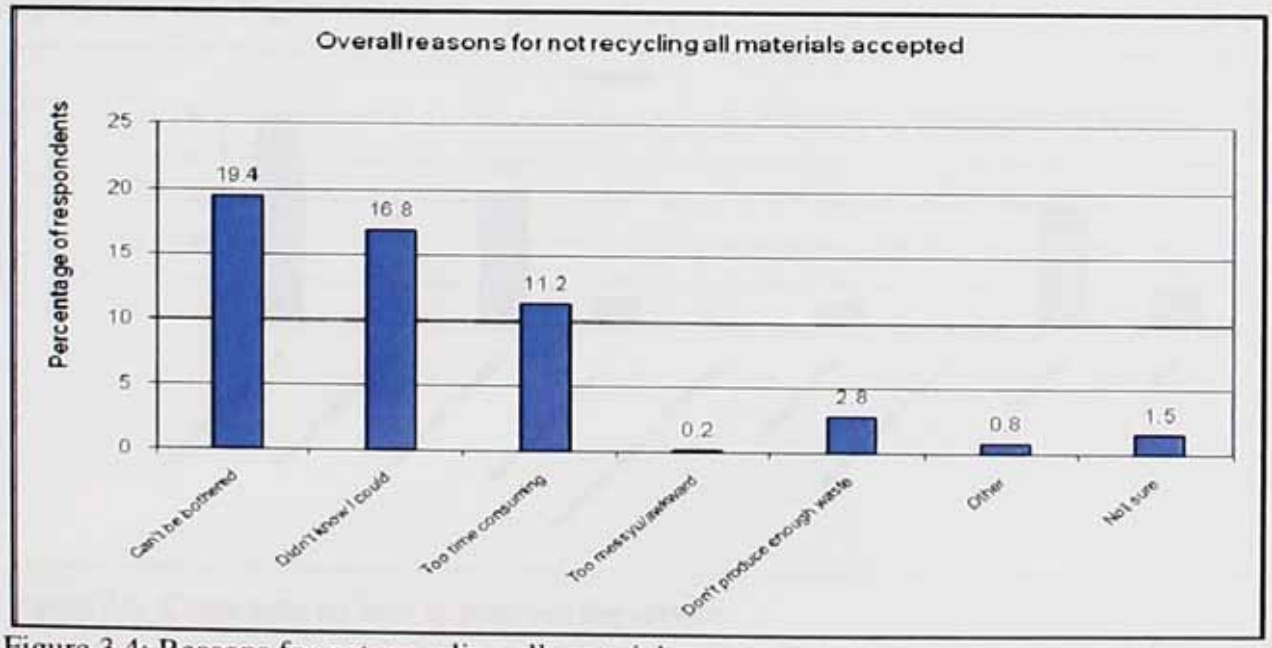


Figure 3.4: Reasons for not recycling all materials

Plastic bags were high on the list of contaminants but a higher percentage did not know what constituted a contaminant. Figure 3.5 shows the varied types of plastics that may be a contaminant demonstrating the need for communication to enhance awareness.

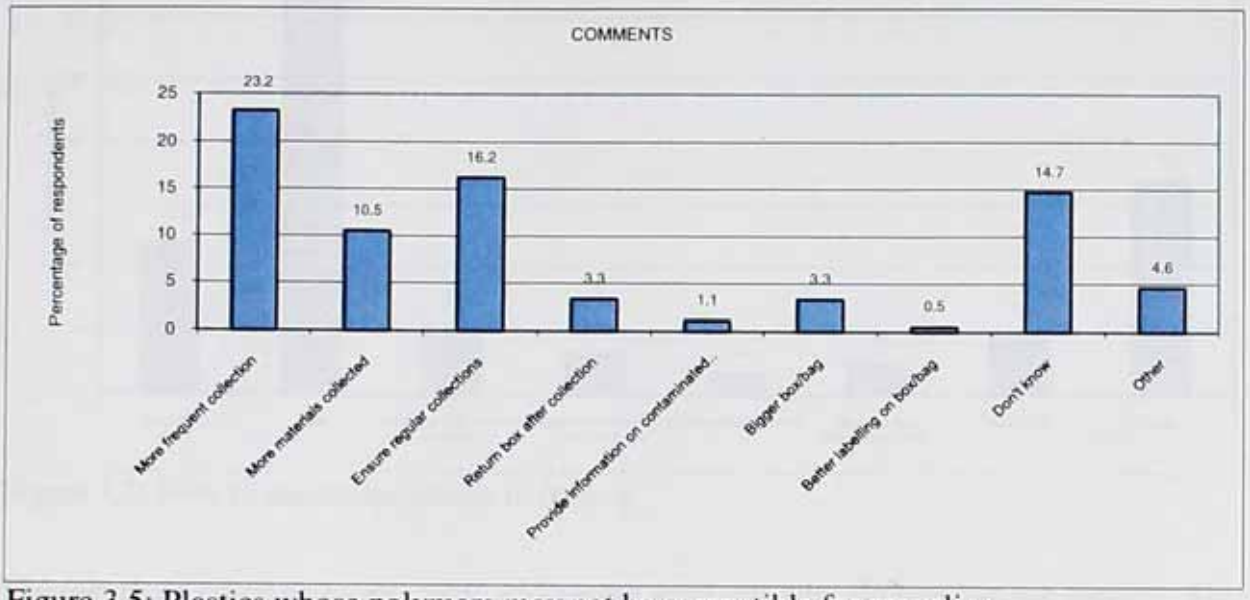


Figure 3.5: Plastics whose polymers may not be compatible for recycling

3.3.7 How to improve the service

The greater percentage of respondents to this question suggested more frequent collections; more materials collected and ensure regular collection, the percentage of suggestions of the replies received (Figure 3.6).

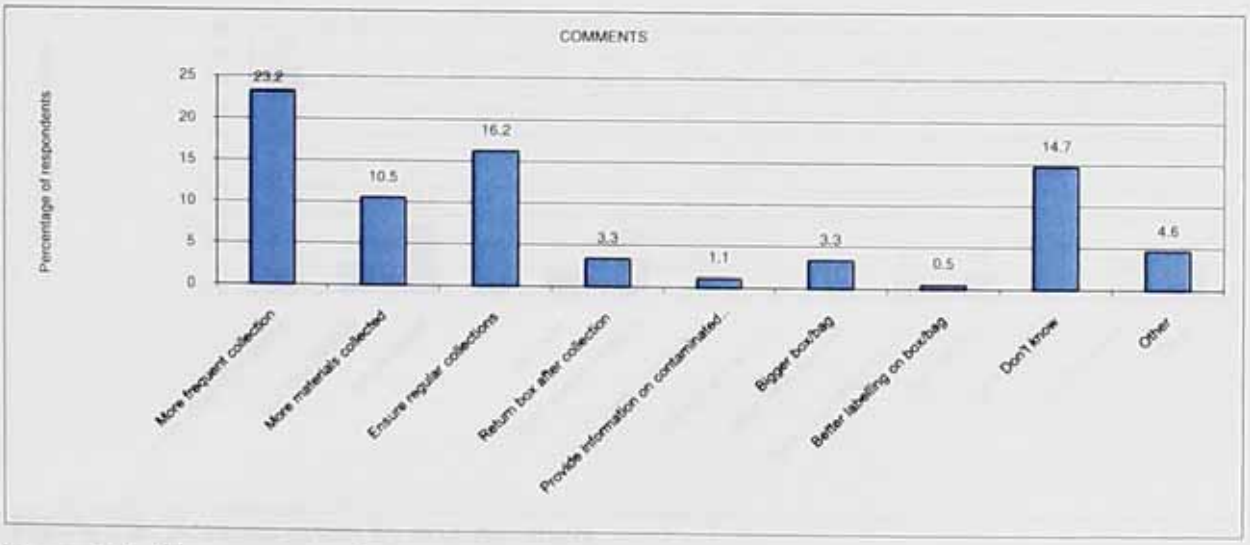


Figure 3.6: Comments on how to improve the service

How to encourage others to recycle? 31.7% of respondents were in favour of imposing fines on the recalcitrant recyclers (Figure 3.7).

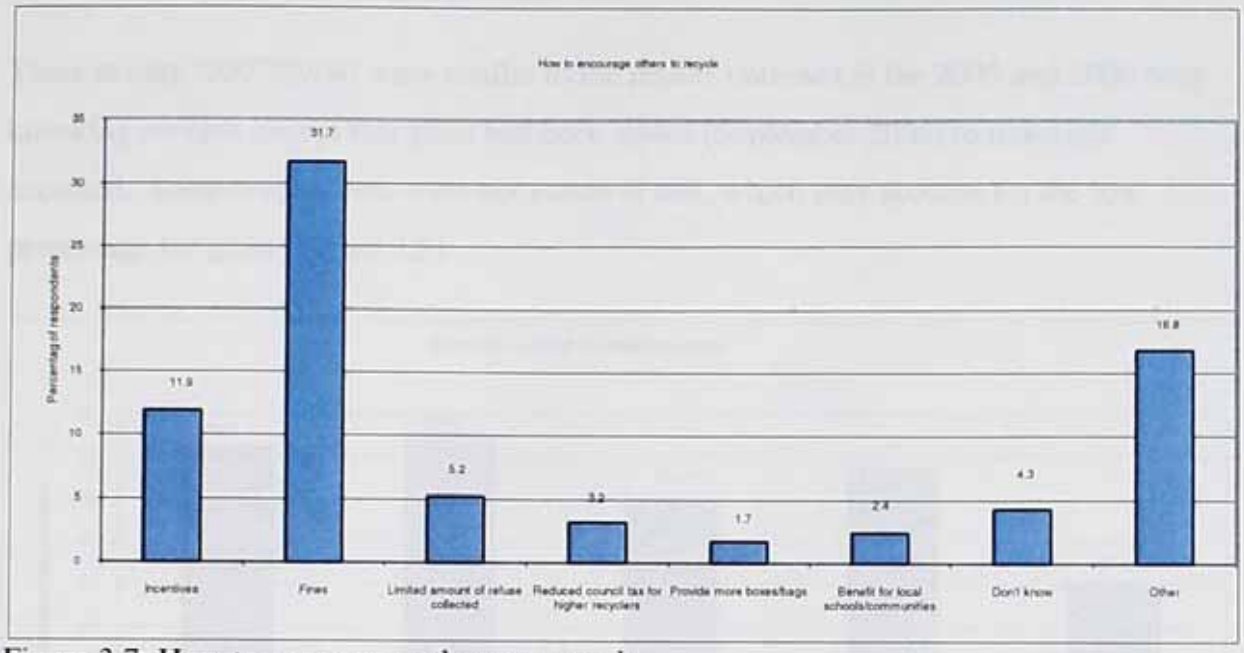


Figure 3.7: How to encourage others to recycle

The questions asked on estates were addressing residents who already had the service. The responses of all residents have been combined so as not to repeat the analysis. 16,566 properties were door knocked with 4,215 interviews conducted (25%-hit rate). 67% of residents interviewed said they were using the clear bags recycling scheme, 33% were not. Figure 3.8 shows the reasons given for not recycling.

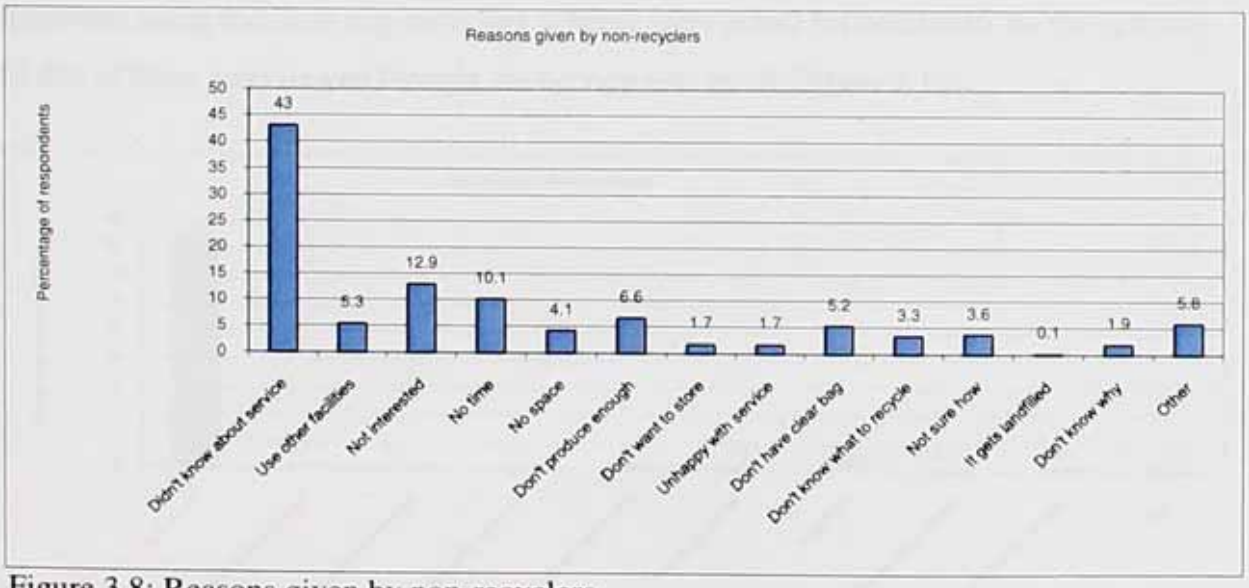


Figure 3.8: Reasons given by non-recyclers

3.3.8 Materials recycled by estate residents.

These results (2007/2008) were similar to the results obtained in the 2005 and 2006 door knocking surveys except that glass had been added (September 2006) to materials accepted. Some respondents were not aware of this, which may account for the low percentage for glass (Figure 3.9).

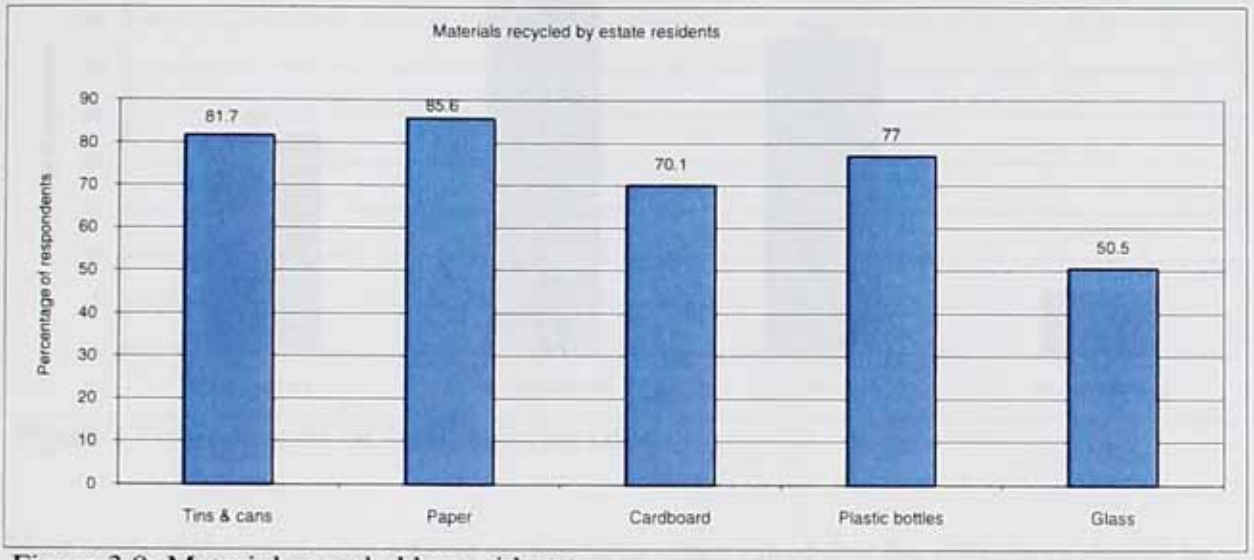


Figure 3.9: Material recycled by residents

3.3.9 Comments on the clear bag scheme.

Residents using the clear bag-recycling scheme were asked for comments on the scheme. 83.6% of those interviewed thought the service was good (Figure 3.10).

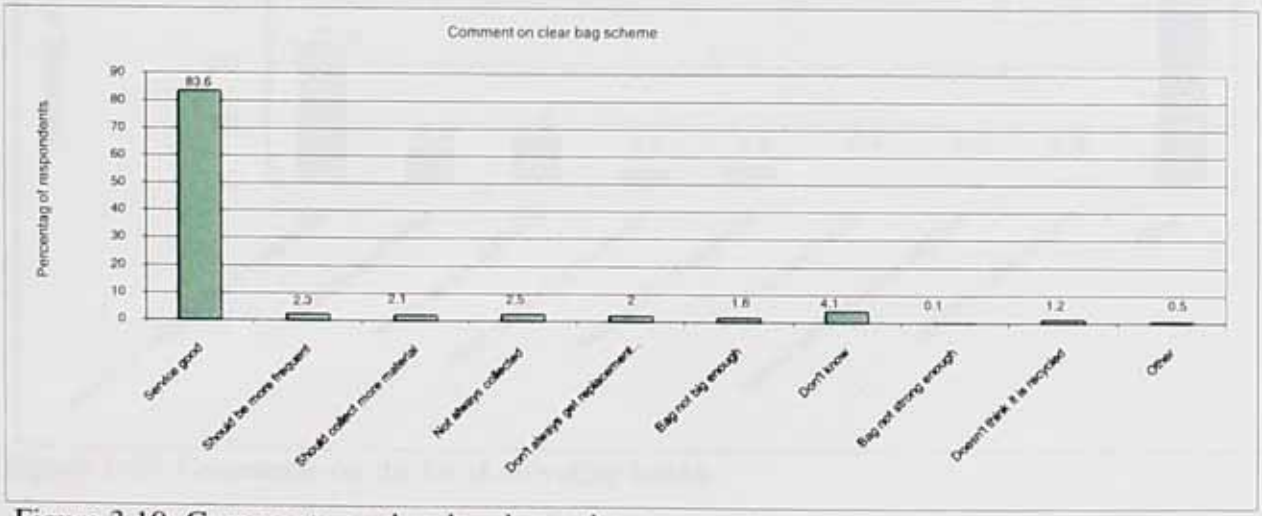


Figure 3.10: Comments on the clear bag scheme

3.3.10 Residents use of local recycling sites

Local recycling sites refer to the mini container banks set up within the precinct of the flats (Figure 3.11).

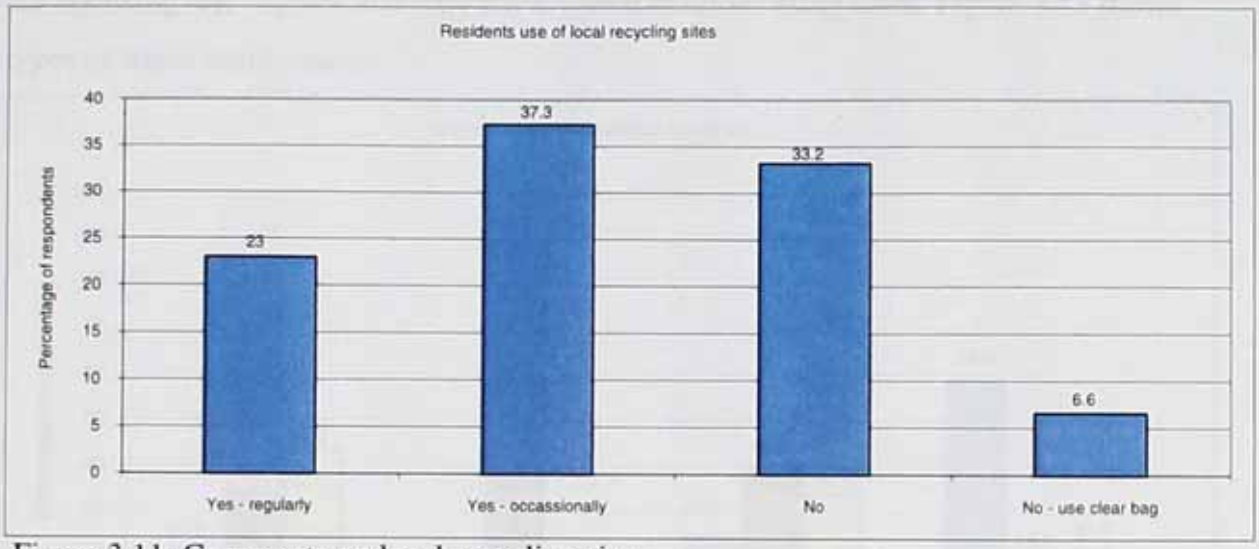


Figure 3.11: Comments on local recycling sites.

Most users of the mini-sites among respondents commented that the containers should be emptied more often. Percentage of other comments is shown in Figure 3.12. Only 8% of respondents had used the Manor Place RRC.

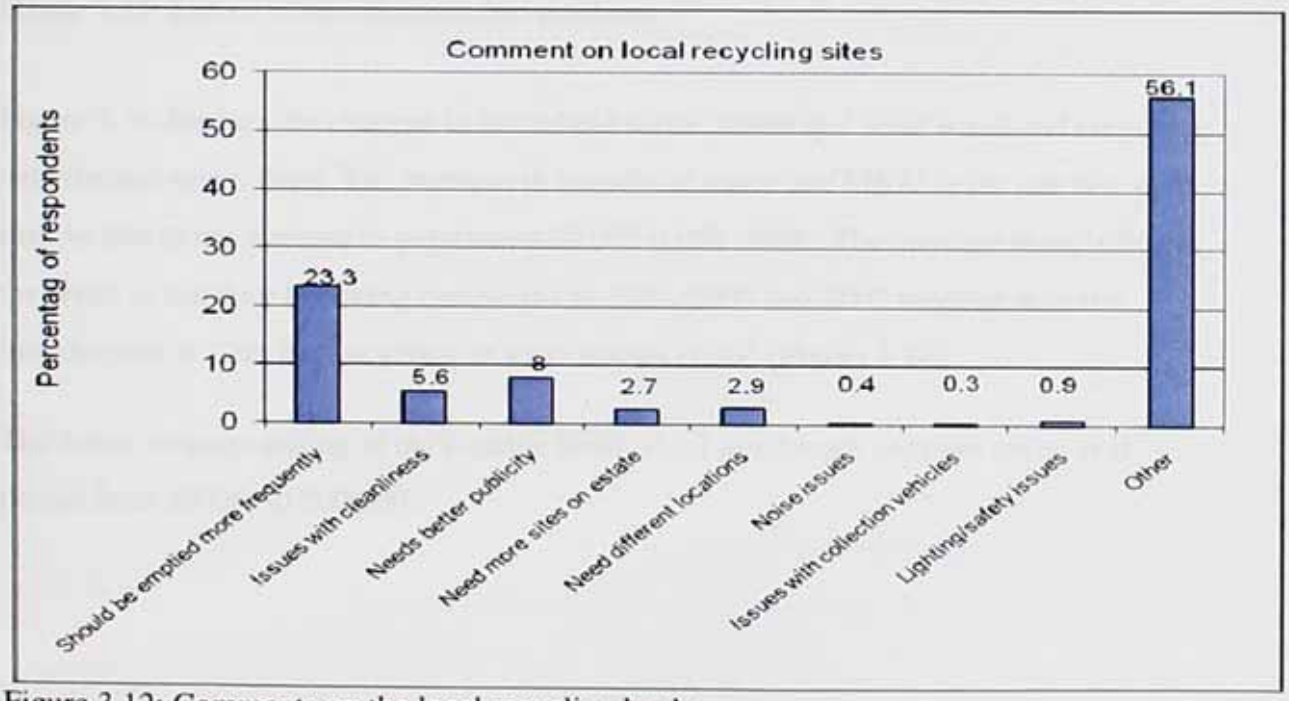


Figure 3.12: Comments on the local recycling banks

3.3.11 Waste minimisation practises.

21.2% of residents said they were using the mail preference service. 25.4% and 58.9% of residents already purchase items with less packaging and donate items to charity. 89.1% are not using real nappies and only 6.8% would consider using them. Figure 3.13 shows types of waste minimisation.

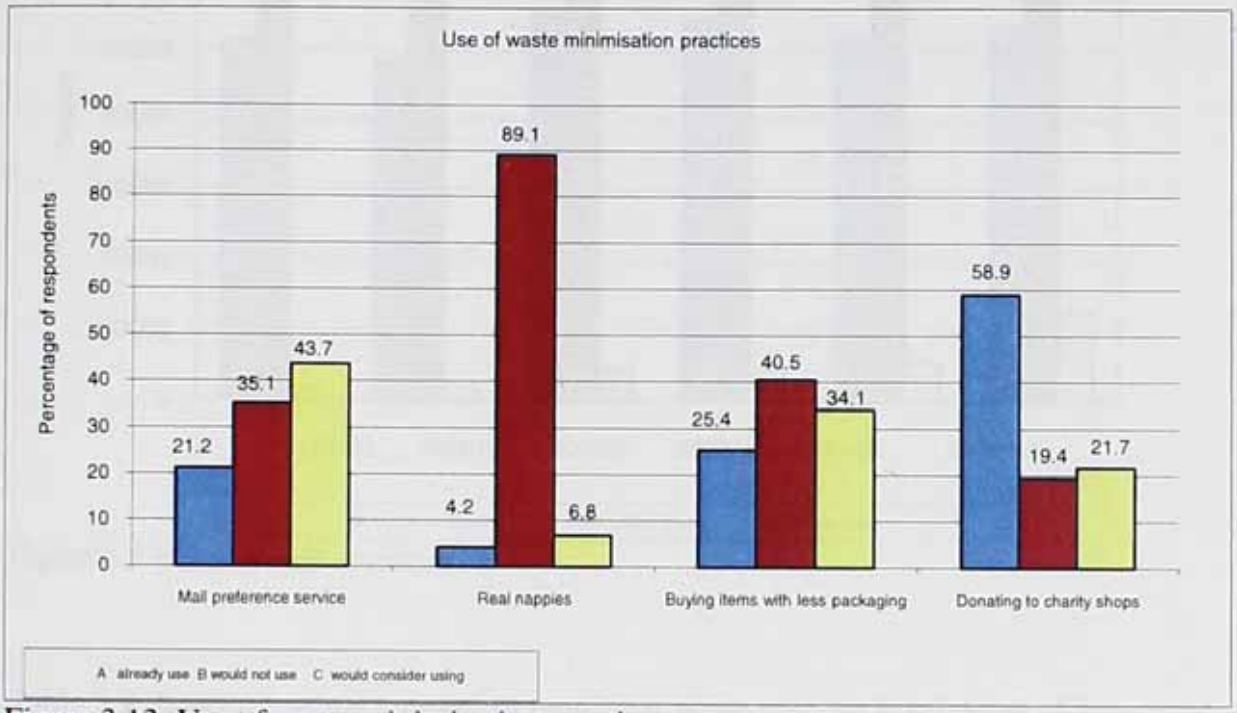


Figure 3.13: Use of waste minimisation practices

Figure 3.14 displays the changes in household waste, municipal solid waste and recycling over the last seven years. The increase in household waste and MSW in the last two years may be due to the increase in population 20,000 (ONS 2008). The increase in recycling is the result of the door knocking campaigns in 2005, 2006 and 2007 together with the introduction of clear bag recycling to more estates (flats) (Figure 3.14).

The actual tonnage arising in the London Borough of Southwark over the seven year period from 2000/1 to 2006/07.

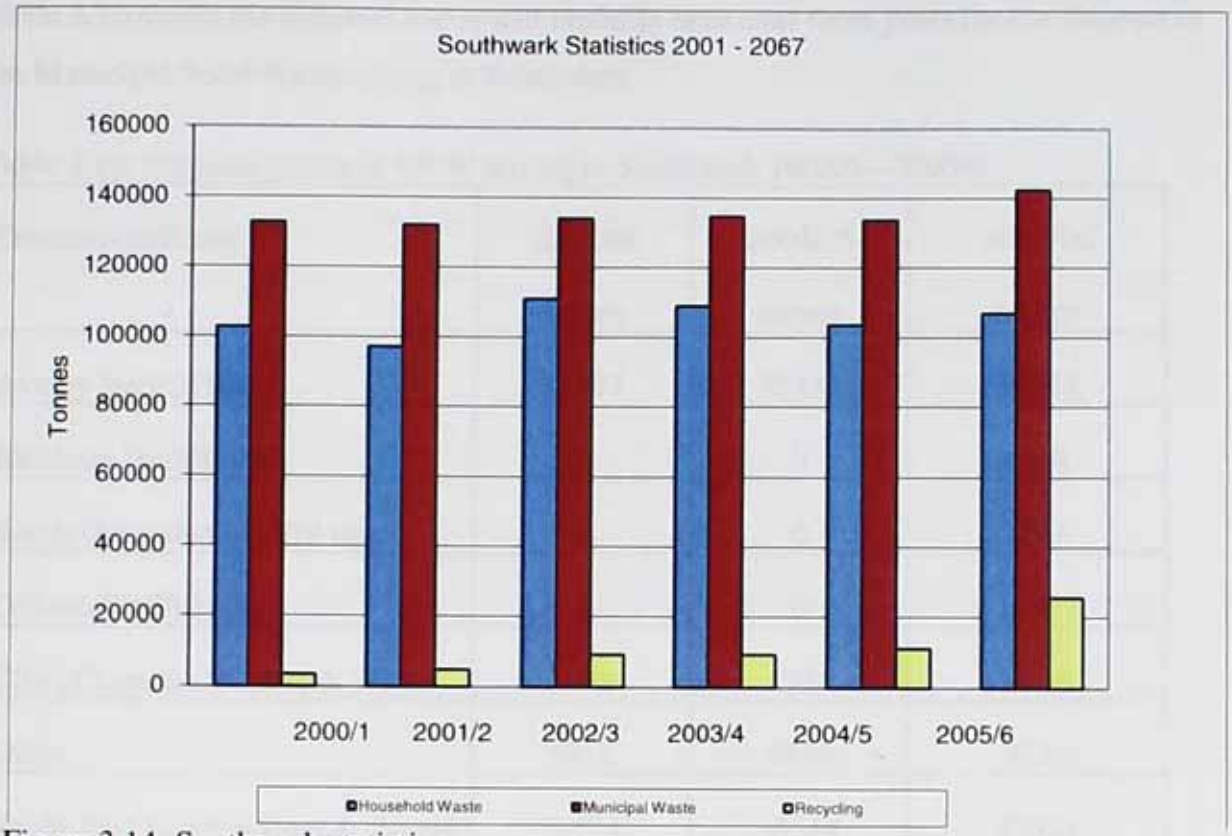


Figure 3.14: Southwark statistics

Table 3.9 shows the actual tonnage of municipal waste with the breakdown of household waste and the percentage recycled arising in Southwark 2000/1 to 2006/7.

Table 3.9: Southwark Municipal waste tonnages

	2000/1	2001/2	2002/3	2003/4	2004/5	20005/6	2006/7
Household waste arising	102729	97198	111066	109077	103601	106947	110033
Municipal waste arising	132671	131983	134032	134714	137714	138503	138525
Percentage recycled	3%	4%	7%	7%	10.84%	14.28%	18.64%

Table 3.10 shows the different routes and methods used over three years for the disposal of the Municipal Solid Waste arising in Southwark.

Table 3.10: Disposal routes of MSW arising in Southwark 2003/4 – 2005/6

Destination/Route	2003/04 tonnes	2004/05 tonnes	2005/06 tonnes
Aveley landfill site	88527	75437	50542
Rainham landfill site	0	0	4768
South Ockenden landfill site	0	0	2241
Offham landfill site	0	0	10937
City of London Walbrook Wharf	5704	4324	4986
Other	5012	4530	4721
South East London Heat & Power plant	31174	38544	32321
North London Incinerator plant	178	117	99
Recycled/recovered	7787	10032	13998
Composted	1198	2964	4554

3.3.12 Conclusions

3.3.12.1 Southwark's Waste Management Plans.

The campaigns have achieved the aims and objectives of reducing the amount of household waste per head of population but this has been negated by the increase in population. Southwark Council's Executive approved a £660 million Public Finance Initiative (PFI) contract. The contract, for 25 years is with a Veolia subsidiary, VES Southwark Ltd and was signed in February 2008. Under Southwark's plans, Veolia will provide a fully integrated waste service within Southwark including a move to commingled recycling collections and a new organic waste collection. The aim of the plan is to prioritise waste minimisation first of all, and then to maximise resource recovery including

as many recyclables as possible. The facility will be constructed on a site in the Old Kent Road, which is a central area in the borough and should be operational by 2011.

The facility will have a Material Resource Facility (MRF) to process 85,000tpa of recyclate and a Mechanical Biological Treatment (MBT) plant to treat 87,500 tpa of residual waste and produce a Residual Waste Derived Fuel (RWDF). The treated residual waste will initially go to SELCHP in Lewisham. The plant could supply heat to Southwark.

3.3.12.2 Partnership

The partnership between Veolia and Southwark is expected to enable the borough to recycle 50% of the 205,000 tonnes of waste generated each year by its residents by 2021.

The plan fulfils the obligation to comply with the Mayor of London's waste management Strategy, (WS2007), and *Planning for waste,* The London Plan – Alterations (2008).

This case study demonstrates the aims and objectives of the research, in progressing best value in municipal waste collection, treatment and disposal.

It also follows the concept of innovation and the requirement of EU Directives to minimise the tonnage of biodegradable waste to landfill (199/31/EC).

3.4 Case study 2 - The London Borough of Hackney

London Borough of Hackney: Kitchen Waste Collection.

3.4.1 Introduction

Recent research has shown that households in the UK throw away 6.7 m tonnes of food waste every year, accounting for a third of all food bought. About 50% of this is edible food. Waste food accounts for about 19% of all UK household waste. In economic terms, a typical household throws away each week between £4.80 and £7.70 worth of food that could have been eaten. This is between £250 and £400 per annum.

3.4.2 London Borough of Hackney

With a population of 217,000, Hackney (London = 7,429,200) is one of the smaller London Boroughs, based on most recent data (Hackney 2004). It ranks 24th out of 33 in terms of population in London. The population is in constant change and 47% of the population are of non-UK origin. There are some 97,042 households in Hackney (London = 3,015,997), with an average occupancy of 2.36. There is a wide mix of house types with many living above ground floor level in flats. On the UK Index of Multiple Deprivation, Hackney's average score made it the second most deprived local authority in England, a challenging place to operate.

The London Borough of Hackney is a Waste Collection Authority (WCA) whose main task is to collect Municipal Solid Waste (MSW) and transfer it to management facilities under the direction of the Waste Disposal Authority (WDA) – which in this case is the North London Waste Authority (NLWA).

The household waste recycling rate in 2002/2003 was only 3%. This rose to 6% in 2003/2004 and had reached 14.9% by 2005/2006. Hackney collects a very high proportion of commercial waste with its household waste. Commercial waste is some 35 % of the MSW stream – the mean in London is closer to 15%. The municipal waste recycling figure in 2005/2006 was 13.2%. The NLWA with its constituent WCAs has a household waste-recycling rate of 20.9% (2005/2006), so Hackney is one of the worst performing WCAs in the WDA.

In its recycling strategy (Hackney, 2004), the Borough recognised that its recycling rate was not growing fast enough to meet set targets. A key measure to reach targets was the development of a waste food collection. This underwent a trial first and was then rolled out. Since March 2007, recycling is compulsory for all residents in street level properties. All street level properties now have a Blue Bin collection for food waste recycling; after initial trials with 14 000 households. There are other receptacles to collect residuals and other dry recyclables. An alternative set of services is open to residents in high rise buildings and above ground flats.

The East London Community Recycling Partnership (ELCRP) food waste scheme was set up to explore the possibility of running a cost effective food waste collection service for recycling. It served 3,014 dwellings per week in the Borough of Hackney.

3.4.3 Methodology

3.4.3.1 Research Objectives; (see 2.3 sections 2.2 and 2.5).

The objectives of the research were to:

- establish set out and weight performance of ELCRP's food waste collection;
- establish levels of food waste in residual waste and thereby to estimate food waste generation and the food waste capture performance of the ELCRP scheme;
- consider the scope for scheme improvement to achieve higher levels of involvement and higher rates of food waste diversion;
- consider the costs of the scheme.

3.4.3.2 Results

Just over one tonne of food waste was collected from 401 households setting out material (excluding a small number rejected for contamination reasons), an average of 2.5 kg of food waste per set out. Set out rates in street level houses were nearly three times higher than in maisonettes and one and a half times greater than in flats (Table 3.11).

An average of 2.5kg of food waste was collected and result showed street level house collections were higher than from maisonettes or from flats (Table 3.11)

Table 3.11: Collection performance over one week from 3rd August 2006:

				Weekly food waste			
Housing type	Sites	Dwelling	Set outs	Set out rate %	Collected (kg)	Average per set out (kg)	Per dwelling passed by (kg)
A: Low income flats of 6 storeys or less	51	1918	260	13.56	669.20	2.57	0.35
B: Low income flats of 7 storeys or more	7	472	64	13.56	133.09	2.08	0.28
C: Low income maisonettes	10	392	29	7.40	69.39	2.39	0.18
D: Low income street level houses	5	232	48	20.69	132.55	2.76	0.57
Total	73	3014	401	13.30	1004.23	2.50	0.33

3.4.3.3 Calculating average food waste set outs summer -autumn 2006

The set out performance recorded in the August survey week with ELCRP was compared with the set out records for three separate weeks, one each in June, September and October 2006. The same dwellings were served in all four weeks. The results of this are in Table 3.11a and 3.11b.

Table 3.11a: Weekly set outs and food waste estimates summer – autumn 2006

Dwellings		June week set outs			August week set outs			September week set outs			October week set outs		
Totals by type	Av. Food Per set out (kg)	No	% rate	Est. food waste collected (kg)	No	% rate	Actual food waste collected (kg)	No	% rate	Est food waste collected (kg)	No	% rate	Est food waste collected (kg)
A: 1918	2.57	318	16.58	817	260	13.56	669	297	15.48	763	293	15.28	753
B: 472	2.08	70	14.83	146	64	13.56	133	62	13.14	129	58	12.29	121
C 392	2.39	27	6.89	65	29	7.40	69	32	8.16	76	32	88.16	76
D 232	2.76	58	25.00	160	48	20.69	133	57	24.57	157	49	20.69	135
Total 3014		437	15.69	1188	401	13.00	1004	448	14.86	1125	432	14.33	1085

An estimate of the food waste potential from hackney flats is shown in table 3.17

The performance recorded in the August survey week with ELCRP was compared with weeks in June, September and October 2006 (Table 3.11a).

The same dwellings were used in both surveys in Table 3.11a, the average of results are shown in Table 3.11b.

Table 3.11b: Average weekly collection performance from summer to autumn 2006

Average weekly food waste							
Housing type	Sites	Dwellings	Set-outs	Set-out rate %	Estimated per set-out (kg)	Estimated collected (kg)	Estimated per dwelling passed by (kg)
A: Low income flats of 6 storeys or less	51	1918	292.00	15.22	2.57	750.44	0.39
B: Low income flats 7 or more storeys	7	472	63.50	13.45	2.08	132.08	0.28
C: Low income maisonettes	10	392	30.00	7.65	2.39	71.70	0.18
D: Low income street level houses	5	232	53.00	22.84	2.76	146.28	0.63
Four weeks average total	73	3014	438.50	14.55	2.51	1100.50	0.37

3.4.3.4 Impact of residual waste collection systems

Dwelling type is not the only predictor of participation in food waste recycling. A further examination of set out data reveals a correlation between set out rates and residual waste collection arrangements. Details are shown in Table 3.12.

The impact of the food waste collection system is affected by both set out rates and collection arrangements are shown.

Table 3.12 Residual waste arrangements and food waste recycling set outs

Refuse arrangements	Blocks/streets served	Households passed by	Average weekly set outs	Average set out rate %
Kerbside	8	265	62.75	23.68
Ground level individual bin in compound	8	214	49.00	22.90
Rhodes estate black bags in individual bin	13	280	54.75	19.55
Ground level bring to bulk container	9	306	38.50	12.58
Refuse chute	33	1697	204.25	12.04
Kerbside, chutes and bulk bins	2	252	29.25	11.61
	73	3014	438.50	14.55

3.4.3.5 Modelling overall food waste generation

The next stage of the research was to estimate how much targeted food waste is generated by the 3, 014 households served by the scheme in an attempt to estimate the food waste capture performance of the scheme. The estimate of food waste generated from different types of households by ELCRP in 2006 was modelled; the result is shown in Table 3.13.

Table 3.13: Estimated food-waste generation and capture for 3014 households served by ELCRP Summer-Autumn 2006

			Average weekly food waste			
Housing type	Sites	Dwellings	Per dwelling (kg)	Generated (tonnes)	Collected for recycling	Capture rate %
A: Low income flats of 6 storeys or less	51	1918	4.03	7.73	750.44	9.71
B: Low income flats of 7 storeys or more	7	472	1.80	0.85	132.08	15.55
C: Low income maisonettes	10	392	5.16	2.02	71.70	3.54
D: Low income street level houses	5	232	4.87	1.13	146.28	12.95
Four weeks average total	73	3014	3.89	11.73	1100.50	9.38

3.4.3.6 Performance over time

For seven weeks in early 2004, ELCRP maintained detailed weight and set out records for 640 households at a local housing estate (Nightingale estate). This was among the first to be served by the weekly door-to-door food waste collection. These records of performance (2004) of the scheme have been compared with weekly average performance calculations for the same dwellings for summer – autumn 2006 (Table 3.14).

Performance over time was compared with data recorded by ELCPR in 2004 and Summer/Autumn 2006 (Table 3.14).

Table 3.14: Comparative average weekly performance Nightingale early 2004 compared with Summer – Autumn 2006

Period and pass bys		Set out No	Set out Rate %	Collected for recycling (kg)	Recycling per set out (kg)	Recycling per dwelling passed by (kg)	Total generated (kg)	Capture rate %
7 weeks February – March 2004	640	128	19,93	347.79	2.73	0.54	2392	14.54
4 weeks summer – autumn 2006	640	92.5	14.45	229.64	2.48	0.36	2392	9.60

3.4.3.7 Comparisons with other food waste schemes

Recent guidance by Waste and Resources Action Programme (WRAP) on establishing food waste collection schemes (WRAP 2006b) includes a summary of local authority or project supplied (i.e. not independently audited) performance data. Comparisons in kg of food waste captured per household are presented in Table 3.15.

Table 3.15: Average capture of food waste per household passed by per week

Food waste scheme	Recycling per dwelling passed by (kg)
Isle of Wight	0.29
ELCRP August 2006 actual	0.33
London Borough of Brent	0.36
ELCRP summer – autumn 2006 estimate	0.37
London Borough of Hounslow	0.40
London Borough of Ealing trial 2	0.43
London Borough of Ealing trial 1	0.45
ELCRP Nightingale early 2004 actual	0.54
LB Hackney ECT Kerbside food waste collection	0.69
ELCRP sites 20% plus set out estimates	0.74
London Borough of Ealing rolling out	0.95
London Borough of Richmond-Upon-Thames	1.00

3.4.3.8 Achieving greater food waste diversion performance

The London borough of Hackney has set ELCRP a task of collecting 233 tonnes of food waste per annum, an average of 4.48 tonnes per week. We have estimated that the 3,014 dwellings currently served by ELCRP generate an average of 3.89 kg of food waste per dwelling per week and that the average weight of food waste set out by those who take part is currently 2.51 kg. Using these values, Table 3.16 below contains model performance changes that would allow the ELCRP scheme to meet the Hackney food waste target.

Model performance changes that are estimated will achieve greater food waste diversion shown in table 3.16.

Table 3.16: Changes that would allow the ELCRP scheme to meet Hackney food waste target

	Dwellings served	Average weekly set outs	Set out rate %	Average kg per set out	Average kg per pass by	Total food waste collected per week (tonnes)	Total food waste generated per week (tonnes)	Captur e rate %
Current weekly position	3014	438.50	14.55	2.51	0.37	1.10	11.73	9.38
Dwellings required @ current average set out weight	12269	1785	14.55	2.51	0.37	4.48	47.73	9.38
Set outs required @ 3 kg average set out weight	10268	1494	14.55	3.00	0.44	4.48	39.94	11.22

3.4.3.9 Food waste performance potential

This finding, presented in Table 3.17, considers how much food waste could be captured if collection performance at the levels recorded by some of the schemes was achieved from all 45,000 'flats' in Hackney. At an average of 3.89 kg per household per week, 45,000 flats would produce an estimated 175 tonnes of food waste per week or 9,102 tonnes per annum (Table 3.17)

Table 3.17: Food waste potential from Hackney flats

Performance at the level of	Kg/household/ passed by/week	Product of passing by 45000 flats/week	Product of passing by 45000 flats/ year	Estimated capture rate @ 3.89kg/week
ELCRP august 2006	0.33	14.85 t	772 t	8.48%
ELCRP summer – autumn 2006	0.37	16.65 t	866 t	9.51%
ELCRP Nightingale early 2004	0.54	24.30 t	1264 t	13.88%
LB Hackney Kerbside food waste collection	0.69	31.05 t	1615 t	17.74%
ELCRP sites 20% plus set out	0.74	33.30 t	1732 t	19.02%
LB Richmond-Upon-Thames	1.00	45.00 t	2340 t	25.71%

3.4.3.10 Costs

Combining recurrent revenue costs (salaries, office costs, transport, replacement bins, liners etc) with depreciation of plant, the annual operating cost of the ELCRP scheme is £110,000.

The ELCRP scheme is collecting an average of 1100.50 kg per week; the cost per tonne of food waste collected is £1,922.

Staff costs are nearly £78,000 or 71% of the budget with over £34,000 in management costs and nearly £44,000 in collection operative costs applied to the scheme.

3.5 Case study 3 - The London Borough of Enfield

Door stepping Campaign to Promote Recycling in the London Borough of Enfield (see 2.2 section 2).

3.5.1 Demographics

Enfield is London's Northern-most Borough, one of the largest in area. 12 miles from Central London, it has a population of 280.500 (ONS 2007). Enfield has a large population of 0 to 14 year olds and a higher proportion of older people in comparison with other London boroughs. A comparison of high and low samples of age groups with the London average shows Enfield 3% above average in combined group A (0 to 19 years) and C (65 to 80+ years) shown in Table 3.18.

Table 3.18: Sample of high and low age groups (percentages of the population)

Authority	0/4	5/ 15	16/ 19	A total	20/ 24	25/ 44	45/ 59	60/ 64	B total	65/ 79	0ver 80	C total	A +C total
Newham	8.8	15.3	6.4	30.5	9.2	34.7	14.3	2.7	64.0	6.3	2.2	9.5	36.0
Bexley	5.9	14.5	5.3	26.7	5.8	28.4	15.2	4.8	58.3	11.6	4.4	16	41.7
Westminster	4.9	7.9	4.6	17.4	11.6	42.9	14.4	3.5	72.3	7.4	2.9	10.3	27.7
Hackney	8.5	13.9	5.2	27.6	7.6	38.8	14.2	2.9	62.2	6.5	2.4	9.9	37.8
Havering	5.4	14.0	5.1	24.5	5.8	26.7	20.2	5.1	63.8	12.9	4.8	11.7	36.2
Enfield	7.0	13.9	5.2	26.1	6.6	31.8	17.8	4.2	60.4	9.7	3.8	13.5	39.6
London (av.)	6.6	12.1	4.4	24.2	7.4	36.6	16.3	3.7	64.0	8.5	3.3	11.8	36.0

Source: ONS, 2006

The Enfield Borough Council municipal solid waste (MSW) collection and recycling statistics for the year 2005/06 (Table 3.19).

Table 3.19: Borough waste management statistics, 2007

Household waste collected 2005/06	87,416 tonnes
Municipal solid waste collected 2005/06	147,880 tonnes
Residual household waste per head	312kg
Dry recycled	24461.55 tonnes
Best Value Performance Indicators (BVPI) 82 2006-07	
Percentage dry recycled	19,36%
Percentage composted	10.28%
Total percentage recycling rate	29.64%

Source: DEFRA 2007, Enfield BC, 2008

3.5.2 Methodology

3.5.2.1 The Enfield Borough Council's door stepping campaign to promote recycling.

3.5.2.2 Aims of the campaign

- To enable the Local Authority to comply with legislation.
- To attain top quartile status for best value performance (BVP) in line with DEFRA guidance (2006) and the waste strategy.

3.5.3 Objectives

3.5.3.1 The objectives were: see (2.3 sections 1.2 and 3)

1. To raise awareness of kerbside collection and the materials that are suitable.
2 Phase 2, to include flats in the scheme and supply bags for their recyclable
3 To avoid incurring financial penalty under the landfill allowance scheme (LAS).
4 Minimise waste

3.5.3.2 Timetable of events

Phase 1 was carried out in July 2007; Phase 2 was carried out in October 2007 and the final report was produced in January 2008.

Phase 1 Planning – project programme, logistics, liaison with Enfield Council

Door stepping survey, awareness raising, information collecting, targets

Number of households, box delivery

Data processing, checking and collating data reporting,

Interim report to Enfield Council

Phase 1 targeted three rounds, approximately 33,300 properties speaking to a minimum of 10,989 residents (33%).

Phase 2 Planning additional premises i.e. flats

Targeting households not spoken to in phase 1

Door stepping flats, delivering bags and boxes

Data processing, checking and cleaning

Final report to Enfield Council

Phase 2 targeted a further three rounds, to achieve a contact rate of 16,500 residents (50%).

3.5.3.3 Door stepping Activities included:

Communication, engage and enthuse residents with the Council's recycling scheme, to deliver information on the wider aspects of good waste management.
Identify and record the basis for any satisfaction or dissatisfaction or suggestions about the service.
Organise 'road show' events to further 'raise awareness.
Deliver Black boxes for dry recyclables and Green boxes for compostable waste.

3.5.3.4 The key objective

To raise awareness of recycling and encourage participation, especially among the high level of Black and Asian Minority Ethnic (BAME) communities. (In order to communicate effectively with these communities, multi-lingual members of the door stepping teams distributed multi-language leaflets) (Table 3.26).

3.5.4 Results

The tasks and outputs were delivered against a tight timetable for both phases of this assignment. These are shown in (Table 3.20a).

Table 3.20a: Timetable of the two phases

Stage	Date	Actions
Phase 1 Planning	May – June 2007	Confirmation of approach and project programme Planning and set-up of logistics (recruitment, route planning, etc.) Liaison with Enfield Council
Phase 1 – Door stepping survey and box delivery	26th June –30th July 2007	Awareness raising and information collecting Target approximately 33.100 households throughout rounds 1.7 &9 Box delivery to residents requesting additional capacity or new boxes
Phase 1 Date processing	3rd, July – 1st. August – 2007	Collation and input of collected data Data cleaning and quality assurance checking
Phase 1 Reporting	3rd. August - 2007	Provision of interim report to Enfield Council
Phase 2 Planning	20th. September – 4th October 2007	Discussion of phase 1 with Enfield Council Decision on direction and focus for phase two campaign Planning and set-up of logistics (recruitment, route planning, etc.)
Phase 2 Door stepping	4th October – 23rd. October	Awareness raising and information collection. Targeting of households that had not been spoken to in Phase 1. Door stepping of flats recently placed on the scheme and distribution of recycling receptacles.
Phase 2 Box Delivery	7th. November 21st November	Box delivery to residents requesting additional capacity or new boxes

The tasks and outputs were delivered for rounds 1, 2, 3 flats against a timetable for both phases of the assignment (Table 3.20b).

Table 3.20b: Outputs for the three rounds

	Delivered	Non-delivered	Total	Percentage
Round 1	794	876	1,670	47.54
Round 2	862	94	1786	4.26
Round 3	608	976	1,584	38.38
Flats totals	2,264	2,776	5,040	44.92
Totals	19,700	14,780	34,480	57.13

In phase 1, when orders were taken for boxes the reason for the request was recorded and 2,707 were delivered. The most common is black (44%), 37% of these were for residents who wanted extra dry recycling capacity. These are shown in Table 3.21.

Table 3.21: Reasons for orders of Green and Black boxes across all rounds.

Reasons for orders across all rounds					
Green Box					
	Broken	Stolen	ordered not delivered	Req. additional capacity	Resident has never had a box
Round 1	75	62	5	65	264
Round 7	48	48	0	75	177
Round 9	36	62	2	66	217
Total	159	172	7	206	658
Black Box					
	Broken	Stolen	ordered not delivered	Req. addition capacity	Resident has never had a box
Round 1	37	61	5	142	300
Round 7	49	42	0	191	173
Round 9	32	62	1	217	193
Total	118	165	6	550	666

In phase 2 an additional 5,169 residents were spoken to and 1,510 residents in flats were visited. In total 34,480 properties were visited and 19,052 (57.13%) residents were directly spoken to. These results are broken down as shown in Table 3.22.

Table 3.22: Residents visited and % hit rate by round.

	Total In	Total Out	Total visited	% Hit Rate
Round 1				
Monday	956	542	1498	68.32
Tuesday	1057	660	1717	61.56
Wednesday	1009	555	1564	64.51
Thursday	1103	850	1953	56.48
Friday	1162	800	1962	59.23
Round 7				
Monday	992	816	1808	54.87
Tuesday	988	818	1806	54.71
Wednesday	1178	512	1690	69.70
Thursday	977	775	1752	55.76
Friday	1160	801	1761	59.15
Round 9				
	1254	804	2058	60.93
Tuesday	1281	738	2019	63.45
Wednesday	1194	812	2006	59.52
Thursday	1164	935	2099	55.45
Friday	1317	733	2050	64.24
Narrow Access Streets in Rounds 1,7 & 9				
Monday	275	422	697	39.45
Tuesday	183	236	419	43.68
Wednesday	34	50	84	40. 48
Thursday	41	47	88	46.59
Friday	111	98	209	53.11
Street based totals	17,436	12,004	29,440	59.23
Flats				

In Phase 1, 6,860 boxes were ordered and in phase 2, 2797 boxes were ordered. In all 5,557 black boxes and 4,010 green boxes were ordered, a total of 9,567 equating to sufficient for 50% of the people spoken to. Summary of doorstep data for phase 1 is shown in Table 3.23.

Table 3.23: Summary of doorstep data in phase 1

Phase One			
	Green Boxes	Black Boxes	Total Boxes Ordered
Round 1			
Monday	168	227	395
Tuesday	244	280	524
Wednesday	246	273	519
Thursday	236	300	536
Friday	217	304	521
Round 7			
Monday	117	211	328
Tuesday	148	234	382
Wednesday	212	299	511
Thursday	189	247	388
Friday	174	275	450
Round 9			
Monday	124	210	334
Tuesday	144	206	350
Wednesday	145	252	397
Thursday	138	250	388
Friday	179	271	450
Narrow Access Streets in 1,7 & 9			
Monday	49	87	138
Tuesday	28	44	72
Wednesday	7	15	22
Thursday	14	19	33
Friday	29	48	77
Totals	**2,808**	**4,052**	**6,860**

In Phase 2, 2,707 boxes were requested within Round One. A summary of the data collected on the doorstep is shown in Table 3.24.

Summary data collected on the doorstep and the box order by requests for Round Area during Phase 2 of the campaign.

Table 3.24: Summary of additional boxes ordered for phase 1 during phase 2.

Phase 2			
	Green Boxes	Black Boxes	Total Boxes Ordered
Round 1			
Monday	63	79	142
Tuesday	120	143	263
Wednesday	82	106	188
Thursday	120	124	244
Friday	87	93	180
Round 7			
Monday	82	123	205
Tuesday	76	85	161
Wednesday	65	110	175
Thursday	65	85	150
Friday	95	102	197
Round 9			
Monday	63	92	155
Tuesday	60	71	131
Wednesday	93	134	227
Thursday	60	69	129
Friday	71	89	160
Totals	**1,202**	**1,505**	**2,707**

Following discussions with Enfield Council, the reasons given by residents for requests for boxes were identified. Only 6% of those residents spoken to made comments. The results are shown in Table 3.25.

Summary of residents across all rounds their reasons for requesting boxes was identified table 3.25.

Table 3.25: Result of reasons given by residents for boxes

Comments	Frequency	Percentage
Bin too small	41	4
Would prefer wheeled bin	53	5
Crew are messy	119	10
Boxes or bins are not returned to where they are left	8	1
Boxes are not emptied properly	22	2
Grass collected but bags left	13	1
Boxes are mishandled	76	7
Missed collections	179	15
Good service	628	53
Collection of more plastic items	22	2
	1,161	100

The necessity for multi-lingual members of the team is demonstrated in table 3.26 and was most noticeable among the older members of the ethnic community.

Enfield has a large population of Black, Asian and Minorities Ethnic (BAME); this necessitated bi-lingual members in the doorstepping team. Number and percentage of non-English speaking residents (Table 3.26), multi-lingual pamphlets were issued.

Number and percentage of residents identified as speaking a foreign language (Table 3.26).

Table 3.26: Multi-lingual pamphlets were issued

Language	Totals	Percentage
Greek	30	10
Polish	40	13
Turkish	177	56
Bengali	12	4
Italian	5	2
Albanian	4	1
Romanian	6	2
Somali	22	7
Others	17	5
Total	**313**	**100**

3.5.5 Headline figures from the door stepping campaign.

The Doorstepping Campaign to Promote Recycling supported by Hyder and the researcher was to increase awareness and encourage residents to participate in the Enfield recycling scheme.

Headline figures from the scheme:

- 34,480 premises visited.
- 19,056 residents spoken to on the doorstep, an overall hit rate of 67.13%
- 9,567 new boxes ordered by residents.
- 5,557 Black boxes ordered and 4010 Green boxes ordered as shown in Table 3.24.

3.6 Case study 4 - The London Borough of Brent

London Borough of Brent: Awareness Campaign

3.6.1 Introduction

Brent has a population of 270,391 in 102,625 households occupying an area of 44.2 km². It is an inner London Borough, a Waste Collection Authority (WCA) and a partner in the West London Waste Authority (WLWA).
Residual waste is delivered for disposal by the WLWA to Ruislip and Hendon Rail transfer stations (RTS) where it is transfer loaded for transport to Calvert Landfill Site in Buckinghamshire and Stewartby Landfill Site in Bedfordshire. Some small quantities of residual waste are disposed at the South East London Combined Heat and Power plant (SELCHP) in Lewisham. The municipal waste statistics for the London Borough of Brent are shown in Table 3.27.

Table 3.27: Waste data for the London Borough of Brent

Household residual waste	87,154 tonnes
Household waste per head of population	323kg
Change over year of household waste collected	-0.20%
Dry recycling percentage	11.25%
Green composting percentage	10.27%
Recycling and composting percentage	21.52%
Residual waste to landfill/RDF percentage	78,48%
Kerbside collection recyclate percentage of households	91.5%
Municipal solid waste /non household	18,216 tonnes
Total municipal solid waste	102,370 tonnes
MSW + household waste per head of population	411kg
Cost per tonne waste collection	£81.49

3.6.2 Background

The project '*A waste Attitude Programme*', 2007, was carried out by Brent Council in partnership with Business Eco Network, funded by London Waste Action through the London Waste Recycling Fund (LWRF). In 2004 Brent had a recycling figure of 8.5% and a target of 20% by 2008; the 2004 survey collection round covered 37 streets containing 2002 properties. This included 10 blocks of flats/housing estates comprising 403 properties. Overall participation was 32% initially and saw an increase to 35.77% following "door knocking" (Oct.2005). The lowest participation rates ranged from 0% - 6% among flats. These were identified and banks of 5 x 1100 l. containers have been installed wherever possible.

3.6.2.1 The review followed in 2007

A Review Board examined the changes made to the refuse and recycling collection in the period since the publication of the strategy in 2004 and door knocking in 2005. The decision was made to commission a further study to raise awareness and improve the participation rate and residents attitude to recycling in 2007.

To acquaint the Review Board of the current situation, three areas were selected for monitoring of the kerbside recycling system over a period of three weeks in October 2007 (see tables 3.28, 3.29, 3.30 and 3.31).

3.6.3 Aims

The aims of the waste attitude and awareness programme were to:

- Evaluate the result of the 2004, education project; the 2005 door knocking campaign; the 2006 'cut contamination' campaign and the Ethnic Minority campaign in 2006.
- Improve understanding of waste issues among a percentage of householders in Brent.
- Change the attitude of non-recyclers in the Borough.
- Increase reuse and recycling rates within the borough and the region.

3.6.4 Methodology

1. Ascertain the percentage of residents using the recycling system
2. Increase the number of participants
3. Inform the residents of the services available for recycling
4. Form focus groups and enlist recycling champions

3.6.5 Results

Participation rate for doors knocked in the designated project areas (see Table 3.28).

Table 3.28: Percentage rate of the door-knocking

Road	P/rate 1	P/rate 2	Increase/decrease
Ash Grove	41.67%	58.33%	16.67%
Chestnut Avenue	40.00%	40.00%	0.00%
Chestnut Court	32.00%	48.00%	16.00%
Chestnut Grove	40.54%	48.65%	8.11%
Elton Avenue	40.91%	45.45%	4.55%
Harrow Road	13.25%	15.66%	2.41%
Maybank Avenue	39.81%	45.97%	6.16%
Priory Close	37.50%	50.00%	12.50%
Priory Park Road	38.46%	46.15%	7.69%
The Croft	40.00%	34.55%	-5.45%
The Dell	35.29%	48.18%	5.88%

The opportunity to re-box and re-issue boxes to new participants is shown in (Table 3.29)

Table 3.29: Participation rates during the monitoring – Streets re-boxed

Road	% Participation rate	% Participation rate 2	% Increase
Elms Court	22.00	55.00	35.00
Elms Gardens	29.73	43.24	13.51
Lothian Close	0.00	42.86	42.86
Perkin Close	26.09	56.52	30.43
Sudbury Crescent	33.33	38.79	5.56
Sudbury Croft	27.27	28.79	1.52
Windmore Close	0.00	15.15	15.15
Average increase			20.58

Table 3.30 illustrates the increase in new participants in the Harrow Road area

Table 3.30: New boxes issued as a result of door knocking

Harrow Road	8 boxes	Maybank Avenue	5 boxes
Chestnut Close	2 boxes	The Croft	2 boxes
Priory Park Road	3 boxes	Elton Avenue	1 box
Priory Close	6 boxes		

The report produced to acquaint the Review Board of the result of the campaign (Table 3.31).

Table 3.31: Post Review Board monitoring (2007)

Number of Households	Area	Collection day	Boxes collected	Average per household kg	Participation rate
1523	A	Monday	676	0.12	44.39
1043	B	Wednesday	542	0.28	52.42
1053	C	Thursday	726	0.30	50.59
Total 3,619		Dec 2007	1,944	0.23	Av. 51.33

The decision to encourage focus groups and recycling champions was instigated at a number of venues across the borough (Table 3.32).

Table 3.32: Focus groups meeting locations

Location	Address for meeting
Brent House	Wembley
Brent Town Hall	Wembley
Vale Farm Sports Centre	North Wembley
Kingsbury High School	Kingsbury
College of North West London	Willesden

The recycling rate achieved in 2006/07 was 21.52% (statutory target 2008 20%).

3.6.6 Recent development

Any resident deliberately refusing to use the recycling service i.e. the blue box will receive a warning, which will be followed by a formal notice if the offence continues. The last resort will be a summons to a Magistrate's court where, on summary conviction, a fine up to £1,000 may be imposed. The reason given for the decision was that to do nothing would

increase costs for waste management by £700,000 per year, a 13% increase to more than £7 million pounds.

In furtherance of the aim of the survey to maximise Best Value, the Council is co-operating with a fuel evaluation. Brent contractor, Veolia Environmental Services is experimenting with the use of Liquid Methane Fuel (LMF) as a substitute for Diesel to operate a waste collection vehicle. The trials are a joint operation between Iveco/Gasrec and Veolia utilising the decomposition of biomass to produce Compressed Bio-Methane (CBM). One tonne of CBM is equal to 1,200 litres of diesel and could supply fuel to power one Heavy Goods Vehicle (HGV) for one week, producing 70% less carbon dioxide.

3.7 Case Study 5 - The London Borough of Richmond upon Thames

London Borough of Richmond upon Thames - Commercial Waste Survey 2006

3.7.1 Demographics

The London Borough of Richmond upon Thames (LBoRuT) is situated in Southwest London, covers an area of 5,095 hectares and is the only London Borough spanning both sides of the River Thames with a river frontage of 21.5 miles. The Borough has a population of 182,000 with approximately 76,000 homes, the average size household is 2.4 people and over 30% of households are single occupant. Census data estimates the lowest percentage of young and the highest percentage of over 85 years old residents compared with the rest of London Boroughs. Non-white ethnic minorities account for 9% of the population (ONS 2004).

3.7.2 Waste management arrangements

Information on Waste Management statistics for the London Borough of Richmond upon Thames 2005/06 is found in table 3.33.

Table 3.33: Waste management statistics – 2005/06

Household waste arising	54,651
Household waste per head	432kg
Cost per household	£67.73
Tonnage recycled per household	293kg
Commercial waste collected a/c[1]	10,896 tonnes
Commercial waste delivered at RRC a/c	12,954 tonnes
Total commercial waste a/c	23,850 tonnes
Total municipal solid waste	78,407 tonnes
Total recycled	24,461 tonnes
Percentage recycled	29.56%

a/c[1] = account customers

3.7.3 Background

There is one Reuse and Recycling Centre in the Borough (RRC) at Townmead Road. The centre accepts commercial waste and is the source of the main income from commercial waste.

Richmond is a partner in the West London Waste Authority (WLWA) which is responsible for the treatment of Municipal Solid Waste (MSW) arising in the Borough's area. Residual waste is containerised in ISO (8x8x20ft) containers at Transport Avenue, Brentford and transported to landfill at Appleford Landfill Site in Oxfordshire by rail.

3.7.4 Methodology:

3.7.4.1 Survey by Questionnaire

3.7.4.2 Aims of the survey (see 2.2 and 2.3 sections 1 and 5)

- To ensure Best Value (BV) by economically utilising labour and transport with methods compatible with quality and of high standard.
- To achieve London Borough of Richmond Waste Strategy targets.

3.7.4.3 Objectives of the survey

To find the best practicable environmental option (BPEO) for the collection, treatment and disposal of commercial solid waste to comply with WS 2007.

To critically evaluate the data to determine the extent of the adoption of best practice in the light of recently developed (2007) DEFRA guidance from the waste implementation

programme (WIP) and in particular the Waste and Resources Research Advisory Group (WRRAG).

3.7.4.4 Commercial Waste

The survey was done to raise awareness of the proposed new service, to indicate which type of service traders may opt for and the reasons why some did not use the service; there were 112 responses. The questions posed in the questionnaire and the responses are shown in the following tables.

3.7.5 Results

90.2% of those who returned the survey had used the Borough's commercial waste collection service. The result of the questionnaire is being used to formulate a commercial waste service that would be acceptable to the majority of the commercial waste producers in the Borough and will help to meet the recycling targets.

Question 1 - Who currently collects the commercial waste from your premises?

Information on the collecting organisation, who are private companies or charities and including Richmond Council, is found in Table 3.34.

Table 3.34: Replies to the questionnaire from organisations collecting commercial waste in the Borough of Richmond.

The London Borough	63
QWS	31
BIFFA	9
Other	6
PHS	3
Total	112

Question 2 - How long have you used your current provider?

Information from the survey of the current, commercial waste collection service in the borough (Table 3.35).

Table 3.35: Length of time the respondent had been using the London Borough commercial waste service

One year or less	0
1 – 3 years	5
Over 3 years	88

Question 3 - customers who used a different service provider?

Information on different service providers is found in Table 3.36.

Table 3.36: Length of time respondent had used other service

One year or less	46
1 – 3 years	1
Over 3 years	3

Question 4 - Information on the reason why commercial waste producers who stopped using the Council's service did so is shown in the answer to question 4.

Question 4 If you used the council's service and have changed to a new supplier in the last year, please give your reason?

Answer: 50 out of 52 who replied stated that it was due to the cost and large increase since April 2004.

Question 5 - how would you rate your waste being collected on the agreed day each week?

Replies to the question 'how would you rate your waste being collected on the agreed day' is shown in Table 3.37.

Table 3.37: Replies to the question of a regulated collection time

Excellent	18.82%
Very Good	31.68%
Good	38.61%
Poor	7.92%
Very Poor	2.97%
	100%

Question 6 - How would you rate your waste being collected on the agreed day each week?

Information on how the user would rate the method of communication of any changes to the users' collection day is shown in Table 3.38.

Table 3.38: Replies to the question on the method of communication of changes to the agreed day of collection

Excellent	2.3%
Very Good	34.48%
Good	24.14%
Poor	25.29%
Very Poor	13.79%
Total	100%

Question 7 - how satisfied are you that containers are fully emptied and left without spillage?

Information on how satisfied the customer is that containers are fully emptied and left without spillage is shown in Table 3.39.

Table 3.39: Satisfaction rating of the bin emptying activity

Excellent	13.86%
Very Good	27.72%
Good	42.57%
Poor	25.29%
Very Poor	13.79%
Total	100%

Question 8 - how satisfied are you with the commercial waste collection service?

Information on user satisfaction with the commercial waste collection service is found in Table 3.40.

Table 3.40: Satisfaction rating of the commercial waste collection service

Excellent	11.88%
Very Good	24.75%
Good	46.53%
Poor	9.90%
Very Poor	6.93%
Total	100%

Question 9 - how would you rate the commercial waste collection service for value for money?

Information on 'how would you rate the commercial waste collection service for value for money' is shown in Table 3.41.

Table 3.41: Replies to the question 'is the service value for money'.

Excellent	1%
Very Good	4.95%
Good	26,73%
Poor	38.61%
Very Poor	28.71%
Total	100%

Question 10 - how would you rate how easy it is to understand our invoices and payment methods?

Information on 'how would you rate how easy to understand our invoices and payment methods is shown in table 3.42.

Table 3.42: Rating of the invoices and payment methods

Excellent	6.93%
Very Good	22.77%
Good	54.46%
Poor	15.84%
Very Poor	0%
Total	100%

Question 11 - if you have used our web site how would you rate it?

Replies to whether the responder had used the Council's web site, how would he/she rate it is shown in table 3.43.

Table 3.43: Replies to how users of the Council website rate it

Excellent	3.85%
Very Good	30.77%
Good	53'85%
Poor	11.545
Very Poor	0%
Total	100%

Question 12 - Which type of waste do you generally produce?

Information on the type of waste generally produced is shown in table 3.44. 112 responded (100%)

Table 3.44: Type of waste generally produced by the participants

Glass	16.96%
Cardboard and boxes	82.14%
Paper	75.89%
Plastics	20.54%
Green Waste	8.93%

Question 13 - Do you currently recycle any of your waste?

Information on recipient currently recycling or not is shown in table 3.45.

Table 3.45: Answers to the question on recycling

Yes	51.96%
No	48.04%

Question 14 - If the Council provided a recycling collection, would you consider using it?

Information on whether an alternative price structure of 50% cheaper or one slightly less expensive than the current waste collection around 5% cheaper would influence user consideration is shown in (Table 3.46).

Table 3.46: Shows how a price change may affect participation

a) If it was 50% cheaper than the current waste charges but you had to separate all recyclable items (including different coloured glass)?	67.11%
b) If it was slightly less expensive than your current waste collection around 5% cheaper and you could put mixed recyclable items together	32.89%

3.7.6 Revenue and Rates

The greater portion of the 2006 commercial waste revenue (£992,021) is derived from the throughput of the Resource and Recovery Centre at Townmead Road, Kew (Table 3.47).

Table 3.47: Income from commercial waste acceptance at the RRC at Townmead Road

Commercial waste type	Revenue (£)
Commercial waste general	773,838.65
Commercial waste – biodegradable	120,404.20
Commercial waste – building materials	19,546.70
Commercial waste – scrap metal	3,459.67
Commercial waste – other recycling	3,957.05
Commercial waste Accounts	70,806.37
Total	999,012.64

Source: LBoRuT 2006

The new charges for commercial waste collection came into force in April 2008 and the difference in charges for segregated waste suitable for resource recovery and waste removed at the higher rate should act as an incentive to influence customers and increase the recycling from commercial premises. This will improve the authority's current figure of 31.71% recycled. The commercial rate charges for 2008/2009 are provided in Table 3.48).

Table 3.48: The increased charge for commercial waste collection to be levied from April 2008

Container	Collect yearly charge	VAT	Subtotal	Bin hire yearly charge	VAT	Subtotal	Yearly total one Collection
1 x sack	£142.13	£24.87	£167.00	£0,00	£0.00	£0.00	£167.00
1 x 240lt bin	£263.45	£46.10	£309.55	£12.30	£2.15	£14.45	£324.00
1/x/360lt bin	£336.09	£58.82	£394.91	£20.50	£3.59	£24.09	£419.00
1 x 770lt bin	£578.40	£101.22	£679.62	£39.47	£6.91	£46.38	£726.00
1 x 1100lt bin	£775.11	£135.64	£910.75	£56.38	£9.87	£66.25	£977.00

The new rate for the commercial waste recycling collection service came into force in April 2008; the new charges are shown in Table 3.49.

Table 3.49: The lower charge for the collection of segregated recyclate from commercial premises operative from April 2008

Container	Collect yearly charge	VAT	Subtotal	Bin hire yearly charge	VAT	Subtotal	Yearly total (one collection
1 x sack	£85.11	£14.89	£100.00	£0.00	£0.00	£0.00	£100.00
1 x 240lt bin	£149.70	£26.20	£175.90	£12.30	£2.15	£14.45	£190.00
1 x 360lt bin	£157.87	£27.36	£185.50	£29.50	£3.59	£24.09	£210,00
1 x 770lt bin	246.61	£43.16	£289.77	£39.47	£6.91	£46.38	£336.00
1 x 1100lt bin	£306.70	£53.67	£360.37	£56.38	£9.87	£66.25	£427.00

The recycling rate for the Borough in 2005/06 was 29.56% there has been an improvement to 31.71% in 2006/07, the Authority is now looking for a larger increase as a result of the price incentive and improved service to the commercial waste customers.

3.7.7 Conclusions

The survey demonstrates how research can compare alternative incentives for the improvement in commercial waste management and maximise the resource recovery in small and medium enterprises; an area of municipal solid waste that has potential for increase of recyclate recovery.

Collecting the data from this survey allows the research to examine the methods used and evaluate the improvements put into Best Environmental Practice by a high performing partner in a joint waste authority area in the light of DEFRA guidance and the WIP Programme.

3.8 Case Study 6 - The London Borough of Harrow

Monitoring and Awareness Campaign 2006

3.8.1 Introduction

Harrow is an Outer London Borough in West London. It has a population of 214,411 (ONS 2007) occupying 85,000 households. The Borough is a partner in the West London Waste Authority (WLWA) and is responsible for the collection of municipal solid waste arising within the Borough area. The WLWA has responsibility for the treatment and disposal of municipal solid waste (MSW) from the Authorities within the partnership. The West London Waste Authority sends residual waste to landfill sites in Bedford by road and rail transport and to Appleford in Oxfordshire by rail transport.

3.8.2 Background

Waste management statistics for the London Borough of Harrow – 2004/5 to 2007/08 are found in table 3.50.

Table 3.50: Harrow waste management statistics – 2004/05 to 2007/08

	2004/05	2005/06	2006/07	2007/08
Population	207,811	214,000	214,411	214,411
Household waste arising	88,575 t	89,524 t	85.365 t	84,989 t
Household waste per head of Population	420kg	424kg	399kg	396kg
Cost per household for MSW collection	£70.56	£78.72	£89.84	£75.39
Percentage recycled per household – dry waste	12.7%	14.7%	22.87%	27.70%
Percentage collected per household green/kitchen waste	6.1%	12%	13.1%	18.0%
Total municipal solid waste	125,602 t	119,101 t	120,866 t	114,084 t
Total material recycled/composted	20,210 t	36,068 t	36,674 t	39.668 t
Total sent to WLWA	105,881t	91,859 t	92,601 t	74,679 t
Total percentage recovered	18.8%	26.7%	27.7%	34.54%

A project *Persuasion through change in collection systems* was carried out in 2005 to examine the options for future development of the collection, treatment and disposal of the municipal solid waste.

3.8.3 Methodology (see 2.3 sections 1, 2 and 5)

In 2006 between July and September, a progress-monitoring door stepping campaign was carried out to raise awareness and to introduce alterations to the recycling service (Table 3.51 options).

Following recommendations from the project report a number of changes were made: The result of these changes can be seen in the statistics for Harrow shown in table 3.50.

3.8.4 Monitoring and awareness campaign 2006

The project and recommendations were followed up with a monitoring and awareness campaign from June to September 2006. Rounds were reorganised from 9 vehicles to 12 vehicles and frequency of collections improved. In the 3 months of the doorstepping campaign there was a 550% increase in the demand for green boxes there was a 300% increase in plastic bottle recycling tonnage collected. The recycling figure of 18.8% in 2004/05 rose to 27.7% for the year 2006/07and has reached 34.54% for 2007/08.

3.8.4.1 Aims and objectives of the project (see 2.2 and 2.3 sections 1, 2 and 5).

- To find the best practical environmental option (BPEO) to ensure compliance with the Government waste strategy (WS 2007).
- To achieve and exceed the mandatory target for the reuse of municipal solid waste (MSW) as a resource.
- To produce a cost effective, reliable and efficient waste management service that will achieve or surpass the targets for waste collection, treatment and disposal set for 2020.

3.8.5 Results of a Kitchen Waste questionnaire

A questionnaire to ascertain the feasibility of a separate collection of kitchen waste was commenced; the results are in tables 3.54 to 3.57. The options to be evaluated for weekly or alternate weekly collection of dry recyclables and the alternative storage containers that may be necessary to accomplish the final decision are shown Table 3.51.

Table 3.51: Future development options for the collection of recyclable waste

Options	Description	Collection Frequency	MRF	Lead-in Time	Vehicles	Tonnage	Revenue	Capital
1	Green box	Alt. Week	No	N/a	6K/side	6600	N/a	N/a
2	GB+G bag	Alt. Week	No	3	9K/side	11000	540k	80k
3	GB+ 2n box	Alt. Week	No	3	9K/side	11000	540k	240k
	GB + G bag	Weekly	No	3	12K/side	18000	1080k	80k
	GB + 2n box	Weekly	No	3	12K/side	18000	1080k	240
	Wheel bin + GB for Glass	Weekly	Yes	24	12 Hybrid Compaction	25000	990k	1200k

Nb. 2n = recycling boxes with removable partition

It was decided what the basic service to optimise recycling and minimise residual waste with a flexible free service would be. This included a brown bin for garden and kitchen waste and cardboard; a green box for dry recyclables and a green wheeled bin for residual waste. The recommended annual charges for additional bin/collection and services, levied to discourage residual waste and improve recycling are shown in Table 3.52.

Table 3.52: Waste minimisation and customer service – Optional extras

	Charge	Frequency	Comments
Additional brown bin	£25 one-off	Alt. Week	Current policy
Additional waste (green wheeled) bin	£75 one-off	Weekly	Current policy
Clinical waste bin	Free	Weekly	As requested by Patient's clinic or hospital

The feasibility study results from two rounds in the trial are shown in Table 3.53.

Table 3.53: Kitchen waste trial – Results of customer survey

Question	Category	Round 1	Round 2	Comments
Total Number of responses (%)		3016 (27.4%)	2205 (20.0%)	
How well are you coping with the trial?	Very well Well Neither Quite badly Very badly	36 34 121 9 9	51 35 9 3 3	Both rounds show positive rating. Round 2 is significantly better than round 1
How well are you coping with the fortnightly green bin?	Very well Well Neither Quite badly Very badly	24 24 10 17 24	N/a	A significant proportion of the respondents found the fortnightly collection difficult to cope with
Have you experienced any problems with excess waste?	Yes No Don't know	49 48 2	N/A	Half the respondents reported difficulty with excess waste
What would be your preferred frequency of collection?	BB Weekly BB fortnightly	46 54	30 70	There is a small majority in Round 1 and in round 2 there is a clear majority in favour of the unchanged

				frequency
Are you recycling more?	Yes No Don't Know	77 17 5	87 8 5	Both sets reported increased recycling
If so, how?	Use GB More materials Banks	17 79 4	15 81 3	No difference between response rates
Should we restrict each house to one wheeled bin for waste?	Yes No Don't Know	43 38 19	57 24 19	There is a clear difference between the 2 sets, which reflects the frequency of collection of green wheeled bin. However both sets showed a majority for the restriction
Should we charge for nappies	Yes No Don't Know	30 44 26	35 38 27	The reduced frequency of collection in round 1 has clearly had an effect on the result. The result from round 2 probably represents the general public's view
Did the kitchen caddy help?	Yes No Don't Know	57 39 4	59 36 5	For a significant minority in both rounds the kitchen caddy was not helpful
Should the scheme be introduced across the borough?	Yes No Don't Know	75 14 11	85 6 9	There is a clear majority from both rounds that the scheme should be introduced across the borough

The following tables show random samples of 100 responses from each round used in the survey and trials. The general thrust of the comments would appear to be broadly representative of all the comments made by participants in the trial. The degree of satisfaction is shown in Table 3.54.

Table 3.54: Which aspects of the trial did you consider most satisfactory?

Round 1		Round 2	
Able to recycle cardboard	10	Introduction of the brown bin	20
Introduction of 2 bins/ brown bin	9	Kitchen caddy	10
Able to recycle kitchen waste	8	Able to recycle cardboard	8
Recycling garden waste	7	Able to recycle kitchen waste	5
Encouraged to recycle more	7	Recycling garden waste	3
Kitchen caddy	3	Convenience	3
Collection weekly	2	Encourage to recycle more	2
Doing more for the environment	2	Doing something for the environment	2
Regular/prompt collections	2	Green box	2
The green box	2		
The information provided	2		

Responses from a random sample of 100 participants in the kitchen waste trials showing the degree of dissatisfaction is shown in Table 3.55.

Table 3.55: Which aspects of the trial did you consider most unsatisfactory?

Round 1		Round 2	
Fortnightly collection of green bin	23	Kitchen caddy	13
Wrapping kitchen waste in newspaper	6	Fortnightly collection of brown bin	6
Confusion in what goes where	4	No caddy	4
Christmas	4	Poor communications/information	4
Lack of in formation	4	Kitchen waste	3
No bag for kitchen waste	4	Cleaning brown bin	2
Didn't get kitchen caddy	4	Confusion on what goes into what bin	2
Overflowing green bins	3	Infrequent collection	2
Too much work/inconvenience	3	Green box heavy	2
Hot weather smells	3	No bin liners	2
Green box too small	3	Wrapping kitchen waste in newspaper	2
Confusion over collection dates	2	Too many bins (unsightly)	2
Unhygienic	2	Unreliable collection	2

An analysis of the results from the kitchen waste trial indicate that if the kitchen waste collection was rolled out across the whole of the borough, a recycling recovery rate of 27.54% could be achieved. A summary of the result is shown in Table 3.56

Table 3.56: Kitchen waste trial – Summary of results

		Round 1	Round 2	Round 3
Number of households		11,000	11,00	11.000
Materials collected		Garden, kitchen cardboard	Garden, kitchen cardboard	Garden
Brown bin frequency		Weekly	Fortnightly	Fortnightly
Green wheeled bin frequency		Fortnightly	Weekly	Weekly
Total weight collected (% in brown bin)	October	758 (30%)	711 (20%)	689 (17%)
	November	596 (40%)	792 (20%)	762 (17%)
	December	475 (31%)	586 (14%)	577 (12%)
	January	582 (28%)	707 (11%)	695 (8%)
Kg of organic waste/household/week		4.13	2.47	1.99
Excess over garden waste		2.14	0.48	0
Tonnes/10,000 households/year		113	234	0
Tonnage across 73,000 households		8100	1700	0
Percentage increase in recycling rate		8%	2%	0
Tot predicted recycling rate across borough when fully implemented		32%	26%	24%

Participants were asked to suggest any changes they think would improve the recyclate collection system that might be incorporated into a new scheme. The majority of suggestions were for increases in recyclate material accepted and increased collections. The suggestions are shown in Table 3.57.

Table 3.57: Responses to suggested changes

Round 1		Round 2	
Collect plastics	20	Collect plastics	23
Manufacturer's/retailers packaging	11	Better information/education	6
Collect green bin weekly	9	Weekly collection of both bins	5
Seasonal difference in brown bin	5	Weekly green box	4
Regular/better communication/information	5	Provide/approve bin liners	4
Collect milk/juice cartons	4	Provide lids for green boxes	4
Provide/approve bin liners	4	Council Tax rebate for recycling	3
Lids for green boxes	3	Get shops to stop giving carrier bags	3

The questionnaire asked the respondent for suggestions or any other comment, these mainly were complaints about the service Table 3.58.

Table 3.58: Any other comments?

Round 1		Round 2	
More rubbish dumped/strewn in the road	3	Returning of bins to property	4
Excess bags encourage rats/foxes	3	Bad customer service	3
Green box heavy	3	Good customer service	2
Excess not collected	2	Mess left after collection	2
		Others contaminating brown bin	2

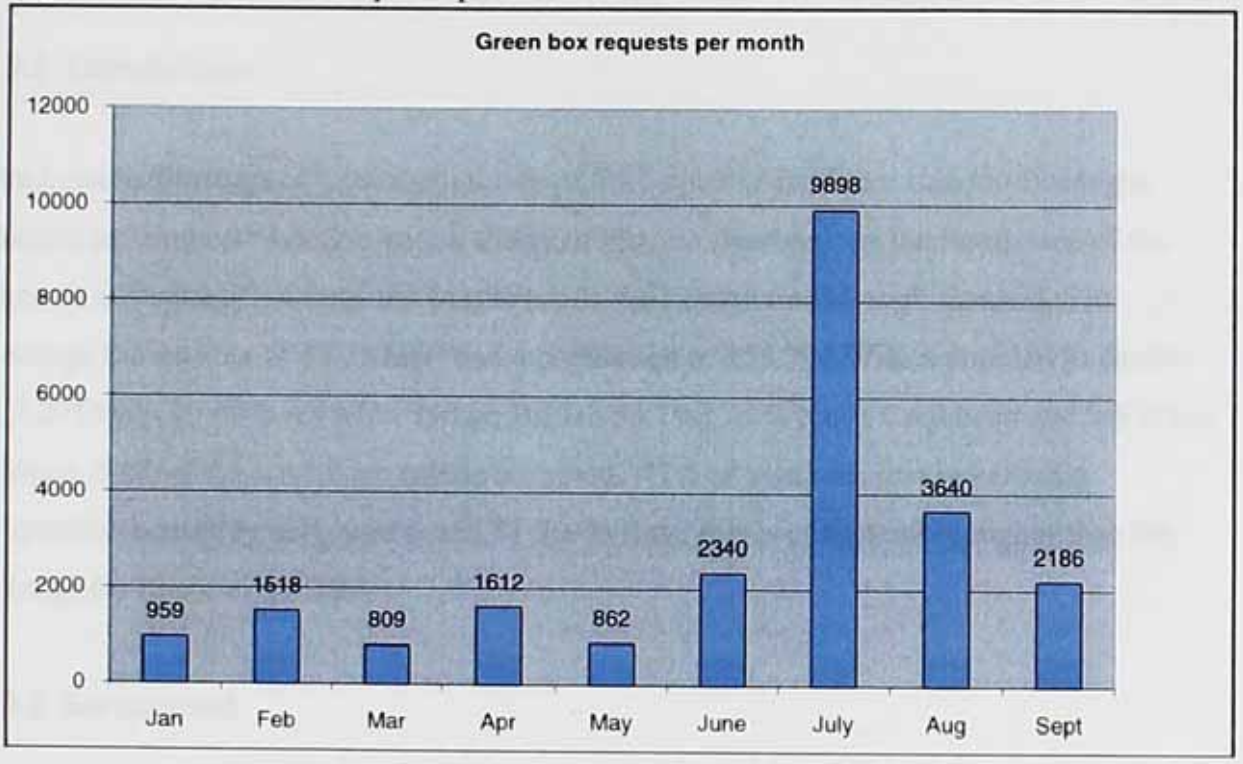
3.8.6 Conclusions and Recommendations

The addition of kitchen waste and card to the fortnightly collection of the brown bin has led to an increase in the tonnage of organic waste collected for composting and the service should be rolled out borough-wide. If the results were replicated there would be a

diversion of an additional 1700 tonnes per annum from landfill. This represents an immediate saving of £80,000 p/a in section 52(9) payments to the WLWA and a potential saving in LATS liabilities.

Flats are 20% of the residential housing in the borough; every opportunity should be taken to bring all of the flats into the recycling scheme. Additional green boxes issued as a result of the campaign is shown in Figure 3.15.

Figure 3.15: Green box requests per month



Monitoring and awareness campaign June to September 2006

Three campaigns in the last four years have proven to be an outstanding success. The household recycling rate has increased by 125% and the municipal solid waste (MSW) recycling rate by 90% in the four years. The collection of kitchen waste increased by 300% through rolling out the brown bin system.

The cost per household reduced by 16% as a result of the 2006/07 and 2007/08 activities.

In the same four-year period the residual tonnage of waste sent to landfill reduced from 105,881 tonnes in 2004/05 to 74,679 tonnes in 2007/08 thus minimising the risk of a LATS penalty.

This case study illustrates the benefit and advantage obtained from continuous review, evaluation and improvement to the practice (Denscombe 1998). This study will enable the research to critically evaluate data from high, medium and low performing waste collection authorities (WCA).

3.9 Case study 7 - The London Borough of Lewisham

London Borough of Lewisham Garden waste collection pilot 2007

3.9.1 Introduction

The London Borough of Lewisham is one of the largest of the Inner London Boroughs situated in Southeast London with a short but historic riverbank on the South side of the Thames at Deptford. An elected Mayor heads the Lewisham Borough Council. The Borough has an area of 35.35 km ^{2} and a population of 255,700 With a population density of 7,2755 p/p/k^2; 66% are white (white British 55.7%), 12% black Caribbean and 9% black African. 50% of the homes are owner occupied. 47% of residents live in kerbside properties (houses or bungalows) and 51.9% in flats; this is considerably higher than the average for England (19.3%).

3.9.2 Background

Lewisham is a Unitary Authority (UA) and is responsible for the collection, treatment and disposal of municipal solid waste arising in its area. The major disposal method for residual waste is Energy from Waste (EfW) through the South East London Combined Heat and Power Plant (SELCHP) situated in Deptford in the North of the Borough. Lewisham has been one of the lower performers in attaining the mandatory recycling target, 15.75% against a target of 18% for 2006/07. That target increased to 21.99% in 2007/08 (WS2007). In an endeavour to increase the recycling collection rate, a pilot garden/green waste project was launched to run between July and October 2007. The pilot scheme was conducted and the results evaluated by London Remade Solutions (Table 3.59).

Information on waste management statistics for the London Borough of Lewisham from 2006/07 is shown in table 3.59.

Table 3.59: Lewisham waste management statistics 2006/07

Household waste collected	102,886 tonnes
Household waste per head	396kg
Tonnage recycled	14,714 tonnes
Household residual waste	98.097 tonnes
Residual waste to landfill	17,886 tonnes
Biodegradable waste to landfill	12,517 tonnes
Biodegradable allowance to landfill	21,776 tonnes
Total municipal solid waste	120,772 tonnes
Percentage recycled	15.96%

3.9.3 Aims (2.2 and 2.3 sections 2and 5)

- To evaluate the tonnage arising and the effective increase in the recycling rate if the scheme is operated Borough-wide.
- To find the Best Possible Environmental Option (BPEO) for the collection, treatment and disposal for garden/green waste as required by the Waste Strategy.

3.9.4 Objectives of the pilot study

- To improve the recycling rate from 15.75%.
- To provide Lewisham with recommendations for improvements.

3.9.5 Results

Timetable for the pilot, July to October 2007 is shown in table 3.60.

Table 3.60: Timetable monitoring periods

Monitoring period	Dates	Services
Pre pilot	11,18,25,July 2007	Dry recycling
During pilot	17,24,31,October 2007	Dry recycling & Garden waste

The number of households monitored on three consecutive collection days for each of the three participation rate surveys is shown in Table 3.61

Table 3.61: Number of households monitored on three consecutive collection days.

Monitoring period	Service	Number of households monitored
Pre pilot	Recycling	895
During pilot	Recycling	931
During pilot	Garden waste collection	775

The participation rates for the performance of the dry recycling scheme pre and during the pilot did not alter. This suggests that the introduction of the garden waste collection service did not encourage more residents to participate in the dry recycling service or that those who participated in the garden waste service were already participating in the dry recycling service (Table 3.62).

Table 3.62: The observed set out rates and participation rates for the recycling and garden waste collection service.

	Set out rates percentage			Participation rate %
	Week one	Week two	Week three	
Recycling: pre pilot	48	52	48	61
Recycling: during pilot	51	43	45	62
Garden waste pilot	48	30	23	52

Information on the number of households served by the recycling rounds covering the pilot area is shown in Table 3.63.

Table 3.63: Households served by the recycling rounds in the pilot area.

Collection day	Recycling collection round ID	Total number of households served	Number of households also on the garden waste collection pilot	% of total number of households on recycling round that were also on the pilot
Monday	R20	2126	608	28.6%
	R25	2170	430	19.8%
Tuesday	R22	2759	413	15.0%
	R23	2514	599	23.8%
Wednesday	R21	2813	1009	35.9%
	R25	2598	199	0.7%
Thursday	R22	2379	171	7.2%
	R23	2822	1168	41.4%
Friday	R23	1420	320	22.5%

The values for average total waste arising were calculated based on the weekly averages and values were rounded up after calculation hence the discrepancy between the figures

given for the total waste arising and the sum of the kg/hh/week collected through the separate services Table 3.64

Table 3.64: Average total waste arising.

	kg/hh/week/pre pilot	kg/hh/week during pilot	Average change in kg/hh/year during pilot compared to average pre pilot kg/hh/year
Refuse	13.8	13.o	-5.8%
Recycling	2.5	2.6	4%
Garden waste	N/A	3.0	N/A
Total waste arising	16.2	18.5	+12.4%

The recycling and composting rate experienced in the pilot area during the pilot is shown in Table 3.65. The total waste arising during the pilot project were 1,666 tonnes (Table 3.65).

Table 3.65: Pilot area recycling and composting rates.

	Refuse	Recycling (BVPI 82a)	Garden waste (BVPI 82B)	Garden waste and recycling (BVPI 82a & 82b)
% of waste before pilot	96	14	Not collected	14
% of total waste during pilot	74	13	13	26
Tonnage collected during pilot	1233.6	217.6	215.0	432.6

A breakdown of the extrapolated tonnage that could be collected by all the services is shown in Table 3.66. It is very unlikely that a garden waste collection service would consistently collect this level of tonnage throughout the year as the material arising during the growing season distorts the total tonnage arising (see table 3.66).

Table 3.66: Extrapolated tonnage collected during a four-month (July to October) borough-wide garden waste collection service.

	Refuse tonnes	Garden waste tonnes	Recycling tonnes	Total waste arising
Extrapolated figures	16,814	3,261	3,360	23,434

The second scenario assumes that the amount of garden waste collected during the months outside the growing season is half that collected during the growing season.

In order to provide some indication of the possible tonnage that could be collected the second model is of:

a) A weekly garden waste service operating in the six months of the growing season and

b) A weekly garden service operating for six months during the growing season with a fortnightly collection during the other six months (Table 3.67).

Table 3.67: Lewisham borough wide 12-month collection systems.

Garden waste service type	Refuse tonnage	Garden waste tonnage	Recycling tonnes	Total waste arising	BVPI 82a & 82b	Garden kg/hh/year
Weekly collection during growing season	50,441	4,891	10,079	65,411	23%	64.3
Weekly collection during growing season and a fortnightly collection during the rest of the year	50,441	7,337	10,079	67,875	26%	96.5

The modelling was carried out assuming that all households on the kerbside recycling collection rounds would be provided with the garden waste collection service. The refuse and recycling figures have been projected using the tonnage collected during the pilot, model 1 (Table 3.68).

Table 3.68: Results of modelling the two different methods of providing the garden waste collection service on the annual tonnage.

Garden waste service type	Refuse tonnes	Garden waste tonnes	Recycling tonnes	Total waste arising	BVPI 82a & 82b	Garden kg/hh/year
Weekly collection during growing season	49,089	4,760	9,809	63,658	23%	64.3
Weekly collection during growing season & a fortnightly collection during the rest of the year	49,089	7,140	9,809	66,038	26%	96.5

This pilot exercise has highlighted critical areas in the current methods for the collection, treatment and disposal of municipal solid waste arising in the London Borough of Lewisham. The Council is considering options through an appraisal of the Council's current waste strategy. The options include a borough-wide garden and kitchen waste collection service and consideration of utilising anaerobic digestion.

3.10 Case Study 8 - East London Waste Authority

East London Waste Authority Compliance with Waste Strategy 2007

3.10.1 Introduction

The East London Waste Authority (ELWA) is the organisation responsible for the disposal of waste collected by the London Boroughs of Barking and Dagenham, Havering, Newham and Redbridge. The ELWA acts on behalf of 888,400 (ONS) residents dwelling in 364,668 households covering an area of 242.9 km² of East London are currently based on 420,000 tonnes of waste each year. Between 2000 and 2004 the population in the four Boroughs increased from 855,068 residents, an increase of 3.86%. The East London Waste Authority is a partnership of the four East London Boroughs of Barking and Dagenham, Havering, Newham and Redbridge. It is one of three statutory Joint Waste Disposal Authorities in London and is responsible for the disposal of 535,000 tonnes of municipal solid waste (MSW) per annum.

The regeneration of the area and the construction of the 2012 Olympic site have compounded this expansion. Disposal arrangements are becoming increasingly difficult and a new approach is needed to take the authority into the next target areas of waste management control. Twenty-first century solutions are necessary to manage the area's waste and resources.

This research was carried out by one-to-one discussion with John Wilson, General Manager of the East London Waste Authority, June 2008.

3.10.2 Methodology (see 2.2 and 2.3 sections 1,3,4,5 and 6)

The questions put to John Wilson to complete the research on what the East London Waste Authority had accomplished in complying with Waste Strategy 2007 included:

1. What is the area waste management Plan?
2. What steps have been taken to minimise the amount of biodegradable waste sent to landfill?
3. What new facilities have been installed to accomplish the waste management plan?
4. What are the 2007/08 tonnage figures?
5. What percentage of this is from resource recovery (CA) sites?

6. What tonnage was disposed at landfill sites?
7. What tonnage was biodegradable?
8. What tonnage was recovered?
9. Individual Borough tonnage?
10. Has there been any change in the tonnage for disposal compared with the previous year?
11. If yes, have you a reason for this?

In your opinion, will East London Waste Authority (ELWA) incur a financial penalty for exceeding the Landfill allowance of biodegradable MSW to landfill, a) in the near future, b) up to 2020?

3.10.3 Results

Q1 - What is the area waste management plan?

In accordance with the Waste Management Hierarchy the disposal of untreated waste in landfill sites is considered to be the least environmentally acceptable option. Analysis of existing and expected landfill space within the South East of England has predicted a severe shortage. The increasing rises in landfill tax, together with a tightening of the law relating to the landfill of waste and the adoption of new waste management environmental policies to have resulted in ELWA considering the options for waste disposal.

It was considered that four options were available: landfill, material recycling, organic treatment and energy recovery by incineration. With a twenty-five year strategy in mind, the advantages and disadvantages of each option were critically examined.

The decision made was to adhere as closely to the waste hierarchy as possible and the first action was to work with the constituent authorities to minimise the waste going to landfill.

In December 2002, the East London Waste Authority signed a 25 year Integrated Waste Management Services Contract with Shanks Waste Services Limited to provide waste disposal operations through a Joint Venture Company (JVC).

The JVC, 'ELWA Ltd.' is operating under the name of Shanks East London and took over the operation of the ELWA refuse transfer station (RTS) at Jenkins Lane, Newham and the four re-use and recycling centres (RRC) on behalf of the constituent boroughs.

Q2 - What steps have been taken to minimise the tonnage of biodegradable waste to landfill?

The first part of the contract was to upgrade the re-use and recycling centres which are Designated Collection Facilities (DCF) under the Waste Electrical and Electronic Equipment (WEEE) Regulations 2007. The Resource Recycling Centre in Ilford has a material recovery facility (MRF) processing the black-box recyclate from Redbridge.

Q3 - What new facilities have been installed to accomplish the waste management plan?

Two Mechanical Biological Treatment (MBT) facilities have been constructed under the contract. The first is at Frog Island, Rainham, Essex and the second at Jenkins Lane, Newham. Both facilities use the Ecodeco© system and the Biocubi® processes which are being promoted as the Intelligent Transfer Station (ITS®). They each process 180,000 tonnes of mixed waste per year utilising the heat produced by biodegradation to dry and 'stabilise' the waste prior to further recycling and recovery. The system outputs, which indicate 100% resource recovery with nil residue to landfill, are shown in Table 3.69.

Table 3.69:Percentage of recovered material

Solid Recovered Fuel (fluff) (SRF)[1]	50%
Water and Carbon Dioxide	25%
Ferrous metal	3%
Glass and Stone	11%
Fines and Compostable	10.5%
Non-Ferrous metal	0.05%
Total	100

Q4 - What are the 2007/08 tonnage figures?

The waste tonnage disposed under the contract for 2006-07 and 2007-08 is shown in Table 3.70 together with the contract charges payable.

Table 3.70: The monthly tonnage of waste disposed under the contract and the monthly amount paid.

	ABSDP		Actual Tonnage		RRC Tonnage		2006/7	2007/8	
	2006/7	2007/8	2006/7	2007/8	2006/7	2007/8	Actual	ABSDP	Actual
April	45511	41984	40573	42736	8178	9895	£2,658	£2,865	£2,885
May	43378	47106	45523	43237	8484	8205	£2,869	£3,124	£3,019
June	47851	49818	48144	43209	9533	8517	£2,954	£3,198	£2,956
July	42148	42726	41277	44372	6913	8572	£2,695	£3,759	£3,730
August	42771	43578	42113	45446	6963	10103	£2,732	£3,797	£3,796
September	45056	44385	42869	42778	7617	8807	£2,758	£3,774	£3,688
October	40311	40948	41114	43339	6113	7719	£2,705	£3,680	£3,768
November	40915	41738	40719	41001	5533	6866	£2,667	£3,656	£3,614
December	38838	38351	35895	36227	4418	5359	£2,471	£3,564	£3,396
January	38244	39116	40802	42975	4772	7255	£2,722	£3,599	£3,730
February	35448	35823	35087	37746	5064	6461	£2,444	£3,274	£3,459
March	40960	40872	41999	36957	7472	5570	£2,726	£3,677	£3,416
Total	501431	506445	496115	498101	81061	91508	£32,401	£41,965	£41,457

Source: Wilson, ELWA July 2008

Q5 - What percentage of this is from resource recovery (CA) sites?

Q8 - What tonnage was recovered?

The answers to questions 5 and 8 are shown in Table 3.71.

Table 3.71: Statistics for East London Waste Authority (ELWA) 2007-08

Household waste collected	407,493 tonnes
Household waste recycled	54,848 tonnes
Percentage household waste recycled	13.46%
Waste from resource/recycling centre	90,651 tonnes
Percentage waste from RRC recycled	18.4%
Total municipal solid waste	498,101 tonnes
Total municipal solid waste to landfill	212,178 tonnes
Biodegradable waste to landfill	149,178 tonnes
Combined percentage recycling rate	18.37%

Source: Wilson, ELWA 2008

Q6 - What tonnage went to landfill?

Q7 - What tonnage was biodegradable?

The answers to questions 6 and 7 are shown in Table 3.72.

Table 3.72: Contract waste and tonnage, the tonnage of the biological element sent to landfill and the LATS target monthly totals from April 2007 to March 2008 (Performance against LAT'S target 2007/08)

Month	Contract Waste		Landfill		LATS Target	
	tonnes	Biodegradable tonnes	tonnes	Biodegradable tonnes	tonnes	Difference tonnes
April	42,736	30,086	25,975	18,286	22,097	3,811
May	43,237	30,439	24,815	17,470	22,097	4,627
June	43,209	30,419	25,952	18,270	22,097	3,827
July	44,372	31,238	24,047	16,929	22,097	5,168
August	45,446	31,994	23,293	16,398	22,097	5,699
September	42,778	30,116	21,065	14,830	22,097	7,267
October	43,339	30,511	23,447	16,507	22,097	5,590
November	41,001	28,865	23,664	16,659	22,097	5,438
December	36,227	25,504	19,931	14,031	22,097	8,066
January	42,975	30,254	25,092	17,665	22,097	4,432
February	37,746	26,573	21,038	14,811	22,097	7,286
March	36,957	26,018	17,351	12,215	22,097	9,882
Cumulative Total	498,101	350,663	275,669	194,071	265,164	71,093

Source Wilson, ELWA July 2008

Q9 - Individual Borough tonnage

Statistics for the constituent boroughs are shown in Table 3.73. Column 5 shows the household recycling and composting rates for the period July to September 2007.

Table 3.73: Constituent borough statistics 2006-07

Authority	Population 2005 (ONS)	Residual Household waste tonnes	Residual h/h waste kg per head	Dry recycling %
Barking and Dagenham	164,500	68,131	414	21.50
Havering	226,200	93,228	412	24.04
Newham	246,200	95,440	388	13.58
Redbridge	251,500	85,171	339	22.25
Total	888,400	341,970		

Source: (Capitalwastefacts, 2007) (ONS 2005)

Q10 & Q11 - Has there been any change in the tonnage for disposal compared with the previous year? – If 'Yes', have you a reason for this?

There has been a very small increase over the last twelve months, about 10,000 tonnes (0.05%). Improved efficiency and commercial waste acceptance at the regenerated recycling and resource recovery centres (RRC) may account for this.

Q.12 - In your opinion will the East London Waste Authority incur a financial penalty for exceeding the landfill allowance for biodegradable MSW to landfill, (a) in the near future (b) up to 2020?

For the year 2007 there are 40,000 Landfill Allowance Trading Scheme points available from the ELWA allowance. There is improvement and efficiency from the new facilities and regenerated resource recycling centres coupled with the new and improved material resource plants. Good prospects of expanding markets for the energy faction from the MBT plants augurs well for nil to landfill in the not too distant future. A 35,000 tonnes per year plastics recycling plant (London Loop Ltd) and a new 50,000 tonnes per year, material resource recovery facility (Bywaters Ltd) became operational in the area in 2008.

3.10.4 Conclusion

This section shows the action and plan for the treatment and disposal of municipal solid waste arising in the East London Waste Authority area fulfilling the requirements of the EU Directive and UK Waste Strategy 2007.

3.11 Case Study 9 - City of London Corporation

City of London. Analysis of commercial waste arriving at Walbrook Wharf Transfer Station

3.11.1 Introduction

The City of London (CoL) is a geographically small city within Greater London. It is almost exactly one square mile and is known as The City or The Square Mile. The City is a major business and financial centre ranking on a par with New York City as a leading centre of global finance, contributing 2.5% of the United Kingdom's gross national product (GNP). Employing 340,000 professional workers who commute on a daily basis, it is known as the richest square mile in the world. Situated on the North Bank of the River

Thames, in AD 50 it was a Roman- built walled fortification and is steeped in history. The City of London Corporation governs the City. It has 25 wards each electing an Alderman. The Aldermen elect a Mayor (The Lord Mayor of London) from among their number at an annual ceremony.

3.11.2 Background

The City is a Unitary Authority with a resident population of 7,800 residents (ONS 2006). It is unique in its composition with a low ratio of residential property in relation to commercial property. Study of an analysis of the commercial waste arriving at Walbrook Wharf Transfer Station (WWTS) would enable future planning to introduce methods to increase the amount of resource material recovered. The transfer station and Environmental Services management offices occupy a riparian site on the north bank of the River Thames in Lower Thames Street, adjacent to Southwark Bridge. Residual waste is compacted into International Standard Organisation (ISO) 8' x 8' x 20' containers and transported by barge (30 containers per barge) down river to Rainham landfill Site in Essex.

The City of London waste management statistics are shown in Table 3.74.

Table 3.74: City of London waste management statistics 2006/07

Household waste collected 2006/07	4,928 tonnes
Residual household waste	3,767 tonnes
Household waste per head	409kg
Percentage dry recycled	28.15
Percentage composted	0.09%
Total recycled	28.19%
Other municipal solid waste (inc. commercial)	37,282 tonnes
Total municipal solid waste	42,210 tonnes

Source: (Capital Waste Facts 2007) (Environment Agency (LATS report) 2007) (DEFRA 2007) City of London *Analysis of Commercial Waste Arriving at Walbrook Wharf Transfer Station*

Recycling and recovery targets for household and municipal waste, England have been increased in Waste Strategy 2007 with a baseline of 2005 and targets for 2010, 2015 and 2020 shown in Table 3.75.

Table 3.75: The recycling and recovery targets for household and municipal waste, England.

	2005	2010	2015	2020
Household waste after re-use, recycling & composting (million tonnes)	18.6 mt	15.8 mt	14.3 mt	12.2 mt
(Percentage reduction from 22.2mt in 2000)	(16%)	(29%)	(35%0	(45%)
equivalent per person figures	370 kg	310 kg	279 kg	225 kg
(Percentage reduction from 450kg per head in 20000	(18%)	(32%)	(40%)	(50%)
Household re-use and recycling	27%	40%	45%	50%
Municipal waste recovery	38%	53%	67%	75%

Source: Waste Strategy 2007, DEFRA Guidance 2008

There is no resource recycling facility in the City but residents may use the resource recovery site in the London borough of Tower Hamlets free of charge. Bring sites are placed at stations and main termini for commuters to dispose of discarded newspapers and magazines. Bulky waste is collected free of charge. Street litter is sorted for recycling, 30% of the litter collected in 2007 was recovered (C of L).

Over 450 commercial premises receive a waste collection service from the Corporation. A variety of containers are use for storage, they include plastic sacks, 240 l, 360 l, 66o l and 1100 l Eurobins. Collection is daily or weekly as required. The City of London's statutory recycling target for 2008 was 20%; the actual rate achieved in 2007/08 is 32.29%. To attain the revised targets the City must increase the tonnage recyclable and recover materials from collected municipal solid waste (BVPI).

There is a nightly collection of black sacked residual household waste and co-mingled dry recyclate in clear plastic sacks from premises that have limited storage space or where a daytime collection creates traffic problems. Other household waste and dry recyclable material is collected twice weekly. The dry co-mingled recyclables are collected in cage-bodied vehicles and delivered to the Material Resource Facility in Smugglers Way, Greenwich or Grosvenor Resource Recovery Facility in Erith, South East London.

The co-mingled materials collected include:

- Aerosols
- Cardboard
- Drink cartons
- Glass
- Cans
- Plastic bottles
- Yellow pages

Caddies with bin liners are supplied for kitchen waste, cut flowers and plant clippings. The liners are collected fortnightly and the material sent to an in-vessel Composting Plant.

3.11.3 Methodology

3.11.3.1 The aims and objectives of the City of London Study

To obtain physical and chemical analyses of waste arriving at Walbrook Wharf Transfer Station collected by the City of London.

To examine the information obtained to enable improvements to be made to the method of recovery of resource material from the waste.

To increase the resource recovery rate from the waste.

To minimise the biodegradable waste being disposed of to landfill.

3.11.4 Sampling the waste

The report on the sampling and analysis of commercial waste arriving at Walbrook Wharf commissioned by CoL was conducted by Waste Research Limited (WRL 2008). Sampling was carried out at Walbrook Wharf on Tuesday 18th and Wednesday the 19th of March 2008 over a 24 hour period. The waste types selected for sampling included 50 bin lifts, 60 skip lifts and 65 refuse vehicle collections (Table 3.76).

Table 3.76: Delivery weights and sample weights for the 24-hour sampling period

Product code description	50 bin lifts	60 Skips	65 Refuse vehicle	Totals
Deliveries number	9	35	16	60
Delivery split % of incoming vehicles shows the potential for increased recycling	15	58	27	100
Deliveries kg	27,950	32,980	45,620	106,550
Delivery split weight %	26	31	43	100
Deliveries sampled No.	3	11	6	20
Scoop samples No.	4	17	7	28
Sample kg estimate	400	1.700	700	2.800
	14	61	25	100

3.11.4.1 Headline waste material categories

During the 24 hour period, individual loads delivered into Walbrook were targeted for sampling. The aim was to collect a composite sample of approximately 3,000kg by collecting one or two scoops of material (approximately 100kg each) from 20 targeted loads that would be representative of the overall material delivered to the transfer station. The target loads were every third skip delivery (total 11), every 3rd refuse vehicle delivery (6) and every 3rd bin lift delivery (3). The number of deliveries and delivery weights for the material passing through the transfer station are given in table 2 alongside figures for the amount of sample collected. The nine divisions used to categories the waste for weighing and the material samples are shown in Table 3.77.

Table 3.77: Headline and waste material categories, with examples

Headline Categories	Ref No.	Sub Category	Material Example
	9	Paper cups	Vending machine cups
	10	Other card	Smooth card
	11	Card packaging	Food, consumer goods etc
	12	White envelopes	
	13	Brown envelopes	
	14	Shredded paper	Office paper security
	15	Coloured paper	Mixed paper coloured
	16	Composite paper	Books, directories, etc
	17	Other paper	Inc tissue paper
		Unclassified	Paper <40mm
Plastic Film (Pf) Dense Plastic (Dp)	18	Refuse sacks	Bin bags
	19	Plastic bags	Carrier bags, food bag etc
	20	Other plastic film	Cling film, wrappings
		Unclassified	Plastic film <40mm
	21	Polystyrene packaging	
	22	Opaque bottles	Washing up, toner bottles
	23	Beverage bottles	Beer, lemonade bottles
	24	Clear food packaging	Sandwich packs, etc
	25	Other dense plastic	
	26	Plastic cups	Vending machine cups
	27	Composite dense plastic	Photocopy/printer ribbon
Textiles	28	Natural/manmade fibres	Clothes

Miscellaneous Combustible (Mc)	29	Wood	Pallets, furniture
	30	Misc. combustibles	Composite items
	31	Miscellaneous items	Electrical goods
	32	Misc. non-combustibles	Ceramic, brick, concrete
Glass (Gl)	33	Green glass bottles	
	34	Clear glass bottles	
	35	Brown glass bottles	
	36	Other glass	Non-packaging glass
		Unclassified	Glass <40mm
Putrescible (Put)	37	Putrescibles	Food, plants animal beds
Metal, Ferrous (Fe)	38	Ferrous food cans	
	39	Ferrous drink cans	
	40	Other ferrous	Coat hangers office equip
		Unclassified	Ferrous metal < 40mm
Metal, Non-Ferrous	41	Non ferrous drink cans	
	42	Non ferrous foil	
	43	Other non ferrous	Door furniture ornaments
		Unclassified	Non-ferrous metal<40mm
Fines (-10mm)	44	Fines	All items<10mmdiameter

3.11.4.2 Waste composition analysis

The sampling and analysis methodology was based on the procedure used in previous waste analysis studies carried out in December 2000 (Three Star Waste Systems) and November 2004 (WRL), (Tables 3.78 and 3.79). It is noted that the analyses conducted in June 1991 (King's Environmental Services), September 1991 (Warren Spring Laboratory)

and March 2003 (WRL) followed different methodologies, so these results are not truly comparable.

3.11.5 Waste Composition analysis

The material categories used for the manual sort are shown in Tables 3.77 and 3.78 and are the same material categories used in previous City of London analyses of waste in 1991 to 2008 is shown as a percentage (Table 3.81).

The summary composition shows that the material predominately collected was paper, 53.70%. The next largest material categories were; putrescible, mainly kitchen waste, at 17.69% and dense plastic at 7.07% as shown in table 3.78. The material was first screened into 6 graduated size fractions (>160mm, <160mm>80mm, <80mm >40, <40mm > 20mm, <20mm >10mm, and <10mm). The grading was achieved using vibrating screens; the material being passed over screens with varying size apertures and then manually sorted into material categories. The three largest size fractions were first sorted into 11 material categories and then into a further 46 sub-categories (Table 3.78).

Table 3.78: Categories weight and size after screening

Category	>160mm	<160 >80mm	<80 >40mm	<40 >20mm	<20 >10mm	<10mm	Total wt. %
Paper & Card	37.54	8.32	6.25	1.44	0.15	0	53.70
Plastic Film	3.25	1.34	0.43	0.04	0.00	0	5.06
Dense Plastic	2.66	3.19	0.92	0.26	0.04	0	7.07
Textiles	1.12	0.44	0.00	0.00	0.00	0	1.56
Misc. Combustible	0.87	0.27	0.37	0.16	0.07	0	1.73
Misc. Non-Combustible	0.00	0.04	0.00	0.00	0.00	0	0.04
Glass	0.12	1.29	1.77	0,.42	0.24	0	4.46
Putrescible (Put)	0.14	3.22	8.65	4.19	1.49	0	17.69
Metal Ferrous	2.87	0.57	0.02	0.10	0.02	0	3.58
Metal Non-Ferrous	0.05	0.29	0.21	0.03	0.01	0	0.58
WEEE	0.00	0.16	0.00	0.00	0.00	0	0.16
Fines (<10mm)						4.35	4.35
							100.00
	48.60	19.76	18.61	6.64	2.03	4.35	100.00

A representative sample of the two smaller size fractions was taken using the cone and quarter method. The sub-sample was hand-sorted into 11 material categories and the weight of material for each category recorded. The smallest size fraction (<10mm) was mass-weight-recorded (Table 3.78).

Summary composition of 11 categories by weight and size of City of London collected waste 18th and 19th March 2008.

3.11.5.1 Size range of the material

The size range of the material shows that the majority of the sample (48.60%) was in the >160mm size range. More than three-quarters of this (77.23%) were paper and card with over 48% being corrugated card. 9.76% of the sample was in the size range <160 >80mm, this was predominately paper and card (42.11%) with putrescible at 16.31% and dense plastic making up 16.13% of this size category. 18.61% was in the size range <80 >40mm, predominately putrescible matter at 46.49%, paper and card at 33.59% and glass 9.49% The <40 >20mm size fraction accounted for 6.64% of the sample. This was largely putrescible, 63.12% with paper and card 21.69%. The <20 >10 size fraction was 2.03% of the sample and was predominately putrescible, 73.28%, and glass 11.85%. Fines (<10mm) made up the remaining 4.35% of the sample. Size range and categories (Tables 3.77, 3.78, 3.79, and 3.80).

Summary size category composition by weight of City of London collected waste 18th and 19th march 2008 (Table 3.79).

Table 3.79: Size in 6 categories and percentage by weight

Categor7	>160mm	<160 >80mm	<80 >40mm	<40 >20mm	<20 >10mm	<10mm	Weight %
Paper & Card	77.23	42.11	33.59	21.69	7.54	0	53.70
Plastic Film	6.68	6.78	2.29	0.65	0.22	0	5.06
Dense Plastic	5.47	16.12	4.96	3.90	2.16	0	7.07
Textiles	2.30	2.24	0.00	0.00	0.00	0	1.56
Misc. Combustion	1.79	1.35	1.98	2.39	3.23	0	1.73
Misc. Non-Combustion	0.00	0.21	0.00	0.00	0.11	0	0.04
Glass	0.24	9.73	9.49	6.29	11.85	0	4.46
Putrescible (Put)	0.28	16.31	46.49	63.12	73.28	0	17.69
Metal ferrous	5.91	2.87	0.09	1.52	1.08	0	3.58
Metal non-ferrous	0.09	0.81	0.00	0.00	0.00	0	0.58
WEEE	0.00	0.81	0.00	0.00	0.00	0	0.16
Fines (-10mm)						100.00	4.35
Column Total	100.00	100.00	100.00	100.00	1100.00	100.00	100.00
Percentages	48.60	19.76	18.61	6.64	2.03	4.35	100.00

Summary material size distribution by weight of City of London collected waste is shown as a percentage in Table 3.80.

Table 3.80: Categorised percentage weights of the size distribution

Category	>160mm	<160 >80mm	<80 >40mm	<40 >20mm	<20 >10mm	<10mm	Total %
Paper & Card	69.90	15.49	11.64	2.68	0.29	0	100.00
Plastic Film	64.19	26.47	8.40	0.85	0.09	0	100.00
Dense Plastic	37.549	45.07	13.06	3.67	0.62	0	100.00
Textiles	71.61	28.39	0.00	0.00	0.00	0	100.00
Misc. Combustible	50.27	15.41	21.35	9.16	3.80	0	100.00
Misc. Non-Combustible	0.0o	95.07	0.00	0.00	4.93	0	100.00
Glass	2.63	43.06	39.55	9.35	5.40	0	100.00
Putrescible (Put)	0.77	18.22	48.91	23.68	8.43	0	100.00
Metal, Ferrous	80.27	15.86	0.45	2.81	0.61	0	100.00
Metal, Non-ferrous	7.86	49.66	35.69	4.92	1.87	0	100.00
WEEE	0.00	100.00	0.00	0.00	0.00	0	100.00

3.11.6 Comparison with previous waste compositions

Comparisons were made with results from previous analyses of City of London collected waste conducted between 1991 and 2008; these are shown in table 3.80. The December 2000, November 2004 and March 2008 studies were carried out following the same methodology and the results are directly comparable (Table 3.81)

Table 3.81: Composition analyses from June 1991 to March 2008

Category Material	June 1991	September 1991	December 2000	October 2002	March 2003	November 2004	March 2008
Paper & Card	66.99	56.70	64.19	53.33	63.97	56.61	53.70
Plastic Film	3.34	2.60	5.10	3.86	5.87	4.54	506
Dense Plastic	8.27	2.60	6.85	3.93	5.50	5.36	7.07
Textiles	0.08	0.10	0.56	0.04	0.17	0,20	1.56
Misc. Combustible	0.00	1.00	1.95	1.39	2.37	1.53	1,73
Misc. Non-Combustible	0.32	5,70	0.34	0.25	0.03	0.31	0.04
Glass	12.89	19.40	8.99	3.12	10.62	12,87	4.46
Putrescible	5.37	4.30	6.42	8.15	7.23	11.36	17.69
Metal, Ferrous	0.96	1.00	1.71	0.73	1.08	3.96	3,58
Metal Non- Ferrous	n/d	0.50	0.85	0.30	0.59	0.47	0.58
Bulky residue	n/d	n/d	n/d	18.49	n/d	n/d	n/d
Fines	1.43	6.00	3.05	6.42	2.56	2.78	4.35
Total percentage	100	100	100	100	100	100	100

n/d = not defined

The 1991 study used different material sort categories to the other reports, for example ferrous and non-ferrous metals are reported as one figure. The September 1991 sample was analysed via a trommel screen at Warren Spring Laboratory. The October 2002 and the March 2003 audits were conducted using Shanks Material Recovery Facility (MRF) at Rainham which necessitated the removal of oversize items that may cause blockages or damage the machinery. The removal of bulky items has no effect on the overall observation from this data as the material was analysed and a detailed material assay was determined. The result is that a majority of the waste collected by the City of London between 1991 and 2008 was paper and card, averaging 59.36% of the waste collected.

3.11.6.1 Paper composition

Paper was the largest element of the waste stream with an average content of 59.36% for all seven audits. The average paper content for the comparable audits (2000, 2004 and 2008) is 58.17%. Differences in the types of paper and plastics are likely due to several evolving factors e.g. computerisation of businesses, letters replaced by Emails, plastic throw-away cups etc (Table 3.82).

Table 3.82: Comparison of the composition of recovered paper in the six surveys

	Septem ber 1991[1]	Decembe r 2000[2]	October 2002[3]	March 2003[a]	Novem ber 2004[o]	March 2008*
White Computer Paper	1.74	0.79	0.47	0.48	0.06	0.00
Green Computer Paper	1.54	0.02	0.04	0.17	0.01	0.00
High Grade Office Paper	20.87	23.15	25.79	26.84	18.44	27.49
Newspapers	9.76	9.75	13.85	11.70	12.83	10.95
Brochures	14.64	8.35	3.69	8.62	3.44	1.51
Magazines	2.35	5.76	9.96	4.97	6.53	10,51
Corrugated Cardboard	18.20	18.09	16.63	16.46	20.71	16.65
Liquid Containers	1.08	0.65	0.50	0.33	0.45	0.61
Paper Cups	0.04	0.87	1.27	1.37	2.91	2.68
Other Card	0.05	1.22	1.39	1.34	1.49	1.51
Card Packaging	3.29	4.88	2.14	1.36	4.26	3.58
White Envelopes	3.52	1.42	1.72	2.76	1.94	1.16
Brown Envelopes	2.71	0.75	0.87	0.81	0.83	0.26
Shredded Paper	0.50	1.36	0.08	0.63	1.97	0.00
Coloured Paper	2.41	0.70	1.27	2.10	1.70	0.52
Composite Paper	5.95	10.75	3.54	2.67	1.92	0.45
Other Paper	11.35	11.50	16.77	17.38	21.50	22.11

1 = Analysis of waste arising from the cities of London and Westminster, Warren Spring Laboratory, September 1991. pp 9.2 = Sampling and analysis of waste arising from the City of London, Three Star Waste Treatment systems. March 2001, pp 11. 3 = Analysis of waste arising from the Corporation of London, Waste Research Limited, December 2002, pp 9. a = Analysis of waste arising from the Corporation of London, Waste Research Limited, March 2003, pp 9. O = Analysis of waste arising from the Corporation of London, Waste Research Limited, November 2004, pp 7. = Determined by this study.

3.11.7 Comparison with other waste streams.

The compositional analysis of City of London collected waste is shown alongside other recent waste analyses data in table 3.83. Compared to commercial and industrial waste (C&I) collected in Wales, the waste collected by City of London has 66.4% more paper, 90.7% less miscellaneous combustible material, 23.2% more glass and 17.2% more putrescible material. Compared to waste collected from households in London, waste collected by the City has 63.4% more paper, 33.9% fewer textiles, 82.1% less miscellaneous combustible material, 62.3% less glass and 38.8% less putrescible. Table 3.83 shows City of London collected waste with comparisons of collected commercial waste and collected household waste in London and Wales.

Table 3.83: Compositions of collected commercial waste and collected household waste in London and Wales

	City of London collected waste March 2008[1]	EA Wales (C&I) waste Jan – March 2007[2]	London household waste November 2003[3]	Wales household waste 2002/03[4]
Paper & Card	53.70	32.33	32.87	23.62
Plastic Film	5.06	7.00	3.34	4.01
Dense Plastic	7.07	7.81	5.69	6.14
Textiles	1.56	1.68	2.36	3.00
Misc. Combustible	1.73	18.65	9.65	8.16
Misc. Non-combustible	0.04	3.62	11.84	7.15
Glass	4.46	3.62	11.84	7.15
Putrescible	17.69	15.10	28.89	35.11
Metal, Ferrous	3.58	3.57	2.19	3,77
Metal Non-Ferrous	o.58	0.86	1.68	1.68
Fines	4.35	3.38	0.47	4.55
Total	100	100	100	100

1 Determined in this study; 2, Environment Agency Wales study to determine the biodegradability of C&I waste in Wales, November 2007; 3, Study in London, London Remade November 2003; the composition of solid waste in Wales, Welsh Assembly Government report December 2003.

3.11.8 Calorimetric Data

The calorimetric data determined for the two sub-samples is shown in table 3.84. There are some differences between these two data sets but they can be considered typical for this type of waste material. The combustion analysis data from previous audits is given in table 3.85. The 1991 data was calculated from combustion audit analyses data determined in the Laboratory. The different moisture content and calorific values can be accounted for in the composition of the waste shown in Table 3.84.

Table 3.84: Calorimetric data from two samples of City of London collected waste

Sample Reference Analyte units	City of London sample 1	City of London sample 2	Average
	Result		
Moisture % Wt	35.71	27.90	31.80
Ash % Wt	10.29	17.06	13.68
Gross CV MJ/kg	12.35	13.47	12.91
Net CV* MJ/kg	10.72	11.86	11.29
Fixed Carbon* % Wt	6.26	4.40	5.33
Volatile Matter * % Wt	47.30	50.21	48.76
Carbon % Wt	29.94	32.82	31.38
Hydrogen % Wt	3.82	4.48	4.15
Nitrogen % Wt	0.36	0.39	0.37
Suphur % Wt	0.05	0.04	0.05
Chlorine % Wt	0.11	0.14	0.12
Oxygen Content % Wt	19.83	17.32	18.58

* Calculated using determined values

Comparison in 3.85 showing calorimetric data from the current calorimetric data from the 2008 analysis shown in table 3.84 and data from previous analyses (Table 3.85).

Table 3.85: Comparison of calorific data from1991 to 2008

Analyte	Units	June 1991°	September 1991[∞]	December 2000[1]	October 2002[11]	March 2003[2]	November 2004[22]	March 2008*	Household waste[3]
Moisture	% Wt	10.94	19.40	20.91	25.51	16.76	18.62	31.80	39.11
Ash	% Wt	19.05	33.40	23.88	9.03	9.92	14.44	13.68	19.55
Gross CV	MJ/kg	15.80	10.10	11.19	14.11	14.81	13.62	12.91	9.58
Net CV	Mj/kg	N/d	N/d	9.90	12.61	13.38	12.31	11.29	7.98
Fixed Carbon	% Wt	N/d	N/d	7.81	8.44	9.36	8.78	5.33	5.77
Volatile Matter	% Wt	N/d	N/d	47.32	57.02	63.96	58.17	48.76	35.58
Carbon	% Wt	N/d	N/d	29.52	33.45	36.32	32.89	31.38	23.43
Hydrogen	% Wt	N/d	N/d	3.67	4.34	4.96	4.12	4.15	3.13
Nitrogen	% Wt	N/d	N/d	0.30	0.32	0.26	O.24	O.37	0.65
Sulphur	% Wt	N/d	N/d	0.17	0.09	0.13	0.12	0,05	0.19
Chlorine	% Wt	N/d	N/d	0.18	0.18	0.11	0.09	0.12	0.19
Oxygen Content	% Wt	N/d	N/d	21.57	27.26	N/r	29.58	18.58	13.57

Analysis Basis: As Received; *= Calculated using determined values. n/d = not determined n/r = not re° = Analysis of refuse from the City of London to determine composition and calorific value, King's Environmental Services, June 2001. [∞] = Analysis of samples of waste arising from the cities of London and Westminster, Warren Spring Laboratory, September 1991, [1] = Average result: Sampling and analysis from the City of London, Three Star Waste Treatment Systems. March 2001 [11] = Analysis of input material: analysis of waste arising from the Corporation of London, Waste Research Limited, December 2002 [2] = Analysis of input material: Analysis of waste arising from the Corporation of London, Waste Research limited. March, 2003. [22] = Average waste arising from the Corporation of London, Waste Research Limited. November * = Average result determined in this study [3] =. WRL average result for collected household waste, 2000 to 2004

3.11.9 Conclusions

This section focuses on the commercial waste collected by the City of London Corporation arriving at Walbrook Wharf Transfer Station. The following main points are drawn from the results:

- The waste collected by City of London is predominately paper – 53.7%.
- This level of paper content has been consistent since 1991.
- The paper in the waste stream is predominately recyclable – 75%
- The paper in the waste is generally of high quality and the option of recovering this material for recycling should be seriously considered.
- The proportion of putrescible material in the waste has increased by an average of 12.3% per year since 1991.
- Maximising the opportunity for resource recovery will minimise the possibility of penalties under the Landfill Allowance Scheme (LAS) and the necessity to purchase under the landfill allowance Trading Scheme (LATS).

Record of waste collected by the City of London arriving at Walbrook Wharf Transfer Station (WWTS) from which samples were taken. Vehicle codes and identification numbers, the tonnage of waste carried per vehicle and date/time of arrival. Also recorded is the type of vehicle and method of collection together with the area-round from which the sample originated. This data and the number of scoops taken from individual vehicles are shown in table 3.86.

Table 3.86: Deliveries sampled

Code	Date/Time	Net Weight kg	Vehicle ID	Round	Scoops
50	19/03/2008 07:44	3580	225	Bin Lift 2	1
50	19/03/2008 09:12	4070	201	Bin Lift 3	1
50	19/03/2008 12:10	3360	223	Bin Lift 1	2
60	1903//2008 06:24	990	125	Skip Round 5	2
60	19/03/2008 06:52	430	127	Skip Round 2	1
60	19/03/2008 07:12	690	124	Skip Round 3	1
60	19/03/2008 07:53	740	126	Skip Round 4	1
60	19/03/2008 08:49	1190	126	Skip Round 4	2
60	19/03/2008 09:00	1230	127	Skip Round 2	2
60	19/03/2008 10:02	1540	125	Skip Round 5	2
60	19/03/2008 11:33	490	127	Skip Round 2	2
60	19/03/2008 11:45	1140	125	Skip Round 5	2
60	19/03/2008 12:14	1410	127	Skip Round 2	1
60	19/03/2008 14:30	410	123	Skip Round11 (late shift)	1
65	19/03/2008 20:47	2020	228	Dust Round 2 (late turn)	1
65	19/03/2008 03:05	4650	226	Dust Round 2 (night)	1
65	19/03/2008 08:28	2870	226	Dust Round 4	1
65	19/03/2008 13:06	1520	230	Dust Round 1	2
65	19/03/2008 13:18	1940	217	Dust Round 2	1
65	19/03/2008 17:20	3230	229	Dust Round 2 (late turn)	1

The result of the analysis shows the potential for increased recycling of dry recyclate and biodegradable waste to minimise the waste sent to landfill.

The analysis also highlights the difference in the constitution of recoverable waste arising in an area of low population and high density of commercial premises against that of waste arising in residential areas.

3.12 Case Study 10 - The London Borough of Camden

London Borough of Camden Energy Audit of the Kerbside Recycling Services

3.12.1 Demographics

The London Borough of Camden covers an area of 22km² of Inner London, north of the West End and the City of London. It was created in 1965 by the amalgamation of three Metropolitan boroughs: Hampstead, St. Pancras and Holborn and is one of the Capitals most built-up areas.

Camden has a population of 227,500 (ONS 2005/6) and a projected growth of 5.5 - 5.6% from 2006 to 2016. The Borough of Camden is a fragment of Greater London, with 6.1% of the jobs and 3% of the population occupying 1.4% of the land area.

Camden has the highest proportion of full-time students in London (11%) and 47% of the residents in employment are educated to degree standard. The population is ethnically diverse and consists predominantly of younger adults; 43% under 30 years old and 73% under 40 years of age. The average age in Camden is 35years.

86% of the households are purpose built or converted flats and just 14% are self-contained houses. 31% of the population are Black and Asian Minority Ethnic (BAME) residents. Statistics relating to waste management are shown in Table 3.87.

3.12.2 Waste management arrangements

The disposal of residual waste arising in Camden is the responsibility of the North London Waste Disposal Authority (NLWA).

The NLWA produced a Waste Strategy and Waste Management Plan (WMP) in 2004 and members of the partnership are currently (2008) studying a report of a Strategic Environmental Assessment. The report recommends a change to the WMP. Important elements taken from the report are shown in the following paragraphs.

Treatment of residual waste not being landfilled will be provided initially through the existing Energy from Waste (EfW) incineration facility.

Later processing capacity will need to be increased giving preference to advanced treatment technologies, especially those from which the products of treatment could be used as fuels.

These are the best options taking into account Net Environmental Impact, deliverability, reliability and affordability and when looking at implied collection services too.

Camden, a Waste Collection Authority (WCA) produced a Waste Strategy 2007 –2010, entitled: Let's talk rubbish, published in January 2007. The data from 2005/06 has been used to make comparison with the data obtained in the Energy Audit of Kerbside Recycling Services.

Table 3.87: Camden waste management statistics – 2006-07

Household waste collected	118,501 tonnes
Household residual waste collected	54,545 tonnes
Household waste per head	348.1kg
	14,592 tonnes
Household recycling rate	22.38%
Composting rate	5.67%
Total municipal waste arising	140,550 tonnes
Total recycled	28,110 tonnes
Percentage recycled	28.05%
Statutory recycling target	30%

3.12 3 Background

The London Borough of Camden has challenging statutory targets for household waste recycling of 30% for 2007-08, 35% for 2010 and 50% by 2020. The landfill directive has set national targets to reduce, by 2010, the amount of biodegradable waste going to landfill to 75% of that produced in 1995.

For their waste strategy 2007 – 2010 Camden undertook a recycling survey between April 2005 and March 2006. A result of the survey was the installation of a kerbside-sorted collection for recyclate. Due to increasing demand from residents for card and plastic recycling, the kerbside sorting collection system for household recyclate was changed to a co-mingled collection system in 2006.

The Council decided that further measures were needed to improve the recycling rate if the statutory targets were to be attained and commissioned an Energy Audit of the Kerbside Recycling Services to run from September 2006 to August 2007.

3.12.4 Methodology

3.12.4.1 The Energy Audit of the Recycling Services

Camden commissioned what is believed to be the first study of its kind by a local authority; an independent audit to assess alternative methods of collecting recyclate, kerbside sorted and co-mingled.
The scope of the investigation was to provide a comparison of the energy use in the collection and recycling of kerbside recycling operations provided by the London Borough of Camden.

Two 12-month periods were used to compare the energy use and operational issues, 2005/06 and 2006/07

3.12.4.2 Scope of the energy audit

The scope of the investigation was to provide a comparison of the energy used in the collection and recycling of kerbside recycling operations provided by Camden Council.

Energy comparison information was collected by interrogation of the LBC waste management services database. Information on fuel consumption and vehicle payloads was obtained from the contractor together with the fuel and energy used at the refuse transfer station (RTS) and the material recovery facility (MRF).
Veolia was the service contractor when both systems were evaluated.

3.12.5 Aims and Objectives

3.12.5.1 The aim of the audit

The aim of the audit was to look objectively at the environmental impacts of collecting household recycling, comparing co-mingled and separated kerbside collections to provide helpful information for planning how to further improve the service.

3.12.5.2 Objectives

- To maximise the efficiency of the collection, treatment and disposal of the Municipal Solid Waste (MSW) arising in the London Borough of Camden.
- To reduce the emission of CO_2 produced by the collection, treatment and disposal of the MSW.
- To find the best practicable environmental option for the collection and treatment of the MSW.
- To obtain data for the introduction of best practise to maximise the recovery and re-use of recyclate from the MSW stream.

3.12.6 Results

The previous system in 2005-06 and the present system in 2006–07 are shown for comparison in Table 3.90 whilst figure 3.16 shows the flow diagrams of the two collection systems.

Table 3.90: Camden statistics for the two systems for comparison.

Year	Previous system 2005/6	Present system 2006/7
System	Sort on kerbside	Co-mingled kerbside
Presentation	Single box	Single bag
Vehicles	8 (+ 2 spare)	6
Vehicle payload	2-3 tonnes	6-7 tonnes
Collection rounds	8	6
Working method	1 vehicle per round	All vehicles on each round
Manning	Driver + 2	Driver + 2
Delivery	Transfer stations	Transfer stations
Bulking/ transfer	-	Yes
Sorting	On vehicle	MRF

Additional data on comparison of the two systems is shown in Tables 3.91, 3.92, 3.93 and 3.94.

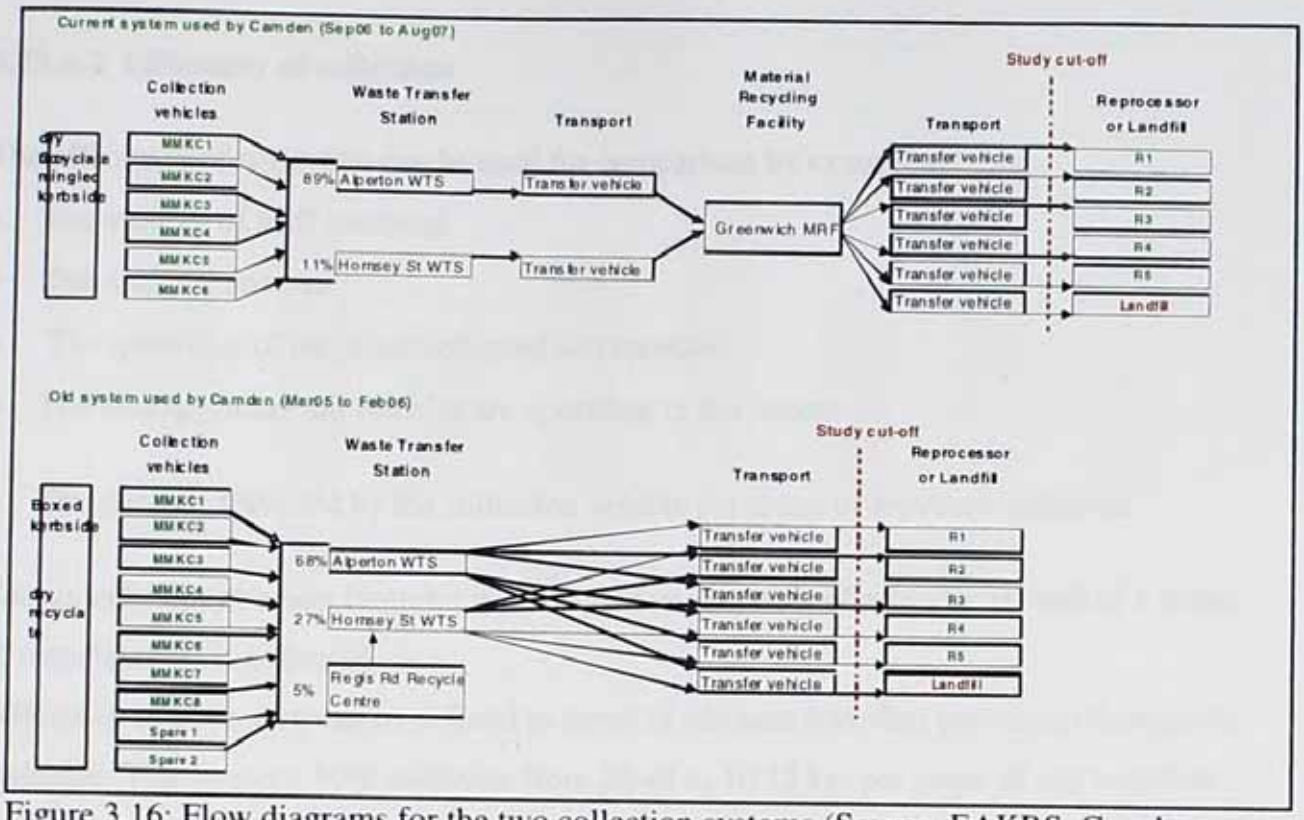


Figure 3.16: Flow diagrams for the two collection systems (Source: EAKRS, Camden 2008)

3.12.6.1 Analysis of the Fuel used in kerbside recycling service collection

The distances covered are made up of the collection round plus delivery to the waste transfer station and return to the round. The fuel consumption and annual distance for system 1, 2005/06 and system 2 are shown in Table 3.91.

Energy and carbon dioxide release were calculated using the calorific value of the fuel consumed and carbon dioxide factors from the DEFRA Guidelines for Company Reporting on Greenhouse Gas Emissions.

Table 3.91: Camden comparison of fuel consumption and staff

System	distance per year (km)	fuel used per year (litres)	total working days/year	days in alternative vehicle	average distance travelled/day (km/day)	average fuel used per day (litres/day)	average hours worked per/day	number of crew
2	101,212	34,257	1,820	198	370	131	61.5	24
1	125,086	43,338	1,560	32	323	151	40.0	18

3.12.6.2 Efficiency of collection

The efficiency of collection can be used for comparison by examining:

- The number of staff involved
- The distance covered
- The quantities of recyclate collected and recycled
- The average hours the vehicles are operating in the streets
- The distance travelled by the collection vehicle per tonne of recyclate collected

Energy efficiency/carbon footprint is calculated on the basis of a functional unit of 1 tonne of recyclate that is collected.
Efficiency of collection can be defined in terms of distance travelled per tonne of recyclate collected. This shows a 50% reduction from 20.48 to 10.12 km per tonne of dry recyclate collected.

In system 2, quantities of fuel used were 9% lower. Recyclate collected increased by 33% and CO_2 emissions per tonne decreased by 32%. The distance travelled by refuse collection vehicles is reduced from 125,089km to 82,344km, a reduction of 34%. The efficiency of collection is shown in Table 3.92.

Table 3.92: Efficiency of collection

	Year	Fuel used	Energy used	Distance travelled	CO_2 produced	Waste collected	CO_2 footprint	Energy efficiency	Collection efficiency
		litres	GJ	km	kg	tonnes	kg/tonne	MJ/tonne	km/tonne
2	2006/7	38.340	1,457	82,344	100,834	8,137	12.39	179	10.12
1	2005/6	42,338	1,609	125,086	111.348	6,109	18.23	263	20.48

The fuel used releases CO_2; the carbon emission per tonne of recyclate was calculated for each system. The relative amounts show a 32% decrease in the CO_2 emission per tonne of recyclate collected. The comparison of the two systems is shown in Figure 3.17

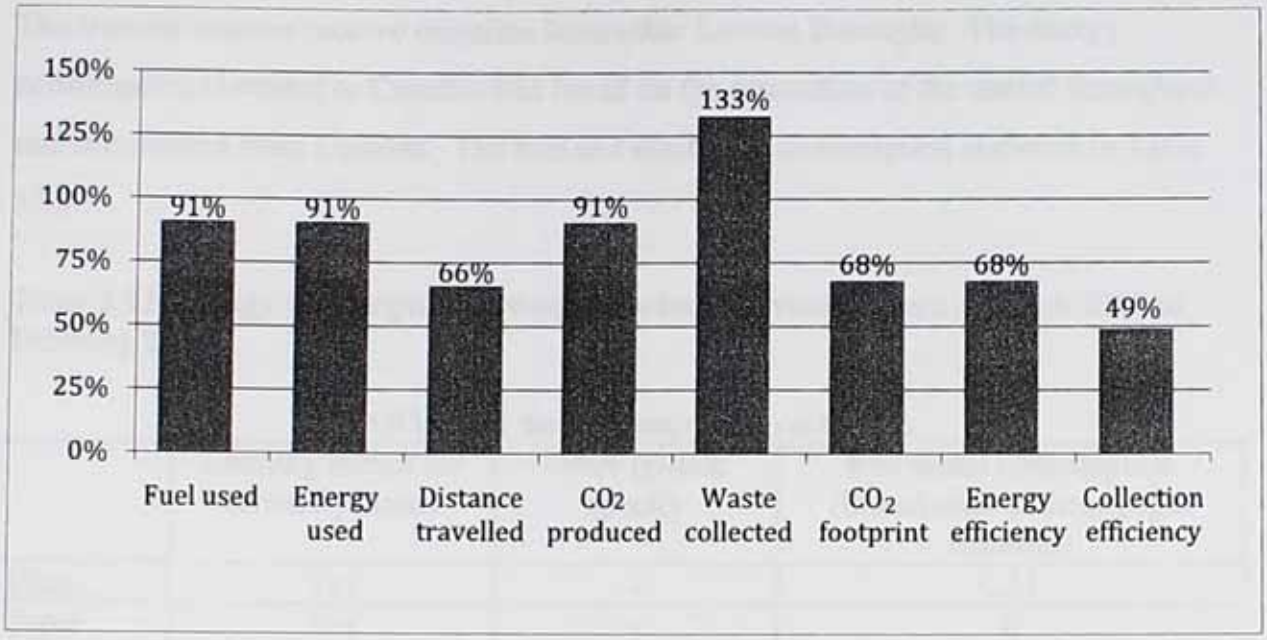


Figure 3.17: Summary comparisons of collection systems 2006/7 system against 100% = benchmark data for 2005/6 system

3.12.6.3 Energy used in the Material Resource Facility and Transfer Station

The collection vehicles from both systems deliver the collected recyclate for treatment. The degree of treatment necessary differs between the two collection systems.

System 1 – Former system

Kerbside sorted material is deposited in bunkers and bulked up in an open-topped skip by a wheeled loading shovel for onward transport to the MRF.

System 2 – Current system

Co-mingle materials are deposited in bunkers and loaded into 80m³ vehicles for transporting to the MRF.

Energy consuming items at the transfer station include:

- Lighting, office and weighbridge
- Mobile plant

Two transfer stations are used:

- The London Waste facility at Hornsey Street, Islington.
- The Veolia facility at Marsh Lane, Alperton.

  The recyclate from the Regis Road Recycling Centre is delivered to Hornsey Street, Islington.

The transfer stations receive recyclate from other London Boroughs. The energy consumption allocated to Camden was based on the proportion of the annual throughput that is collected from Camden. The fuel and electricity consumption is shown in Table 3.93.

Table 3.93: Energy consumption of waste transfer - Previous system – March 2005 to February 2006

3.93a. Red diesel consumption activities

	Loading lorries for onward journey	Other (please specify	Red diesel consumption (litres/tonne of throughput material)
Glass	Yes	-	0.51
Paper	Yes	-	0 0.51
	Yes	-	0.51

3.93b. Electrical consumption activities

	Compactors	Other (please specify)	Electrical consumption (kWh/tonne of throughput material)
Paper	No	Office and weighbridge	1.39
Glass	No		1.39
Metal	No		1.39

Current system – September 2006 to August 2007

3.93c. Red diesel consumption activities

	Loading lorries for onward journey	Other (please specify)	Red diesel consumption (litres/tonne of throughput material)
Co-mingled	Yes	-	0.47

3.93d. Electrical consumption activities

	Compactors	Others (please specify)	Electrical consumption (kWh/tonne of throughput material)
Co-mingled	No	Office and weighbridge	1

3.12.6.4 Transport from waste transfer station to Material Resource Facility, Greenwich.

The transport of materials from the transfer station to the MRF was 41km for one round trip requiring 4.5 hours at an average of 14.5km per hour. The vehicle used was a 44t articulated bulk transport vehicle with an average payload of 19 tonnes. At this speed the carbon dioxide emissions are double those at normal drive cycle speed.

The energy use and emissions were estimated for the functional unit of 1 tonne of recyclate.

The energy consumption and carbon footprint of the waste transfer operation of the two systems are shown in Table 3.94.

Table 3.94: Energy and carbon footprint of the waste transfer operations.

3.94a. System 2 Waste transfer

	Year	Fuel used	Energy used	CO_2 produced	Waste collected	CO_2 footprint	Energy efficiency
		litres	GJ	kg	tonnes	kg/tonne	MJ/tonne
Electricity (kwh)	2006/07	8,137	29	3,499	8,137	0,43	4
Fuel oil	2006/07	3,824	145	10,249	8,137	1,26	18
Total transfer	2006/07	3,824	175	13,748	8,137	1.69	21

3.94b. System 1 Waste transfer

Source	Year	Fuel used	Energy used	CO_2 Produced	Waste collected	CO_2 footprint	Energy efficiency
		litres	GJ	kg	tonnes	kg/tonne	MJ/tonne
Electricity kwh	2005/06	8,491	31	3,651	6,109	0,60	5
Fuel oil	2005/06	3,115	118	8,194	6,109	1.34	19
Total transfer	2005/06	3,115	149	11,845	6,109	1.94	24

Relative quantities of recyclate from each transfer station were used in the calculation to allocate consumption and distance from the two transfer stations. An aggregate figure for fuel consumption and emissions per unit of recyclate was calculated. This is shown in Table 3.95

Table 3.95: Distance and fuel consumption for bulk haulage to the MRF

Location		Energy used	Distance travelled	CO_2	Waste collected	CO_2 footprint	Energy efficiency	Waste 'miles'	Collection efficiency
	litres	GJ	km	kg	tonnes	kg/t	MJ/t	t km	km/t
Alperton	14,703	559	24,505	39,404	7,207	5.47	77.5	232,796	3.40
Islington	1,174	45	1,957	3,147	930	3.39	48.0	18,590	2.11
Total	15,877	603	26,462	42,551	8,137	5.23	74.1	251,387	3.25

3.12.6.5 The Material Recycling Facility (MRF)

The MRF receives the recyclate from Camden as a single co-mingled stream. The operator, Veolia, supplied information on the overall energy consumption used by the MRF per tonne of co-mingled recyclate. This is in the form of diesel fuel and electricity consumption and is shown in Table 3.96.

Table 3.96:Material Resource Facility electricity and fuel consumption.

Fuel type	Annual fuel consumption per tonne of feedstock (MRF input) material 01 Sept. to 31 August 2007	
Electricity	30	kWh/tonne of feedstock
Red diesel	1.73	litres/tonne of feedstock

The cumulative CO_2 release from the current collection and bulk haulage to the MRF is 35% less than that from the 2005/06 kerbside-sorted collection. The additional releases of the MRF process give a carbon footprint that is 82% more than kerbside-sorted recyclate collection. The energy consumption per tonne is 54% higher as a result of the co-mingled service using the MRF. The percentage difference is shown in Table 3.97.

Table 3.97: Energy use and emissions from the Material Resource Facility.

3.97a. System 2 MRF

Source	Year	Fuel used	Ener4gy used	CO_2 produced	Waste collected	CO_2 footprint	Energy efficiency
Electricity		litres	GJ	kg	tonnes	kg/tonne	MJ/tonne
	2006/07	244,104	879	104,965	8,137	12,90	108
Fuel oil	2006/07	14,077	535	37,022	8,137	4.55	66
Totals		14,077	1,414	141,987	8,137	17.45	174

3.97b. Sub-totals to the MRF

System	Year	Fuel used	Energy used	Distance travelled	CO_2 produced	Waste collected	CO_2 footprint	Energy efficiency	Collection efficiency
		litres	GJ	Km	kg	tonnes	kg/tonne	MJ/tonne	km/tonne
2	2006/7	58,041	2,235	108,806	153,133	8,173	19.31	275	13.37
1	2005/6	45,453	1,758	125,086	123,192	6,109	20.17	288	20.48

3.97c. Sub-totals to the MRF output

System	Year	Fuel used	Energy used	Distance travelled	CO_2 produced	Waste collected	CO_2 footprint	Energy efficiency	Collection efficiency
		litres	GJ	Km	kg	tonnes	kg/tonne	MJ/tonne	Km/tonne
2	2006/7	72,118	3,649	108,806	299,119	8,317	36.76	448	13.37
1	2005/6	48,568	1,758	125,086	123,192	6,109	20.17	288	20.48

3.12.6.6 Transport of Recyclate after sorting

For the previous kerbside sorting system, segregated materials were held in bunkers and when a load had accumulated was bulked direct to the processor for recycling. In the case of the co-mingled MRF system, the separated materials are bulked and sent to various processors. To allow stability of comparison it was decided to assume all recyclate is to be transported as far as the M25 motorway ring. The distances from the MRF and transfer station were estimated from a map and the fuel use and efficiency of the systems compared.

Comparison of the carbon footprints indicates that there is a 30% improvement in the carbon dioxide emissions and efficiency as a result of the proximity of the MRF to the M25 (Table 3.98).

Table 3.98: Carbon dioxide and efficiency comparison of transfer of recyclate to the M25.

System	Year	Fuel used	Energy used	Distance travelled	CO_2 produced	Waste collected	CO_2 footprint	Energy efficiency	Collection efficiency
		litres	GJ	km	kg	tonnes	kg/tonne	MJ/tonne	km/tonne
2	2006/7	2,083	79	6,944	5,478	8.137	O,67	10	0.85
1	2005/6	2,192	83	7,306	5,788	6,109	0.95	14	1.20

The distance to the processor can influence the efficiency and this is demonstrated in the recycling of paper from Camden. At the time of the first collection system paper was transported to Ellesmere Port, Cheshire and in the second system to Allington Paper Mill in Kent. The addition that this has on the overall footprint and efficiency is demonstrated in Table 11. The effect of the reduction in transport to the processor is to make the overall carbon footprint and energy efficiency in the case of paper recycling similar for both systems (Table 3.99).

Table 3.99: Carbon dioxide and energy efficiency for collection processing and delivery of recyclate to Re-processors only.

System	Year	Fuel used	Energy used	Distance travelled	CO_2 produced	Waste collected	CO_2 footprint	Energy efficiency	Collection efficiency
		litres	GJ	km	kg	tonnes	kg/tonne	MJ/tonne	km/tonne
2	2006/7	2,083	213	18,703	14,767	5,611	2.63	38	3.33
1	2005/6	2,192	876	76,806	60,600	3,337	18.16	262	23.02

3.12.7 Overall performance of the Collection and Processing Systems

An analysis of the figures for the overall performance of the collection and processing systems indicates that the co-mingled service used 459 MJ/tonne compared with 301 MJ/tonne for the kerbside sorted collection.

The carbon footprint is 37.43 kg/tonne for the co-mingled collection and 21.12 kg/tonne for the kerbside sorted collection; a 77% increase in carbon emissions for the co-mingled over the kerbside collection.

The reduction in transport from Cheshire to Kent shows an improvement for the kerbside sorted collection of 35% to make the carbon footprint and efficiency in the case of paper recycling similar to that of the former system; (Table 3.100).

Table 3.100: Overall Carbon Dioxide and Energy Efficiency for Collection, Processing and Delivery of Recyclate as far as the M25.

System	Year	Fuel used	Energy used	Distance travelled	CO_2 produced	Waste collected	CO_2 footprint	Energy efficiency	Collection efficiency
		Litres	GJ	km	kg	tonnes	kg/tonne	MJ/tonne	km/tonne
2	2006/7	74,201	3,728	115,749	304,598	8,317	37.43	458	14.23
1	2005/6	50,760	1,841	132,391	128,980	6,109	21.11	301	21.67

3.12.8 Waste quantities and composition

The composition of the recyclate handled by the waste transfer stations and the MRF was analysed from recorded vehicle delivery weights and waste compositional survey information. The change in composition, quantities and the amounts received by each of the transfer stations is shown in Table 3.101. By comparison it can be seen that the overall quantity of recyclate has increased. This is apparent in the additional classes of material collected in the 2006/07 survey, e.g. metal, plastic and card.

Table 3.101: Summary of total waste in each class

Year		2006/7			2005/6	
2005/6 classes	2006/7 classes	Tonnage Total	Greenwich MRF % split (as reported by Veolia)	By 2005/6 class	Tonnage Total	% Ex. Co-mingled
			% total average	% average		
	Soft mixed paper	181	2.27			
	News & Pams	3,524	43.30			
Paper	Mixed paper	1,533	18.83	64.40	3,337	67.5
	Cardboard	372	4.58	4.58		
	HDPE	0	0.00			
	PET	1	0.02			
	Plastic Sacks	0	0.00			
	Mixed plastic	285	3.49			
Plastic Bottles	Plastic film	60	0.73	4.23		
	Cans Steel	206	2.52			
	Cans aluminium	39	O,47			
Metals	Cans Mixed	188	2.31	5.29	28	0.6
Glass	Glass NC	1,402	17.31	17.31	1,562	0.6
Residual	Waste	350	4.27	4.27		
Total		8.143	100,00	100.00	4,943	100.00

3.12.9 Health and Safety

A comparison of the hazards and risk was made of the two collection systems. The source data for the 2006/7 are the risk assessment and reports by managers over the period December 2004 to February 2006. The essential tasks for the kerbside collection are taken from the risk assessment dated December 2004 (kerbside sorting).

From the assessments, the number of tasks that have a significant risk were identified and compared. This showed 15 hazards for the kerbside sorting collection and 10 for the co-mingled collection.

The number of staff on the collection rounds is changed from 24 with the kerbside sorting collection system to 18 for the co-mingled collection. The risk factors are shown in Table 3.102.

Table 3.102: Risk factor for kerbside collection

Collection System	2004/5	2006/7
Significant risk	15	10
Number of staff	24	18
Risk factor	360	190
Percentage of kerbside sorting	100%	53%

3.12.10 Resident satisfaction

The survey was instigated in response to residents' desire for an increase the categories of items collected to include plastic and card and an improvement in the service as demonstrated in the Camden 2005 waste survey (Table 3.103).

Table 3.103: Residents Waste Survey (2005).

Issue	Count	% surveys issued
Plastic/card collection	703	36.4
Bin lids not replace / spillage not cleared	258	13.4
Box/bag request	185	9.5
Boxes for estate residents	109	5.6
Unreliable recycling service	74	3.7
Green waste issue	68	3.5
Unreliable refuse service	64	3.3
More recycling collections	58	3
More recycling banks	56	2.9
Bulky waste issue	54	2.8

3.12.11 External costs for kerbside collection

The external costs: included changes to the collection and transport system and inconvenience during the change-over both to residents and road traffic. These were calculated from the distances and emissions from the fuel that was consumed using emission, infrastructure, congestion, noise and accident cost factors. The absolute external costs for the recycling operation are increased marginally by 10%. This is off set by the increased tonnage of recyclate collected under the new system that results in a 19% reduction in the cost per tonne from £15.28 to £12.46. The costs are shown in Table 3.104.

Table 3.104: External costs for recycling kerbside collection.

	System 1	System 2
External cost	£	£
Infrastructure	3,742.22	7,499.67
Noise	1,664.39	1,490.29
Congestion	58,837.55	60,234.67
Accidents	8,905.45	7,426.66
Pollution	19,210.24	24,745.04
Totals	93,360.86	101,396.34
External cost per tonne collected	15.28	12.46

3.12.12 Comparison results

Figure 3.18 is the same base as the 2004/05 system so that it is directly comparable to figures 5 and 6. Collection comparison old and new systems for 2006/07 volumes.

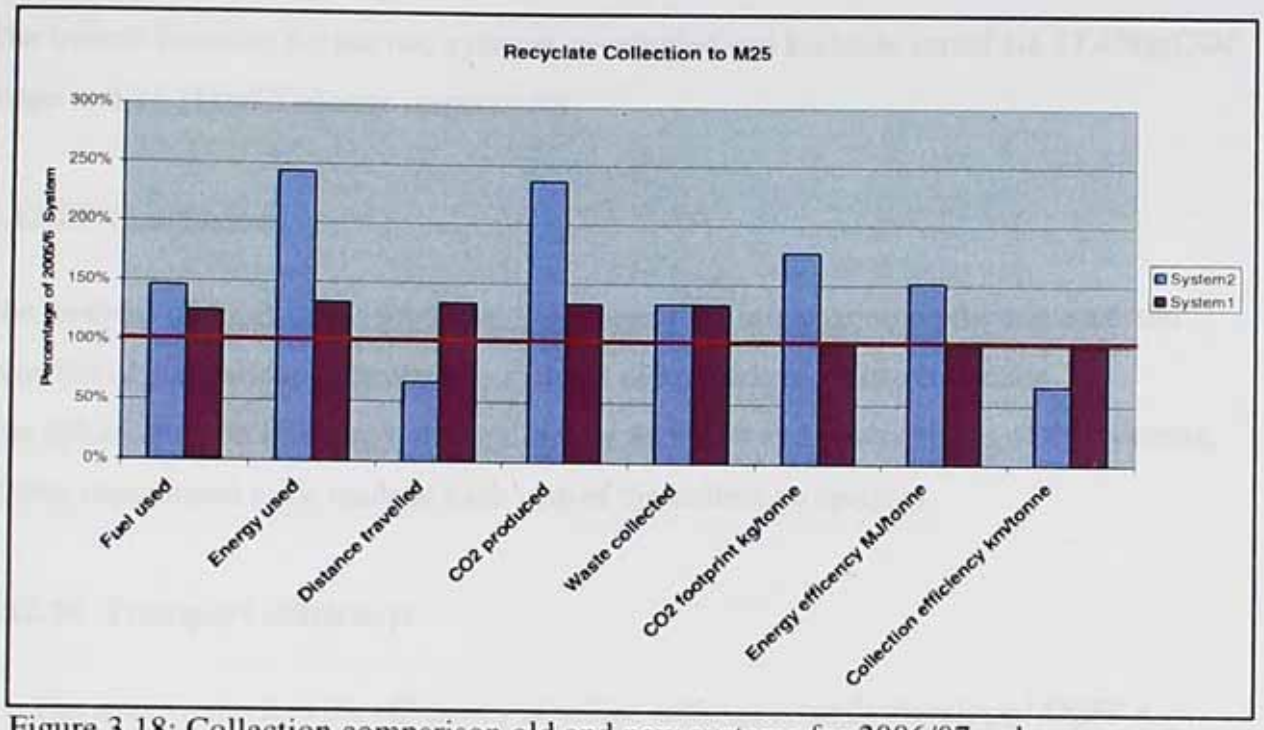


Figure 3.18: Collection comparison old and new systems for 2006/07 volumes.

Figures 3.19 and 3.20 show the benefit of the larger collection vehicles and also the effect of the MRF.

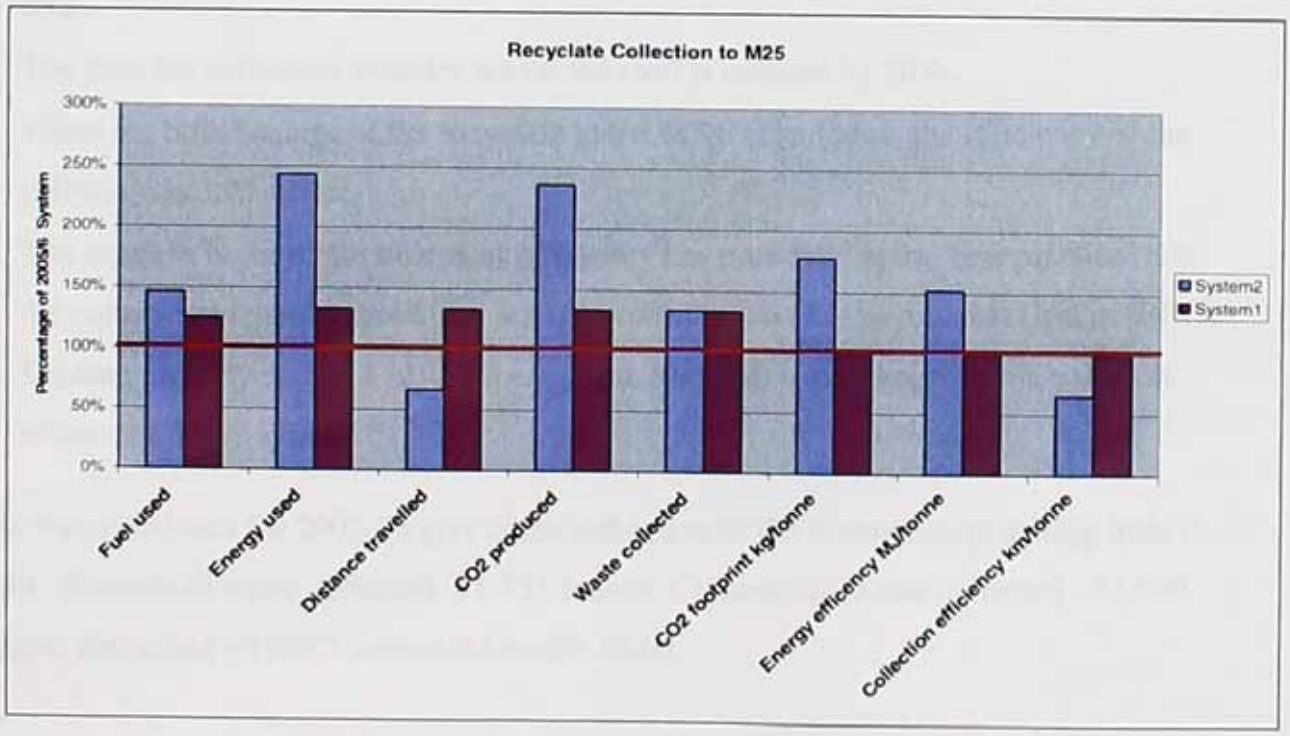


Figure 3.19: Shows distances travelled, time on the road, energy consumed and CO_2

Figure 3.20: Comparison of the 2 systems with 2005/06 baseline 100%

The overall footprint for the two systems co-mingled and kerbside sorted are 37.43kg/CO_2/ tonne and 21.11kg/CO_2/tonne respectively

3.12.13 Conclusions

The analysis of the data has produced some important information on the controversial question of comparison between two systems of kerbside recyclate collection.
The information on efficiency, energy, carbon footprint and relative costs of the systems, allows comparison to be made at each step of the collection systems.

3.12.14 Transport efficiency:

- The improvement to the efficiency is in line with the recently developed DEFRA Guidance from the Waste Implementation Programme.
- The overall distance the refuse vehicles travel in the Borough is reduced in absolute terms with the introduction of the co-mingled service.
- The efficiency of collection in kilometres travelled by the vehicles is improved by 50%.
- The time the collection vehicles are on the road is reduced by 30%.
- When the bulk haulage of the recyclate to the MRF is included, the efficiency of the collection is 35% better.
- The increase in recyclate treatment efficiency has improved upon 'best practice' and the reduction in carbon emissions leads toward the Best Environmental Option (BEO).
- Sending the recyclate to a MRF closer to the Borough would improve the transport efficiency of the system.

The waste statistics for 2007-08 give some indication of the improvement arising from the audit. Household waste collected- 51,753 tonnes; Commercial waste collected - 57,010 tonnes; Recycling - 19,607 tonnes (Metcalfe 2008).

3.12.15 Energy and Carbon footprint:

- The energy used to service the co-mingled recyclate has reduced by 9%.
- The carbon footprint of the collection is 32% smaller per tonne of recyclate collected.
- The advantage is reduced to 4% when the transport to the MRF is added.
- The carbon footprint of the MRF treatment is as much as the collection and bulk transport combined.
- The carbon footprint for the whole process for the co-mingled collection, transfer and MRF is 77% greater than the kerbside sorted recyclate collection system.
- Long distances to re-processors used for the kerbside sorted materials give a comparable effect on the footprint as the use of the MRF.
- The introduction of the co-mingled scheme has been successful in stimulating recycling of additional materials: - card, plastic and mixed paper.

The energy audit and quantifying of the carbon footprint satisfies the investigation into innovation. It offers a blueprint for other Authorities operating, or considering, kerbside collection of dry recyclate who need to establish the carbon footprint of the operations.

The Collection, Treatment and Disposal of Municipal Solid Waste Arising in London: Key Recommendations to ensure compliance with European Commission Directive led Drivers and Targets

This research contains the findings from research into the methods used for the collection, treatment and disposal of municipal solid waste management of the 33 London Boroughs who have the duty and responsibility to ensure these duties are carried out under government legislation in compliance with European Waste Management Directives.

4.1. Practice for Municipal Solid Waste Collection in London

Waste Collection Authorities data; Examples of waste management statistics that are available for each of the collection authorities can be found in Tables 3.8, 3.27, 3.33, 3.5, 3.59. 3.74, 3.89. The information is used within the authority to monitor progress as the component statistics change (e.g. population, costs, etc). It would be less useful as a comparison with other waste management collection authorities without taking into consideration the barriers faced by other WCAs. This also applies to the performance ranking, e.g. Bexley LB 40% recycling rate. (2006/07) appears at the top of the ranking and Tower Hamlets 11.75% (2006/07) at the bottom (Tables 3.1 and 3.2), Tower Hamlets may learn something from Bexley however, traffic congestion and high-rise premises have problems that cannot be overcome so easily (Table 3.1 and 3.2).

The number and types of materials accepted for resource recovery by the WCAs differ from 4 types to 11 types (Table 1.6). To comply with the waste hierarchy (Fig 1.1) and to maximise the potential of recyclate available this area needs to be fully exploited. However, there are barriers that must be overcome (Table 1.10 and 1.11). The more complex barriers require Government intervention and funding Tables 1.20 to 1.24 and 1.49 show the mandatory targets and the time scale in which they must be achieved. WRAP (Table 1.13) is among Government and non-Government organisations set up to assist in the improvement and development of waste resource management by overcoming the barriers.

Methods for storage of waste are found in case studies 1-8 and Figures .3.8, 3.10 (recyclate bag system), 3.21, 3.23, 3.24 (recyclate box system) 3.25, 3.30, 3.15, 3.102. These indicates the success of the campaign to raise awareness and increases resource recovery. Table 3.49 shows sack and bin types with the charges for hiring and emptying to improve the collection of commercial waste. Table 3.51 displays a series of option of boxes, bags and collection periods. In Chapter 3, Table 3.52 shows the charges levied on optional extras. Option of choice is governed by traffic and population density together with the type of property e.g. Bexley 408 multi-storey and local traffic average speed 22mph, Tower Hamlets 19,000 multi-storey premises and local traffic average speed 10/12mph.

In general the projects concentrate on recyclate and residual household waste and collection of kitchen waste. Table 1.47 is being widely adopted (Case Study No. 6 and No. 2). Green waste and/or combined kitchen waste is a key area and is covered in Case Study No. 7, (Ch.3).

'Doorstepping' (Read 2003) is extensively used to raise awareness to educate and inform the Residents of the service available and the reasons and importance of maximising the resources. With the exception of Case Study No.9, some form of doorstepping is used in all Case Studies (see Tables 1.48, 3.4, 3.18, 3.28). Tables 3.4, 3.5 and 3.6 illustrate the method of group selection, the time and cost involved in 'doorstepping'.

LB Southwark used a nine-point questionnaire in their door-stepping campaign to increase resource recovery. Fig 3.1 shows the stringent targets to avoid the financial penalty from the Landfill Directive. Figs. 3.2 to 3.10 demonstrate the need to inform the residents and improve the service. Fig. 3.3 covers materials collected and especially the use of 'bring' sites and the resource recovery facility (RRF) - Fig 3.11, 3.12. Use of waste minimisation as in Fig 3.13 signifies a trend in using real nappies.

The result of the increase in residential high-rise flats and multi-storey office accommodation with commercial outlets is shown in Table 3.9 along with the 600% increase in recycling over the last 6 years. The disposal routes for Southwark are in Table 3.10, (Ch.3 Case Study No.1).

Green waste i.e. kitchen waste and garden waste is an important element in the environmental impact of municipal solid waste, in particular food waste. Putrescible waste

at 27/28% by weight in the average household is a significant proportion of available resource recovery material (see Chapter 2 2.3 section 1 and 2).

Although being the second most deprived local authority on the UK Index of Multiple Deprivation (IMD), and among the poorest performers for recycling in London, ranked 24th, Hackney Borough Council is still required to attain the mandatory targets for resource recovery and minimisation of MSW to landfill.

To minimise the residual waste being sent to landfill and avoid the risk of Government sanctions and to improve the Borough recycling rate a trial kitchen waste collection service was developed. The set outs and kilograms collected with the number and type of dwelling indicate the collection from flats is less productive than from street level premises (Tables 3.11, 3.11a, 3.11b and 3.13). A kitchen waste collection service may be influenced by the collection arrangements made for the collection of residual waste (Table 3.12).

Comparison was made with the results from optional schemes that show Hackney scheme in the upper second quartile (Tables 3.15 and 3.16), although in Table 3.17 the comparison from flats was less favourable. Possible advantageous changes are in Table 3.16. (Ch.3 case study 2). In section 3.5.3.10, ELCRP, an example of costs for a comparable kitchen waste collection scheme is produced.

In the reorganisation of the London Boroughs (1965), the 33 new Authorities were allocated areas with approximately similar numbers of population. Case Study No 3 illustrates how the numbers in age groups of a population can affect management financial policy in a London Borough. Enfield has above average numbers in the high and low age groups (Table 3.18).

The Borough waste management statistics with Best Value Performance (BVP) (Table 3.19) highlight the need to increase the recycling rate in line with published guidelines (DEFRA, 2006).

To achieve an increase in resource recovery and promote recycling a 'doorstepping, campaign was carried out (Hyder) starting in July 2007 with a particular objective to increase awareness among the high level of Black and Asian Minority Ethnic (BAME) Communities, multi-lingual pamphlets were issued (Table 3.26). The timetable of actions (Table 3.20), and the results from the number of premises visited (Tables 3.20a, 3.21, 3.22,

3.24) give the results of new and additional participants. Observations i.e. box or wheeled bin, poor /good service among other complaints (Table 3.25) help to shape the final conclusion. The result of the campaign has achieved the objective by increasing participation and the resource recovery rate.

A Waste Attitude Programme was launched in 2007 as a joint partnership of Brent Council and Business Eco Network (BEN) to raise awareness for improvement in the collection, treatment and disposal of the municipal solid waste arising in the London Borough of Brent (Chapter 3 case study 4). The Borough statistics 2006/07 (Table 3.27) illustrate the need for MSW to be diverted from landfill disposal in order to avoid a financial penalty (LATS). A Review Board (2007) commissioned a review of the current method of municipal solid waste management (Tables 3,28, 3.29, 3.30 and 3.32). The percentage rate of door-knocking (Table 3.28) and the participation rate of streets re-boxed (Table 3.29) followed by Table 3.30, were monitored prior to a report to the Review Board.

Focus Group meetings were held to increase awareness and explain the reason for segregating and increasing recycling of household waste (Table 3.32). Although the campaign was successful in increasing the recycling rate, the Council decided residents who do not participate would be sent warning letters and may subsequently be summoned in a Magistrate's Court.

The joint waste management partnership of Brent Council and Veolia ES are trialing the use of Liquid Methane Gas in the refuse collection vehicles as a means of minimising the carbon footprint and improving the best value performance (BVP) of the service.

Waste arising in a local authority area which is often over looked is the commercial waste produced by Small and Medium Enterprises (SME). In pursuance of BPEO and compliance with the spirit of the Mayor of London's waste strategy, the London Borough of Richmond upon Thames Council installed a new commercial waste collection service. The main arrangement for the management of commercial waste is acceptance at the Townmead Road Reuse and recycling Facility, it is the main source of income from commercial waste management.

In Richmond, there is a high (30%) single person occupancy together with a low percentage of young and above average percentage of over 85 years old residents compared with the rest of the London Boroughs. Non-white ethnic minorities account for

9% of the population (ONS 2004) in Richmond. The waste management statistics with costing and recycling figures for the Borough of Richmond upon Thames 2005/06 are in Table 3.33.

The survey was a written questionnaire followed up by Council personnel making visits in reply to answers in the questionnaire. Who currently collect the waste and how long has the respondent used the service are in Tables 3.34, 3.35, 3.36. Questions 4, 5 and 6 sought opinion on proposed new arrangements in Tables 3.37, 3.38 and the degree of satisfaction with the current commercial waste collection service in Tables 3.39, 3.40 was 80/90% - good to excellent. The question 'is the service value for money' (Table 3.41) was not so good with 67% thought the service was poor or very poor value for money. The Council's method of payments on the web site had a better response with 85% classing them good to excellent. 52% of the respondent said they currently recycle (Table 3.45).

The type of waste produced for recycling by percentage in Table 3.43 shows mainly paper and card. 67% of the respondent would increase their participation if the price for collection was reduced by 50% (Table 3.46).

The type of commercial waste accepted at the Townmead Road RR Facility and the revenue arising from the service, almost £1 million in 2006 (Table 3.47). Charges for collected commercial waste were increased in 2008 (Table 3.48). There was a reduced rate for segregated recyclate collected (Table 4.49). Recycling rates increased from 29.56% in 2005/06 to 31.71% in 2006/07.

A project, `Persuasion through Change in Collection`, was carried out in the London Borough of Harrow in 2005 followed by a progress and monitoring 'doorstepping' campaign in July to September 2006. The result of the increased awareness and changes to the recycling service are shown in Table 3.50. Although there has been an increase in population there has been a decrease in household waste arising and per kilograms head of population. The recycling rate per household has increased by almost 100% and for MSW the recycling rate for 2007/08 has risen to 34.54%. The table also shows a 200% increase in the collection of kitchen waste and an 18,000 tonne decrease in waste sent to the West London Waste Authority for disposal.

Options for future consideration (Table 3.51) included additional containers and charges for additional services to include a free clinical waste collection bin if requested by patient or hospital (Table 3.52).

A questionnaire on the Kitchen waste trial that had been carried out produced data on customer attitude and comments (Tables 3.51, 3.52, 3.53, 3.54 and 3.55). A summary of the results (Table 3.56) displays a fluctuation of participation over 3 different collection areas but the final analysis suggests an increase in recycling between 24 and 32%. Suggestions for improvements and complaints are dealt with in Tables 3.57 and 3.58. The kitchen waste tonnes collected increased by 300%. At the commencement of the monitoring campaign there was an immediate increase in requests for additional green boxes (Figure 3.15). Household recycling rate increased 125%, MSW recycling up by 90% and Residual waste tonnage to landfill down from 105,881 in 2004/05 to 74,679 tonne in 2007/08.

The conclusion drawn from the result of the survey if replicated across the Borough would divert 17,000 tonne of biodegradable waste per annum from landfill a reduction of £80,000 per year to WLWA and minimise the risk of a LATS penalty.

This study highlights the results that continuous publicity and monitoring together with the inclusion of more separation of recyclable material, here, kitchen waste, can lead to achieving the objectives of less residual waste to landfill. Reaching the mandatory targets at a lower cost demonstrates the success of the campaign.

Another area sometimes neglected is the seasonal arising for disposal of garden waste. Houses with a small garden composting may be limited unless the occupant is a dedicated gardener. Garden/green waste now included in the latest definition of MSW may be a problem with some authorities collecting it free of charge and other authorities charging for the collection and disposal.

Waste management statistics 2006/07 for LB Lewisham are in Table 3.59. The London Borough of Lewisham (Case Study 7) has failed to achieve the set mandatory target for recycling and The Council decided to instigate a pilot Garden Waste Collection Scheme in conjunction with London Remade Solutions. The objectives were to evaluate the tonnage arising and effect an increase in the recycling rate; to find the Best Possible Environmental

Option (BPEO) for collection and disposal and to provide recommendations for improvements.

The timetable monitoring periods July to October 2007 are in Table 3.60 and the number of households monitored in Table 3.61. Data on the set out rate, households served, total waste arising and composting rate in Tables 3.62, 3.63, 3.64 and 3.65. Extrapolated tonnage in Table 3.66 produce figures for the possible total amount of garden waste for disposal.

Two alternative methods for collection were evaluated (Tables 3.67 and 3.68) and the results were analysed to form a conclusion. Option 1, to introduce a free garden waste collection throughout the Borough area all year round and option 2 to offer a free garden waste collection service from April to October. The Mayor of Lewisham's committee rule that a free service would be too costly to operate. The decision was made to retain the current system i.e. residents may purchase sacks @ 10 sacks for £10 which will be collected on request. To be augmented by 4 designated sites across the Borough where a vehicle and attendants would be located from April to October on Saturdays and Sundays from 8am to 10am to accept garden waste delivered by residents free of charge.
The pilot exercise highlighted other areas of the MSW collection system that would benefit from a method change and The Council is considering option through the waste management strategy. The options will include borough-wide collection of garden and kitchen waste.

4.2. Potential Practice for Municipal Solid Waste Management and Treatment in context of London

The main drivers for the treatment of MSW arising in the London Boroughs are the mandatory targets for recycling material and the need to minimise the biodegradable waste sent to landfill. Under The Landfill Allowance Scheme (LAS) each waste collection authority (WCA) has been allocated an annually diminishing target for biodegradable waste that it is permitted to discharge in a landfill site (Figure 3.1 and Table 3.8). Every tonne exceeding the annual quota will be penalised with a fine of £150 per tonne (LATS).

Options of treatment for recyclate vary from borough to borough governed by local conditions, market availability, the proximity principle and adherence to the Waste

Hierarchy. The recycling figures for all the waste management authorities for 2006/07 are found in Tables3.1 and 3.2. The barriers to the improvement of resource recovery and the methods used by collection authorities to overcome them are in Tables 3.3 and 3.4.

Recyclate available in household waste is in Table 1.16, (Parfitt 2002). The numbers and types of materials collected at kerbside, 'bring' banks and resource recovery facilities (Figure 3.11) by each collection authority vary between 4 materials and 12/13 material e.g. Figures 3.3, 3.9 with recycling statistics in Figure 3.14 and Table 3.9. An example of recycling progress is in Figure 3.14 and Tables 3.9, 3.101. Data on borough recycling tonnage collected, percentage and target achieved can be seen in "Borough Waste Management Statistics" (Tables 3.8, 3.19, 3.27, 3.50,3.59 and 3.74).

Other waste material, similar to household waste, found in municipal solid waste (MSW) that would be suitable for resource recovery include garden waste (case study 7); kitchen waste (case study 2 and case study 6); old furniture and waste electrical and electronic equipment (WEEE). Commercial and some industrial waste arising is mainly handled through a resource recovery facility. Type of waste generally produced for recycling by participant in commercial enterprises is shown (Table 3.44 and case study 9).

Initial treatment may be separation at source i.e. kerbside or co-mingled to a material recovery facility (MRF) (case study 10) or with bulky items by special collection. After separation at the MRF the homogenous materials are sent for refurbishing or recycling. The biodegradable element maybe treated at the resource recovery facility by aerobic (composting) or anaerobic treatment as part of mechanical biological treatment plant (MBT) (case study 8)

There is a large amount of variation across the borough recycling rates (Tables 3.10 and 3.2); these tables also show a wide variation in the kilograms per head of residual waste arising. Although there is a slight increase where an authority has instituted a compulsory system for segregation of dry recyclables (Section 3.7.6), it does not appear to be significant. Density of population (Table 3.18), i.e. inner or outer borough only shows a modest effect on the figure mainly from areas containing more or less flats.

Discounting the figures produced in case study 9, (City of London,) an exception that would distort the figures, the paper content in an average household is about 28/30% by

weight. Newspapers and magazines are the most readily segregated and many daily newspapers use over 80% of reclaimed paper in their production.
Putrescible waste accounts for around 27% by weight in the household residual waste stream and the move to install a weekly collection of kitchen waste for utilisation is an important measure to meet the statutory targets for recycling and landfill.

The Hackney project investigated variations between street level and high-rise properties (Table 3.11, 3.11a, 3.11b), and estimated food waste generation (Table 3.13) shows more kilograms per dwelling from street level properties than kg from flats (Table 3,12). The success of the project is found in Table 3.15 where comparison is made between other projects and over time. Recommended changes that could improve the aim to meet the targets and the potential available from flats are in Tables3.16 and 3.17.

An example of the progression and follow-up of a monitoring and awareness campaign is produced in Table 3.50 with the kitchen waste collected increasing 200%. The table also shows improvement in all other figures except in the cost of collection. Part of the campaign to investigate the reaction to the introduction of a kitchen waste collection (Tables 3.54, 3.55), The summary of the results (Table 3.56) has a majority of participant would like an increase in number of materials recycled and increased collections (Table 3.57). The demand for recycling containers as a result of the campaign is in Figure 3.15. A result of the campaign was a 300% increase in kitchen waste collection, the cost per household reduced by 16% and over the four-year period of the campaign residual waste to landfill decreased by 30% (31,000 tonnes).

'Green' or garden waste is often considered along with kitchen waste; if the end product is to be a soil conditioner or compost, many authorities have combined the two into one container collection system.

The London Borough of Lewisham with 47% of the population living in kerbside properties and 51.9% living in flats, of this population 33% are Black and Asian Minority Ethnic (BAME). Lewisham disposes the greater percentage of the municipal solid waste arising in the borough to the South East London Combined Heat and Power Plant (SELCHP). To minimise waste that was being disposed in landfill and to increase the poor recycling rate, the Council ran a pilot scheme (2007) to evaluate the collection of garden waste (case study 7). The progression of the project can be traced in Tables 3.60, 3,61,

3.62, 3.63, 3.64 with the composting rate (Table 3.65) and extrapolated figures (Tables 3.66 and 3.67). Although showing an increase in waste collected and two options analysed, the final conclusion taken by Council was to retain the current system of charging £1 per bag for collection to be augmented by acceptance, free of charge, at one of 4 designated site. This to operate from April to October on each Saturday and Sunday from 8am to 10am. is Borough-wide free collection service was not considered a viable option (Section 3.10.8).

18 of the London collection authorities collect garden waste separately, 3 of these collect weekly, 9 collect fortnightly and 5 collect on request. 7 WCA collect kitchen waste and garden waste mixed. 12 WCAs collect kitchen waste separately 10 with a weekly collection, 1 collects twice a week and 1 collects fortnightly.

13 issue kitchen caddies, 4 use disposable bags, 5 use re-usable bags, 8 use wheeled bins and 2 rely on the resident to supply own bag. Kilogrammes collected vary from 2kg to 232kg for mixed food and garden waste and 3kg to 270kg for garden waste only. The Green waste is treated by anaerobic digestion at composting plants within the M25 area e.g. Sutton, Bromley, Slough, and at Frog Island and Cleanaway site in Essex.

4.2.1. Case Studies

CS1. The London Borough of Southwark with a recycling rate in 2006/07 of 18.64% dry recyclate to Grosvenor Recycling Facility in Greenwich and 4.28% composted, MSW recycling rate 22.92% (Table 3.8).

CS2. The London Borough of Hackney has a recycling rate of 18.64% from household waste and 25% MSW (Section 3.5.2).

CS3. The London Borough of Enfield has a dry recyclate rate of 19.36%, composting figure of 10.28% and MSW percentage at 29.4% (Table 3.18). The aims of Enfield Council, using a doorstepping campaign, was to increase the number of types of materials recovered by the kerbside collection system. To include flats into the recycling scheme and to minimise the tonnage of residual biodegradable waste going to landfill. The increased demand for green and black boxes during and after the campaign (Tables 3.21, 3.32, 3.34) prove the value of the exercise. Table 3.25, a question on satisfaction, highlights areas where immediate action is required.

CS4. The London Borough of Brent in 2006/07 produced a recycling rate of dry recyclate of 11.25%, for composting the figure was 10.27% and MSW 21.52% (Table 3.27). The success of an awareness campaign produced a 20.85% participation rate among residents (Tables 3.28, 3.29. and 3.30). Using the recycling box service is compulsory with the possibility of a fine for persistent offenders.

Brent Council and their contracted waste management partner are co-operating on trial using compressed methane gas fuel for the transport fleet to achieve Best Value and to minimise the carbon footprint of the service (Section 3.7.6).

CS5. The London Borough of Richmond upon Thames showed in 2006/07 a dry recycling rate of 29.56% and MSW rate of 31.71% (Table 3.49). The project the Council instituted was in the form of a questionnaire to be followed up by visits from members of the project team. The aim was to examine the current manner of recyclate collection from commercial premises and to offer an alternative to the current method. Tables showing the results include satisfaction with, and or change of, the current organisation, options for a new service with charges and method explained are in Tables 3.34,3.35, 3.36, 3.37, 3.38, 3.39, 3.40 with Tables 3.41 and 3.42 displaying the revised charging system offered for discussion (Table 3.48).

Types of commercial waste accepted at the Townmead Road Resource Recovery Facility and the income from this service are in Table 3.47 with the new scale of collection charges in Tables 3.48 and 3.49. The Council is anticipating an increase in the recycling rate as a result of these changes.

CS6. The London Borough of Harrow in their table of statistics has a dry recyclate rate of 22.87% from household waste and 34.54% rate for MSW 2006/07 (Table 3.50)

The table has comparative figures from 2004/05 to 2007/08, with the household recycling rate for the last year at 27.07%, a 5% improvement after the campaign. The tonnage of biodegradable waste sent to landfill and the increase in resource recovery from 18.8% to 34.54% illustrates the improvement resulting from the actions taken over this period.

The campaign "Persuasion through Change in Collection Systems" (2005) examined the options for future development of collection, treatment and disposal of the MSW. The Monitoring and Awareness Campaign investigated the progress and introduced alterations to the recycling service (Table 3.51) and a kitchen waste questionnaire to ascertain the

feasibility of supplying a collection service (Tables 3.45, 3.55, 3.47 and 3.58). A summary of the results (Table 3.56) has the increased recycling percentage rate and the increase in the demand for recycling containers (Fig. 3.15).

Suggestions for improvement and comments on the service (Tables 3.57 and 3.58) produced areas requiring further investigation. Although the huge demand for additional containers (3.15) and the resulting increase in the household recycling rate (+125%) and the decrease in biodegradable waste to landfill indicates the campaign is a proven success.

CS7. The London Borough of Lewisham sends the largest portion of the residual waste arising in the Borough to the SELCHP plant. Statistics (Table 3.59) have a combined household/MSW waste, recycling figure of 15.96% for 2006/07. The need to improve this rate induced a pilot scheme to evaluate the collection of garden waste and find the Best Possible Environmental Option (BPEO). For collection, route and the number of participating house were set out (Tables 3.60, 3.61, 3.62, and 3.63). Total waste arising both before and after the pilot scheme shows an increase in recyclate of 100% (Tables 3.64 and 3.67). Extrapolating the figures gathered in the four months (July to October) across the Borough (Table 3.66) produced a 99% increase in recyclate.

Two options were considered (Tables 3.67 and 3.68), this shows that option 2, weekly during the growing season and fortnightly for the rest of the year, is the most favourable option. The Council discussed the options and decided on financial grounds that a modified version of the 'status quo' remain. The current system is £1 per sack collected on request. The modification is a refuse collection vehicle (RCV) with 2 attendants at each of 4 locations across the Borough on every Saturday and Sunday morning from 8am to 10am from April to October to accept residents delivered garden waste free of charge. The garden waste is treated by aerobic digestion at a plant in Bromley (Kent).

CS8. The East London Waste Authority (ELWA) is responsible for the residual waste disposal for the four East London Boroughs of Barking & Dagenham, Havering, Newham and Redbridge. The data for the study was obtained by a one-to-one meeting with John Wilson, General Manager of ELWA.

ELWA Limited, a joint waste management company was formed by a 25 year contract with Shanks Waste Services Limited is operating under the name of Shanks East London (SEL). The joint company took over the responsibility for the operation of four existing

recycling centres and upgraded them to resource recycling facilities. The Ilford Recycling Centre (RRC) has a material recycling facility (MRF); all the facilities are Designated Collection Facilities (DCF) under the WEEE regulations. Dry recyclate from the authority area is passed to Bowater's Material Resource Facility (MRF), with the recyclable plastic going to London Loop Limited, both plants within the authorities area thus complying with the 'Proximity Principle' (PP).

There are two Mechanical Treatment Facilities classified as Intelligent Transfer Stations (ITS®) using the Ecodeco© system and the Biocubi® processes. Each plant processes 180.000 tonnes per year of mixed waste using the heat from degradation to dry the waste for further recycling treatment. The system claims that 100% recovery with nil residual going to landfill can be achieved (Table 3.69 and 3.72). The 50% of solid recovered fuel (SRF) (Table 3.69) is utilised in the production of cement; the ash is incorporated in the product so there is no residue from the kiln.

A comprehensive list of tonnage handled and the cost, monthly figures for 2006/07 and estimated for 2007/08 is in Table 3.71. A breakdown of the half a million tonnes of waste handled from the different areas (Table 3.71). The desired result of the contract appears in Table 3.72 with nil to landfill and nil LATS (Table 1.43) requirement. The constituent Borough's recycling figures are in the statistics (Table 3.73).

CS9. The City of London is unique among the London Boroughs in that it has a very small residential population and a high daily commuter influx of office and service workers in an area of one square mile. The Corporation must comply with the statutory requirement for the management of the waste arising in it's area (Table 3.75) (2007). The statistical data (Table 3.74) shows that household waste is 12.5% of the MSW arising.

To increase the recycling rate in the City and to obtain physical and chemical analyses of the waste a study ordered, 'The Analysis of Commercial Waste Arriving at Walbrook Wharf Transfer Station' (WWTS) was performed. The study was conducted by Waste Research Limited (WRL 2008).

Co-mingled dry recyclate is collected twice weekly and delivered to an MRF at either Southwark or Greenwich. Sampling of deliveries and method of random selection (Table 3.76) were recorded and the waste categorised into 9 divisions and then into 44 sub-divisions (Table 3.77). The waste categories were weighed and the size recorded (Table

3.78) with the percentage of material by weight (Table 3.79). This analysis was compared with analyses from previous studies (Tables 3.80, 3.81); the loss of computer paper may be due to less print-outs and/or through private collection due to the value of computer paper (Table 3.82). A comparison was made with an analysis of commercial waste carried out in Wales by the Environment Agency (2007) to determine the biodegradability of commercial waste (Table 3.83). The calorimetric values of were calculated (Table 3.84) and compared with data from the data from 6 previous analyses (Table 3.85). Data on the deliveries sample is in Table 3.86.

The result of the study suggests that 75% of the paper in the waste stream is recyclable and of high quality and greater effort to capture this paper for recycling. Although the putrescible content arising has increased, the food waste collection should recover more of the waste available. The study highlights the difference between high and low-density communities and high commercial occupation but should not be used to compare with other London Boroughs.

CS10. The London Borough of Camden is a Partner of the North London Waste Authority (NLWA). The residual waste that is not disposed in landfill receives treatment at the energy from waste plant (EfW) at Edmonton. The statistics for waste management in Camden are in Table 3.89.

A result of a recycling survey in 2005/2006, Camden installed a kerb-side sorted collection of dry recyclate. Due to increasing demand from residents to expand the number of materials collected the kerb-side system was changed to a co-mingled collection system in September 2006. The Council decided to commission an 'Energy Audit of the recycling Services' (2006/07) to audit the Environmental Impact (EI) of both services. The objectives were to maximise the efficiency of the waste management service; to reduce CO_2 emission; to find the best practicable environmental option (BPEO) and best practice (BP) to maximise resource recovery.

Data from 2005/06 and 2006/07 were compared (Table 3.90) and transport and treatment data were compared Figure 3.16 for energy and carbon dioxide release. Comparison of fuel consumption is in Table 3.91; this information was used to find the efficiency of collection based on a functional unit of 1 tonne of recyclate that is collected.

System 2 with a collection efficiency of 20.12 km/tonne, using 9% less fuel, CO_2 down by 32% and recyclate collected up by 33%; the refuse collection vehicles (RCV) travelled 34% less mileage. A comparative efficiency is in Table 3.92 and with 100% benchmark for 2005/06 in Fig. 3.17. These figures suggest that system 2, co-mingled kerbside collection of recyclate is the best environmental option (BEO).

The energy consumption of waste transfer to material resource facility is compared from the data for system 1 in Tables 3.93a, b, c and d and for comparison, system 2 in Tables 3.94a and system 1in Table 3.94b. System 2 figures again show an efficiency advantage. Aggregate figures for haulage to the MRF are in Table 3.95.

The overall energy used (electricity and fuel consumption) per tonne of co-mingled recyclate is in Table 3.96. The cumulative CO_2 for MRF and bulk haulage is 35% less than system 1. However, the releases from the MRF give a carbon footprint that is 82.5% more than kerbside sorted and the energy consumption is 54% higher when treating co-mingled recyclate (Tables 3.97a, b, and c).

In consideration of the 'Proximity Principle' (PP) the M25 ring road was used as a hypothetical disposal point for the recyclate, carbon dioxide and efficiency comparison of the recyclate (Table 3.98). The current disposal points for recyclable paper are Allington in Kent and Ellesmere Port in Cheshire (Table 3.99). Overall carbon dioxide and Energy Efficiency for Collection, Processing and Delivery of Recyclate as far as the M25 for systems 1 and 2 is in Table 3.100.

A description of the materials collected in Systems 1 and 2 with tonnage and percentages shows the vastly improved (33%) increase in the collection of recyclate as a result of the installation of the 2 systems (Table 3.101). The results are demonstrated in Figures 3.18, 3.19, 3.20and 3.21.

Using risk assessments and reports by Managers over the two periods and identifying the number of tasks in each system that have a significant risk a table was drawn up to show the risk factor for kerbside collection (Table 3.102).

Although the external costs are increased by system 2, the overall cost per tonne is reduced by the increase in recyclate collected i.e. from £15.28 per tonne to £12.46 per tonne (Table 3.104).

4.3. Practice for Disposal of MSW in London

Options for the disposal of municipal solid waste (MSW) arising in London are influenced by a number of barriers (Table 1.10 and 1.11), legislative requirements (Table 1.1, 1.2 and 1.3) and tools (Table 1.9). To enable actions (Table 1.8), many waste management authorities require assistance and financial aid, to overcome the barriers (WRAP 2008) (Table 1.10 and 1.11). This assistance was made available through government departments (e.g. DEFRA) and non-Government organisations (Tables 1.14, 1.15, 1.16, 1.17.and 1.18). The case studies are examples of actions taken with the help of these organisations. Overcoming these barriers had an influence on the approach to the planning for the disposal of the waste.

The need to implement the waste hierarchy to attain the increasing recycling target and to avoid the financial penalty of LATS through the diminishing allowance of biodegradable waste to landfill is imperative. Recycling offers more environmental benefits and lower environmental impact than other waste management options (WRAP 2006). Minimisation (WMA 1998) increasing recycling and composting (22% 2006) has reduced disposal to landfill to 70% (case studies). Biodegradable household waste to landfill is down to 52%, achieving the current mandatory target.

More than 90% of dry recyclate from households pass through one of the 41 resource recovery facilities in and around London. Fifteen of the London Collection Authorities send dry recyclate to the Grosvenor Material Resource Recovery Facility (RRC) at Erith that has a 200,000 tonne per annum capacity. Paper goes to Aylesford paper mill, Smurfitt and RM Real; Glass to Day Aggregates; Steel cans to AMG; Aluminium cans to Novelis; Plastic bottles are exported and 90% of plastic bags are recycled. All types of plastic may be recycled at Close Loop London Limited in East London and Express Recycling and Plastics, Havering (case study number 1).

Large capacity MRFs are available at Greenwich (Veolia), Shanks and Cleanaway in Essex (East London) Grundon's at Colnebrook (W London), Bywater's at North east London, Viridor at Beddington Lane, IVC, Sutton and NLWA, IVC at Edmonton Eco-Park, Western Riverside Waste Authority (WRWA) Wandsworth. Many of the authorities operate a materials 'swap' scheme for local residents to exchange unwanted items.

All the collection authorities encourage home composting, subsidising containers and offering guidance on home composting with the assistance of WRAP. Home composting could produce 105kg per household per year minimising the collecting by 115kg per household (WRAP 2007). Seventeen collection authorities collect kitchen waste, 10 collect as a separate material and 7 collect mixed with garden waste, going for composting at various facilities. Sites used are at Grundon's, Slough; Croydon L B; Beddington Lane, Sutton; Cleanaway, in Essex; BJD, Bromley; Edmonton E-P and Vertal Limited, waste food processor at Mitcham (SW London). Other disposal options under consideration include Autoclaving; Gasification and in-vessel composting, Plasma Arc burning.

Anaerobic digestion is the natural biological conversion of organic materials to methane and carbon dioxide (syngas). The process takes place in the absence of oxygen, the gas may be used for combined heat and power (CHP) (Novera 2006), a typical composition of biogas is 75% methane and 25% CO_2. A number of authorities have or are considering MBT as a means of diverting MSW from landfill. An example of MBT and disposal can be seen in the two plants operated by Shanks Environmental Ltd. in East London. One is in Jenkins Lane, Newham and the other at Frog Island, Havering, Essex.

The East London plants use the Ecodeco© system employing the Biocube® process to obtain the highest possible recovery of energy and materials from MSW, Shanks describe it as the Intelligent Transfer Station (ITS). Receiving recyclate segregated MSW in a fully enclosed building; the waste is shredded to 20 – 30cm. It is transported to an aerobic fermentation area and layered in 6m high rows that are maintained at a temperature of 50 - 60°c for 12 to 15 days. Biodrying takes place and the residue has a heating value between 15Mj/kg and 18Mj/kg. Secondary shredding (10 – 15cm) and extraction of ferrous and non-ferrous metals, glass and stones leaves approximately 50% for use as a Solid Recovered Fuel (SRF). Both plants have an annual throughput capacity of 180,000 tonnes of residual MSW. Outputs are: 50% recovered fuel (fluff, currently supplying energy in a cement kiln) (case study number 9); 25% water and carbon dioxide; 3% ferrous metal; 11% glass and stone; 10.5% fines (compostable or landfill) and 0,5% non-ferrous metal. The resource recovery sites (RRF) also have a material recovery facility (MRF) and a Monsanto Gasification unit.

Gasification is a thermal process in which solid feedstock (MSW) is heated in the presence of steam and a limited amount of oxygen, at temperatures of 700-900°c. This produces an

energy carrying synthesis gas, which is a mixture of hydrogen, carbon monoxide and carbon dioxide. After gas cleaning emissions are substantially lower than incineration. A planning application is in progress for a 90,000tonnes of MSW per year gasification plant in London, technology by Enerkem and operated by Novera Energy. The plant will produce 10MW of electricity for the Ford car plant and surplus to the national grid (DEFRA 2006). Plans by Energos claim Advanced Conversion Technology (ACT) with low carbon monoxide (CO) and nitrogen oxides (NOx) emissions and bottom ash low carbon content has less than 3% TOC.

Energy from waste (EfW) is the thermal treatment of waste to recover renewable energy in the form of electricity and/or heat. Accounting for 22% of municipal solid waste (MSW) treatment in London, EfW plays a crucial role of meeting the targets of the landfill directive. Energy from waste utilises the calorific value of organic material to produce heat; the heat raises the temperature in a water-boiler producing steam power. The steam may be used for heating and hot water supply or to drive a steam turbine to produce electrical power. When hazardous/clinical wastes are incinerated, a temperature of 900/1000°c must be maintained for 2 minutes to ensure vitrification and complete destruction of the waste.

Incineration accounts for about 24% of MSW arising in London. This is via the NLWA power plant at Edmonton (80,000 tonnes / pa), in the South East London Combined Heat and Power plant (SELCHP) (40,000 tonnes / pa) and in Grundon's Incinerator –plant at Colnebrook, West London. Disposal capacity will be available at the Riverside Resource Recovery plant (530,000 tonnes / pa) at Belvedere, South London in 2011. The London Borough of Bexley are contracted, and scheduled to commence delivering municipal solid waste for treatment at the Belvedere resource recovery facility from the 1st of January 2011.

Plasma is a high temperature ionised gas generating intense heat in a safe and controlled manner. Simplistically, it is gasification of organics and vitrification/smelting of inorganic, utilising anode and cathode plasma arcs coupling in free space. The system processes complete destruction of all organic and hazardous wastes.

The Plasma Converter System is an electrically driven system that uses ion-charged plasma to create an arc of lightening that causes the dissociation of the molecular bonds of waste.

The system, which produces temperatures in excess of 15,000°C and transforms carbon based, organic materials into Plasma Converted Gas (PCG), producing a hydrogen rich synthesis gas mixture. Melting non-organics such as glass, dirt and rocks, resulting in an obsidian-like, glassy silicon compound that has useful application for the construction industry. The hydrogen can be separated by filtering out and used as 'Green Power'.

The primary object of composting is to optimise the output of high-quality compost by the transformation of organic materials into humus. The action of the process is aerobic and the nature of the material will influence the method used. Animal by-products must be processed by in-vessel composting (aerobic) unless the waste has been sanitised (ABPR 2002). Other organics e.g. 'green waste' may be screened and shredded to encourage the material to ferment and biodegrade in open windrows. A moisture content of 60 to 70% and oxygen are a requisite (WRAP 2007) the material is turn periodical for about 6 weeks to encourage biodegradation, windblown aerosols may be a health hazard. The carbon/ nitrogen ratio (C: N) is important in compost production, it must be between 25-40:1, municipal food waste is 15. Drainage and leachate control must be adequate; in-vessel system requires gas cleaning and odour control.

Autoclave is a process that uses saturated steam designed for the bio-stabilisation, volume and weight reduction of municipal solid waste. Residual waste is fed into a pressurised vessel where the saturated stream is injected, Organic wastes are cooked and stabilised, glass metals and plastics are delaminated. The result is a cellulosic biomass that is easily screened to extract recyclate. The biomass fibre can be utilised as a timber substitute or as a refuse-derived fuel Fernwwood). The Sterecycle Autoclave Process has plant capacity for 100,000 tonnes per annum, claiming 60 70 % volume reduction; biomass 60% and non-organics 40%. The biomass is 90% fibre with 25% reduction in biodegradability and is readily suitable for composting (WRAP 2007).

4.4. Planning Guidance for the Siting for Enhanced Practice for MSW in London.

The requirement of EU legislation Waste Framework Directive 75/442/EC and amendments 91/156/EEC and 91/689/EEC led to the production of national strategies in the UK. Waste Strategy 2000 and 2007 set the changes, aims and objectives for the management of waste in England to 2020 with reviews in 2005, 2010 and 2015. The policy

introduced the Waste Hierarchy, The Proximity Principle, Self-sufficiency, Consistency and Design-making tools (BPEO). The Planning and Compulsory Purchasing Act 2004 set Planning Policy Statements (PPS), PPS 10 for Forward Development and Planning (FDP), PPS11 for Regional Spatial Planning (RSP) PPS12 for Local Development Framework (LDF).

The Mayor of London was charged with the responsibility to produce a Waste Management Strategy and Waste Management Plan (Tables 1.37 and 1.38). The 33 Municipal Waste Authorities must each produce a waste management strategy and plan for the waste arising in their authority area. The plan must be consistent with the Mayor's Strategy and Spacial Plan. The utmost importance must be given to health and safety of people, animals and the environment with strong adherence to the Waste Hierarchy, sustainability and proximity. Plans formulated by the boroughs must comply with the edicts from the Mayor and be submitted to the Mayor for approval before the plan can be implemented. In the waste management plan, the West London Waste Authority (WLWA) included 100,000 tonnes per year of residual waste to be disposed by incineration at a plant planned to become operational in 2010.

Mayor Livingstone's plan (2007) excluded the disposal of waste by incineration and put an embargo on the plan. The delay in deciding alternative means for disposal and seeking approval meant that the agreement for the incineration of waste become void and the capacity for 100.000 tonnes per year is no longer available. The WLWA have excess residual waste that if sent to landfill will incur a financial penalty (LATS). Fortunately a change in policy (WS 2007) has enabled WLWA to take advantage of 50,000 tonnes of burning capacity available in the incinerator at Colnebrook Resource Recovery Facility.

Example (2) the plan to construct an Energy from Waste (EfW) plant in the London Borough of Bexley started in 1978 was delayed by planning and public enquiries and was finally shelved. The plan was resurrected in 2005 and the Resource Recovery plant is now under construction with a planned capacity to manage 563,000 tonnes of waste per year.

These parameters and the waste strategy targets for increased resource recovery and the minimising of BMW to landfill has influenced waste management planning in London. Waste management plans indicate a preference for aerobic and anaerobic treatment for residual organic waste i.e. after the separation of recyclate. Planned and operational

facilities include 6 MBT plants, 3 In-Vessel Compost Facilities and 2 Energy from Waste plants for the treatment of residual municipal solid waste (MSW) arising in London.

4.5. Summary

Key findings from the research are as follows:

Aims and objectives

to ascertain compliance or non-compliance with requisite targets

- to see what action has been taken to overcome barriers to success
- to find "Best Practice"
- to obtain expert opinion

Aim 1 – objective 1 – Collection

Data for an analysis on the current position was gathered from a questionnaire, published statistics and personal contact with the Principle Officers responsible for the collection of municipal solid waste in the 33 London boroughs.
There is a large amount of variation amongst the methods used by the 33 authorities, but there is no single factor that determines the *modus operandii.*

The research shows that within the constraints occurring in each individual borough all the authorities are aware of the legal requirements and are endeavouring to attain the requisite targets.

Recommendation – acceleration of agreement to forward planning for possible changes in the method of storage and collection of residual waste e.g. eliminate bias and prevarication mainly by the elected representatives.

Aim 1 – objective 2 – Barriers

The variability in performance of boroughs is influenced by one or more factors, the barriers that can be overcome most readily, have or are being removed or minimised, the more difficult are being addressed as a matter of priority see 3.1.4.

The Mayor of London has organised the 33 boroughs into 5 geographical regions, for waste management the groupings are inclined to the method for disposal. The Outer

London Boroughs have the capability to operate methods for improvement that are not practicable for Inner London Boroughs e.g. using larger vehicles for collection or using alternative or additional storage containers. Density, ethnicity and transience of the population have an influence on the method of collection to a large extent in the inner boroughs. Road traffic conditions may dictate the hours of operation and the point of disposal, both primary and secondary (see 3.1.3).

The influence of the elected members of the Council on their prioritising of the Council's financial budget and/or their preference for alternative methods for collection/disposal dictate management strategies.

Recommendation: Where possible changes to collection methods are made, but many of these led to higher costs, proximity may be an answer.

Aim 1- objective 3 – Best practice

The actions taken in the short term have proven successful in all the boroughs in their aim to achieve the targets set by the Government, i.e. less biodegradable waste sent to landfill. The borough that has made most progress to attain best value is the London Borough of Bexley.

Recommendation – where circumstances permit other authorities should apply the Bexley formula for staffing and public awareness.

Aim 1 – objective 4 – Expert opinion

The targets for re-use, recycling and composting have been more difficult to attain, but individual percentage increases are encouraging (Bexley 50%, June 2009). The storage and collection of recyclate have improved significantly with the guidance from WRAP and the introduction of additional resource recovery facilities boding well for the future see 3.6 and 3.6.3.3.

The use of alternative methods for the use of resource materials and innovation recovery methods; e.g. mechanical biological treatment (MBT) (see 3.9) with an expansion of the use for energy heat and power. This and the increase in aerobic digestion (composting) have minimised the possibility of incurring increased costs from the escalating increase in landfill tax.

Recommendation – reduce the time taken between the start of a plan and the physical operation of the improved method, (see case study 3.2.6.1), Bias or 'anti' opposition, either environmental (energy from waste) or political be eliminated.

Aim 2 – objective 1 - Treatment

Markets for the re-use and recycling of resource materials recovered from the MSW stream have increased significantly due to the efforts and advice from WRAP (see 3.6), WIP, WID and the Mayor of London's Waste Management Strategy. This has encouraged increased efforts to reach the targets for recycling and comply with the Waste Hierarchy, encouraging acceptance of change and innovation such as WDF, kitchen (see 3.3) and green waste collections (see 3.8); facilities for aerobic and anaerobic digestion (see 3.9) and separation through Material resource recovery plants.

Recommendation – Consider all feasible alternative method for treatment for all the waste arising to attain zero waste (at least to landfill) taking into account cost/benefit, environmental impact and carbon footprint.

Aim 2 – objective 2 – Barriers

Barriers to the treatment of resources from MSW include the reluctance of residents to participate (see 3.5; 3.7), the method adopted for storage and collection and the dearth of outlets for the materials, only paper and metals were assured of some kind of market. The latter, markets, has to some extent been improved through the work of WRAP through funding from Central Government. The operation of the waste hierarchy, proximity and sustainability together with the increase in landfill tax has been the impetus to drive local authorities to reach the requisite targets.

Methods for the storage and collection are dictated by the elected representatives, mainly governed by factors shown in Aim1, obj1. Awareness and education (see 3.4) has been the main problem and measures have been taken to overcome the reluctance of residents to comply with requests for co-operation see case study.

Recommendation – examine guidance from WRAP, WIP, DEFRA, Capitalwaste, etc.

Aim 2 – objective 3 – Best practice

Best Environmental Option (BEO) is important in the treatment of resources from waste; it is imperative that the carbon footprint of option is examined in the early stages of planning. Use new markets and outlets as they come on stream e.g. London Loop for plastic recovery in East London aiming at proximity.
Recommendation – Ensure that a senior, professionally qualified manager with the knowledge and power to progress efficient use of the resource material, labour and transport through the best practicable method is in control.

Recommendation – use Improving Recycling Rates in London.

Aim 2 – objective 4 – Expert opinion

There is a proliferation of advice and expertise available and expert opinion can be obtained from many quarters (see aim1 obj. 4). Personal contact on a 'one to one' basis on the particular method you are interested in could prove very fruitful (see case study 3.9).

Recommendation – Gather as much information as possible from practising operators and stakeholder meetings.

Aim 3 – objective 1 – Disposal

The main objective of the 33 MSW collection authorities in London is to minimise the possibility of a financial penalty under the LATS legislation (see 3.2). To comply with targets set under the EU Directive and Government strategy on recycling and biodegradable waste to landfill and the escalating burden of the landfill tax. The authorities in the five regions (see 3.1) are co-operating in the treatment and disposal of the waste and current practice has reduced biodegradable waste to landfill to less than 60% (DEFRA). Facilities coming on stream and in the construction phase should reduce this by 50% by 2010/13 (see Fig 3.13).

Recommendations – Ensure plans and the construction and use of facilities are expedited as a priority. Increase the ability to recycle to attain at least 40%. Consider the alternatives to landfill including energy from residual waste.

Aim 3 – objective 2 – Barriers

There are few barriers to the disposal of MSW arising in London; the main areas for concern include poor markets for all recyclate. Insufficient capacity to process all biodegradable waste without using landfill, and under use of all treatment capacity. This situation is receiving considerable attention from Central and Local Government.

Recommendation – Consider utilising available capacity in facilities in the private sector i.e. more co-operation with the commercial and industrial waste management sector.

Aim 3 – objective 3 – Best practice

It will be extremely difficult to obtain proximity and sustainability within the London boundary, landfill in the area can be completely ruled out. Utilising all the options, including largely untried innovations will be necessary to attain zero waste (almost possible as plans published by Bexley BC indicate an achievable and viable possibility.

Recommendation – A comprehensive study of the waste arising of a cost/benefit analysis to establish the feasibility in financial, environmental/carbon footprint terms to ascertain the optimum level of targets to attain maximum environmental benefit at minimum cost.

Aim 3 - objective 4 – Expert opinion

The strategic plans for the management of MSW arising in London have been drawn up after lengthy discussion with experts in waste management from government departments, professional advisers, construction engineers and consultants. No one method is suitable for all authorities (see aim 1, obj. 2) but this research indicates that all the London authority's plans for the management of MSW in the Capital augment well up to 2020 and beyond.

4.6. Conclusions

Waste prevention is the first and probably the most important element in the waste hierarchy and every opportunity must be taken to minimise the amount of waste leaving the household.

All 33 of the London municipal solid waste (MSW) Collection Authorities have carried out "Doorstepping" and/or awareness campaigns, as demonstrated by the case studies in the result section. This together, with the accompanying leaflet and other media publicity, has shown compliance with the mandatory targets of the European Directives. The resultant increases in resource material recovered and the decrease in biological waste going to landfill prove the efficacy of the methods employed. The results of the campaigns, showing the progressive increase in householder awareness and involvement in the separation of the dry recyclate and the green/kitchen waste collection are evidence that best practice is working.

London is a metropolis, far greater in population than many countries, and with the added complexities of congestion, multifarious nationalities and a fluctuating and increasing population. Taking these conditions into account and the diversity between the boroughs, together with the boroughs geographical and historical aspects, it would be unfair to label any one borough worse than any other, a critic may suggest that one authority displays greater enthusiasm or manages better than another. The case studies in the result section were not chosen to prove 'best' or 'worst' but as examples of different method of complying with the legislation.

The collection and treatment of recoverable municipal solid waste has largely been slow in complying with the Waste Framework Directive. The major problem was the lack of markets for the recyclable material. Due to the intervention of the Government (e.g. WRAP) and Non-Government organisations this situation has vastly improved. New markets have been established and alternative uses found for re-use of material (e.g. glass back to sand). The case studies illustrate the increase in material resource recovery facilities allowing more types of materials to be recovered.

The management of biological waste has improved with all the authorities aiming to segregate green/kitchen waste for treatment either for composting, 'home' or in a dedicated composting facility e.g. IVC, augmented by the introduction of anaerobic digestion (MBT) to maximise and utilise biogas production and residual derived fuel (RDF). The number of facilities for these activities is planned to increase so that London's municipal waste management will comply with the 'Proximity Principle' and 'Sustainability'. With the evidence of newly operational and planned facilities for the treatment if MSW arising in London, objective for treatment (3.1.2) is achieved.

A primary objective of the municipal solid waste management in London is to collect and dispose of the municipal waste arising with the least possible cost to the ratepayers. The plethora of legislative requirements incurs unavoidable costs and possible financial penalties (LATS). Many methods for disposal of the waste are used or are being considered in line with the waste hierarchy.

Waste Strategy 2007 indicates that the use for heat recovery from 25% waste is a desirable option. Aerobic (IVC) and anaerobic (MBT) digestion, Gasification and Autoclaving methods for disposal are also approved methods to possibly minimise the tonnes of biodegradable waste going to landfill.

The MBT described in case study number 9 (ELWA) is the fore-runners of several more in the discussion and planning stage for MSW arising in London, the treated waste is utilised as an energy source. The additional use of heat recovery at Belvedere (RRF) and at Colnebrook (Grundon RRF) is a step forward. The planned MBT plants planned in Southwark, North London Waste, Sutton and Brent will make a big difference as will the AD; Combined Heat and Power plant (CHP) in Edmonton (Greenstar) and In-vessel Composting in Croydon (Novera).

The conclusion can be drawn that apart from a possible minor setback in 2013, London's municipal solid waste management will comply with the European Waste Framework Directive in both recycling targets and biodegradable waste to landfill (LAS).

The tonnage of household waste arising that is non-recoverable is decreasing due to alternative routes for disposal and minimisation is still the main priority. Local Authorities in London's spend on waste management in 2007 was £774 million and only £1 million was spent on minimisation, more money and effort should be put into this important area (CIPFA 2008).

Awareness campaigns and publicity should be maintained as a regular feature in the Local Authority's agenda and publications emphasise the adverse environmental impact.

There is evidence that suggests that there is a need to encourage the introduction of environmentally acceptable alternative technologies for the recovery, treatment and disposal of waste material. The Government has gone some way to endorse this philosophy by promoting AD and heat generation.

This research has led to moved date sets that have been evaluated to determine barriers and success factors for MSW management in London. The lessons learned will be used across London to guide future development of sustainable practice.

Many of the London Boroughs, in particular the Inner London Boroughs, have a preponderance of flats and multi-storied premises' this is an area where more research is needed to evaluate the cost and to improve the tonnage of kitchen waste collection.

Future Research

Future research into the management of municipal solid waste (MSW) arising in London must have as it's primary aim zero waste. This philosophy should be applied in the context that after all re-usable, recoverable material in the waste has been utilised as far as is practicable the residual waste is disposed of by using the best environmentally available and acceptable method for the disposal. A fully funded project needs to be introduced soon to determine the possible success factors.

Much of the future research need should be configured around the Waste Framework Directive themes (numbered below) for waste prevention for London. These include:

A. Measures that can affect the framework conditions related to the generation of waste

- The use of planning measures, or other economic instruments promoting the efficient use of resources.
- The development of effective and meaningful indicators of the environmental pressures associated with the generation of waste aimed at contributing to the prevention of waste generation at all levels, from product comparisons at Community level through action by local authorities to national measures.

B. Measures that can affect the design and production and distribution phase

- The provision of information on waste prevention techniques with a view to facilitating the implementation of best available techniques by industry.
- The use of awareness campaigns or the provision of financial, decision making or other support to businesses. Such measures are likely to be particularly effective

where they are aimed at, and adapted to, small and medium sized enterprises and work through established business networks.

- The use of voluntary agreements, consumer/producer panels or sectoral negotiations in order that the relevant businesses or industrial sectors set their own waste prevention plans or objectives or correct wasteful products or packaging.

C. Measures that can affect the consumption and use phase

- The use of awareness campaigns and information provision directed at the general public or a specific set of consumers.
- 16. The promotion of the reuse and/or repair of appropriate discarded products or of their components, notably through the use of educational, economic, logistic or other measures such as support to or establishment of accredited repair and reuse-centres and networks especially in densely populated regions.

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