

The Application of Waste Minimisation to Business Management to Improve Environmental Performance in the Food and Drink Industry

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1. Introduction

The food and drink industry is one of the major sectors in the UK and makes a significant contribution to national and regional economies. The sector produces a large amount of waste compared to other industries and it faces increasing demands to improve resource efficiency and environmental performance through European legislation and policy and UK waste strategy. Waste minimisation is considered to be one of the best approaches for improving sustainability performance in industry, including for the food and drink industry, as it achieves environmental, economic and social benefits by reducing waste at source, achieving cost savings and creating new employment opportunities.

The most cost effective gains will be achieved by companies that apply the “reduction at source” principle at thinking and decision-making stages i.e. in business planning and in business management processes upstream of the production or manufacturing processes. However, what normally happens is that challenges to environmental performance and cost effectiveness are discussed separately by groups such as engineers and business managers. There is rarely an integrated approach.

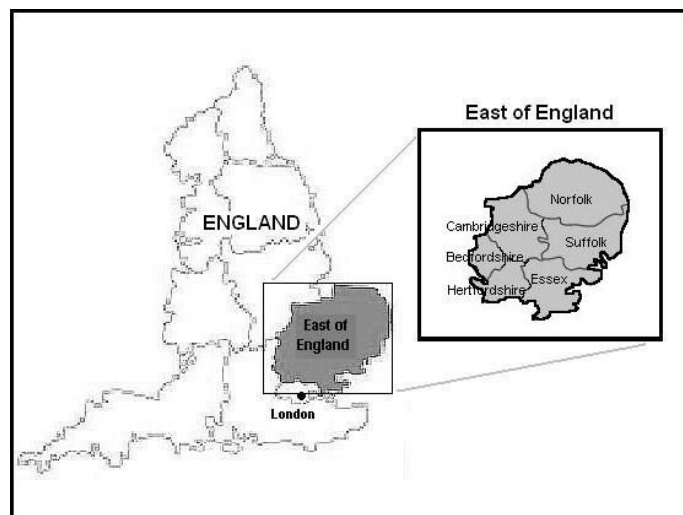
This paper investigates the adoption of waste minimisation practices by the food and drink industry in the East of England. The aim is to identify problems faced by food and drink companies attempting to introduce waste minimisation into their business management, by tracing the link between materials flow studies and business management. The research examined both actual industrial practices and the expectations of key policy makers obtained through questionnaire survey, waste audits, and interviews.

2. Background

2.1 Importance of the Food and Drink Industry

The food and drink industry is the largest manufacturing sector in the UK, with a turnover of approximately £69.4 billion, accounting for almost 15.5% of total turnover by all manufacturing. The sector employs around 500,000 people, representing 13.7% of all manufacturing workforce in the UK (Food and Drink Federation (FDF), 2005). In the East of England (Figure 1), the food and drink industry is an important sector for the regional economy, and is also one of the largest in the UK in terms of manufacturing employment.

Figure 1
Location of the East of England region



Employment by the food processing industry in the East of England represents approximately 14% of total food and drink industry employment for England. In terms of regional turnover, the sector generates £436.4 million, accounting for 5% of the regional GDP and 16.8% of total turnover by the food and drink industry in England. In the East of England, the sector has been identified as having a relatively high location percentage making an important contribution to wider sectoral clusters. This results from the close proximity of productive agriculture and broad food supply chains in the area. The trends for growth of the industry are extremely positive at both national and regional levels (Department of Environment, Food, and Rural Affairs (DEFRA), 2000; Environment Agency (EA), 2004a).

Major sub-sectors of food processing in the East of England include sugar, meat and poultry, refined oil and fats, malt, and starches/starch products (Cambridge Econometrics, 2003). Other significant sub-sectors are bakery products, beverages, confectionary/deserts, dairy, fish, fresh produce, sauces/preserves/snacks, and vegetables (DEFRA, 2000). The remarkable size and scope of the sector is acknowledged by the EA (2004a) as having potential to regularly generate adverse environmental impacts.

In food and drink production, the raw materials originate mainly from agriculture and in turn processing these requires other additives, chemicals, water and energy. The EA (2003) reports that the food and drink industry buys two-thirds of all UK's agricultural products, uses more than 2% of UK power and 10% of the water abstracted by all manufacturing industry. Indeed, it has been reported that of all the manufacturing industries, the food industry makes the largest demand on packaging, representing over 50% of the total value of the packaging industry sales (Lillford & Edward, 1997; Greasby, 1998; Key Note, 2003).

Due to the nature of the food and drink industry, the waste generated generally comprises: dust, odours, combustion gases, and refrigerant leakage into air; biochemical oxygen demand (BOD), chemical oxygen demand (COD), and suspended solids (SS) into waste water; and large volumes of organic and packaging wastes onto land (Henningsson *et al.*, 2001a; Hyde *et al.*, 2001; Henningsson *et al.*, 2004; EA, 2004b). The Policy Commission on the Future of Farming and Food (2002) stresses that packaging and food waste from food processing and its supply chain comprise a large proportion of UK's annual waste production. However, unnecessary resource consumption and inefficient processing, that also impact on the environment and add costs to the food and drink sectors, are also considered to be waste.

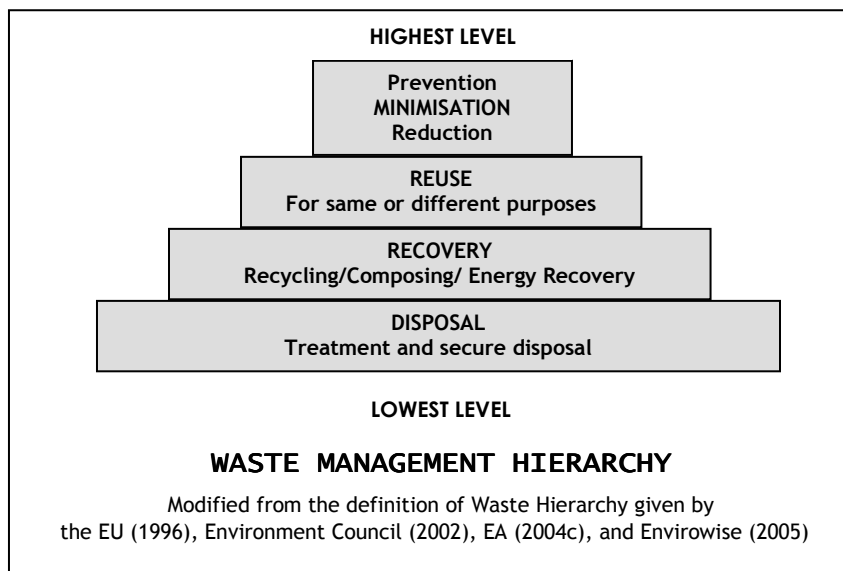
From the EA National Waste Production Survey 1998, waste generated by the food, drink and tobacco industry was the second largest type of industrial waste in the UK. In the same year, the food, drink and tobacco industry produced the largest waste arisings among all industrial sectors in the East of England, accounting for 21.06% of total industrial waste in the region, or 11% of waste for this sector in England and Wales. The largest components of waste from the food and drink sector were general and biodegradable waste (44.3%) and food waste (27.7%) (EA, 2004a).

2.2 Waste Minimisation

Minimisation is at the highest level of the waste hierarchy and is based on the principles of prevention and reduction, to eliminate or reduce waste at source (see Figure 2). The levels are prioritised in the order of: reuse for the same or different purpose; recovery of value or energy from the waste e.g. recycling, composting, and energy recovery; and safe disposal by landfill or incineration. Waste minimisation is considered to be the highest level to reach in the waste management hierarchy as it achieves both environmental and economic benefits by reducing waste and costs at the same time (Bates & Phillips, 1999).

Waste Strategy 2000 for England and Wales (Department of Environment, Transport and Regions (DETR), 2000a, 2000b) states that integrated waste management can guide decision makers to the best alternative for waste management. The strategy requires the implementation of Best Practical Environmental Option (BPEO) (Phillips *et al.*, 2001) which is based on key principles that include: the waste hierarchy, the precautionary principle, the proximity principle and life cycle assessment (LCA) (DETR, 2000b).

Figure 2
Levels of the Waste Management Hierarchy



Despite the priority of the waste management options, the application of the hierarchy can be flexible as long as the chosen technique(s) is(are) the most appropriate way(s) in practice. In fact, waste minimisation has no rigid definition. It involves any technique/process/activity which either avoids/eliminates/reduces a waste at its source,

usually within the confines of the production unit, or allows reuse/recycling of the waste for benign purposes (Crittenden & Kolaczowski, 1995; Ciambone, 1996; Organisation for Economic Co-operation and Development (OECD), 2001; European Environment Agency (EEA), 2002a).

Proactive firms that actively work to improve their environmental performance can achieve competitive advantage through manufacturing efficiencies and improved yield management by minimising waste. Waste minimisation is an important management tool for a business that aims to be competitive and sustainable. The East Anglian Waste Minimisation in the Food and Drink Industry Project (Hyde *et al.*, 2000) found benefits to business of waste minimisation to include:

- Reduction of operating costs per unit output;
- Improved profitability;
- Improved competitiveness;
- Improved company image and stakeholder confidence;
- Enhanced management profile; and
- Strengthened teamwork and company culture.

2.3 Drivers for the Food and Drink Industry to Minimise Waste

As in other major industrial sectors, the food and drink industry is currently facing demands to reduce their environmental impacts. The Integrated Pollution Prevention and Control (IPPC) Directive (96/61/EC) (The Council of the European Union, 1996) will, for the first time, place new environmental obligations on a range of companies within the food and drink sector. These new requirements for the food and drink industry come in addition to a range of policy instruments produced by the EU, mainly the Landfill Directive (1999/31/EC) (The Council of the European Union, 1999), to reduce the amount of waste, including organic waste, sent to landfill. Many of these policies are based on the waste hierarchy and the European directives have been the main drivers for the development of the UK national waste strategy (Gervais, 2002).

Increasing pressure from European legislation, especially the Landfill Directive (1999/31/EC) has led to the publication of Waste Strategy 2000 for England and Wales (Cheeseman *et al.*, 2000). One target of the strategy is to

reduce industrial and commercial waste going to landfill by 85% of 1998 levels by 2005. In addition, the IPPC Directive (96/61/EC) has become one of instruments that can be used by the regulator to support the objectives of the Waste Strategy to improve the management of waste by industry (DETR, 2000a). Accordingly, a number of major sectors within the food and drink industry are being encouraged to improve waste reduction to help achieve national targets.

The identification of the Best Practicable Environmental Option (BPEO) is a fundamental principle within the Waste Strategy's decision making framework. This identifies waste minimisation, at the top of the waste hierarchy, as the BPEO to be applied by all sectors and operations (DETR, 2000a; Phillips *et al.*, 2001; Pratt & Phillips, 2000). The Waste Strategy has also laid out a framework for regional and local authorities to develop their own waste management plans underpinned by BPEO and the national waste reduction targets.

Despite clear direction on industrial waste management, the Waste Strategy has fewer targets for this type of waste compared to municipal waste (East of England Region Waste Technical Advisory Body (RWTAB), 2002). The targets for municipal waste are a statutory requirement for local authorities, whereas the targets for industrial and commercial waste are voluntary and set to inform businesses (DETR, 2000a). For that reason, the main focus of local waste management plans is on the reduction of municipal waste. However, regional and local authorities are given freedom to deliver a set of plans on sustainable waste management that is consistent with their circumstances i.e. social, environmental, technical and economic factors. Therefore, the regional authority and some local authorities in the East of England have included policies and activities in their waste plans that involve encouraging and supporting waste minimisation in local businesses.

2.4 Business Supporters on Resource Efficiency and Waste Minimisation

Following the Waste Strategy 2000, the Government has established a range of measures to promote sustainable waste management including waste minimisation by businesses. Agencies and initiatives created to help businesses to improve waste management include:

- Waste and Resources Action Programme (WRAP);
- Envirowise; and
- Waste awareness campaigns e.g. through Business Link, etc. (DEFRA, 2001).

WRAP has programmes on waste minimisation, awareness raising and recycling and it works with retailers, consumers and local authorities. Both Envirowise and EA have programmes aimed at producers and manufacturers. Envirowise also has some programmes that target retailers, and the EA has programmes with local authorities (Strategy Unit, 2002).

Envirowise and the EA provide a significant range of resources on waste minimisation to support business. Business Link is another major business supporter funded by national government (through the DTI – Department of Trade and Industry). Branches of Business Link are located in most regions across the UK. They provide business management support and some have environmental business advisors.

Other business support agencies/programmes/campaigns are Action Energy, Institute of Environmental Management and Assessment (IEMA), etc. They have extended their support and services from the national to regional and local levels. In the East of England, local support to encourage the adoption of waste minimisation is available through Envirolink UK (owned by the local Business Link), FoodEast (focuses on the farming and food industries) and other local authority initiatives (examples are given below).

Commonly, county council efforts are devoted to the management of municipal waste. However, most of the councils in the East of England have policies for reducing business waste – also known as trade waste or commercial/industrial waste. Some of the councils have implemented initiatives on business waste, for example:

- Bedfordshire County Council has set up a range of sustainable environmental management programmes, cooperating with businesses and other public sectors;
- Business TravelWise is a programme to promote energy efficiency through business travel plans across Hertfordshire, supported by the Hertfordshire County Council;
- Cambridgeshire Material Exchange is a free information service for businesses to exchange their unwanted materials, funded by Cambridgeshire County Council and the East of England Development Agency (EEDA);
- Eastex is a regional materials exchange that allows users to broadcast their requirements to a wide regional audience where materials are of sufficient value to warrant exchange over larger distances, funded by the East of England Development Agency (EEDA);

- Norfolk Waste Recycling Assistance (NORWRAP) established by Norfolk County Council is a service to assist local businesses with easier approaches to waste recycling,;
- Norfolk Materials Exchange is a free online information service where organisations can access information about redundant stock or surplus raw materials available from other organisations, supported by Norfolk County Council; and
- Peterborough Environment City Trust (PECT) – a partnership initiative of local authorities, businesses, community and environmental organisations in Peterborough city – supports resource efficiency and waste minimisation in businesses through a wide range of services including a waste minimisation club.

2.5 Waste Minimisation in the Food and Drink Industry in the East of England

In the East of England, one of the first projects to focus on waste minimisation in the food and drink industry on a regional basis was initiated as a waste minimisation club (WMC) in 1997. The East Anglian Food and Drink Waste Minimisation Project, a public-private partnership, involved 15 independent regional food and drink companies, whose turnover ranged from £150,000 to more than £100,000,000 (Hyde *et al.*, 2000). During the project, the companies achieved £1,100,000 annual savings from waste minimisation opportunities with an overall average payback time of 8 months (Henningsson *et al.*, 2001a, 2004). This supports previous findings that food and drink companies can make annual savings of greater than 1% of turnover by implementing waste minimisation strategies (Bates & Phillips, 1999; Hyde *et al.*, 2001).

Waste minimisation in the member companies led to the reduction of: (1) waste emissions; and (2) natural resource consumption. Through the waste minimisation opportunities implemented, the Project reduced waste and emissions by 1,370 tonnes of solid waste, 5,950 m³ of effluent, and 650 tonnes of carbon dioxide. In addition, the Project reduced resource consumption by 35 tonnes of paper and packaging, 0.04 tonnes of consumables, 70,000 m³ of water, 1,170,230 kWh of electricity, 6,520 kWh of Gas, and 3.3 m³ of liquid fuel (Henningsson & Smith, 2000).

The Project sought opportunities for environmental improvements and cost savings by applying the principle of reduction at source to material flows and utilities such as: raw materials; manpower; electricity; packaging; consumables; water and effluent; and others e.g. time, space in storage, etc. There were 115 waste minimisation opportunities implemented at the beginning of the project and these grew to 167 overall opportunities because many

savings had an impact on other operational areas. The particular opportunities to achieve the cost savings and minimise waste for the food and drink industry (Henningsson & Smith, 2000) included:

- Raw material efficiency;
- Packaging minimisation;
- Refrigeration efficiency;
- Water efficiency;
- Effluent reduction; and
- Environmental strategy.

Financial savings due to raw material efficiency were found to have the largest potential for the food and drink industry to profit from waste minimisation (Henningsson *et al.*, 2001a). Although cost savings from effluent and waste reduction were lower, these will have a greater priority as land fill and consent charges increase.

The different kinds of implementation techniques applied to achieve the opportunities included: technological change; procedural change; good house keeping; input change and product modification. Technological changes gave the greatest results in financial savings. However, this measure was responsible for the highest expenditure for the Project - approximately 90% of the total capital expenditure by member companies. On the other hand, changes in procedure – at no or low cost – resulted in significant cost savings. Despite the low cost and short payback periods, this measure required significant time, since they required changes to people's way of thinking and behaviour (Henningsson & Smith, 2000). Good house keeping, input change and product modification were simple techniques used to support the other two measures.

The Project established that the WMC approach provided collective benefits associated with teamwork and these were achieved using techniques such as brainstorming, innovation, motivation, knowledge transfer, and management strategies. It was also suggested that essential catalysts to raise waste minimisation awareness amongst the whole food supply chain – to suppliers and beyond the sector to food retailers – were (1) optimising waste minimisation opportunities in the area of putrescent waste and packaging, and (2) improving consensus and dialogue (Hyde *et al.*, 2001, 2003).

3. The Investigation

The investigation reported here comprises research on: (1) waste minimisation awareness and performance of food and drink companies; and (2) the policies and actions of government and business support organisations' to promote waste minimisation in the food and drink industry. Four different research methods were applied in the investigation:

- A questionnaire survey of environmental performance and waste minimisation awareness in food and drink companies mainly in the East of England;
- One-day waste audits for the companies who completed the questionnaire and volunteered their sites for the audits;
- In-depth follow-up interviews some time after the audited companies had received the audit report and recommendations; and
- Structured interviews with key policy makers and influential organisations at national, regional, and local levels.

Initially, companies were recruited via telephone and face-to-face conversations after which the questionnaire was sent by post or email. Later, the questionnaire was sent directly to companies with a covering letter. 47 companies were approached via prior personal contact resulting in 15 completed questionnaires (32% response rate). 1,117 companies were approached directly resulting in 24 completed questionnaires (2% response rate). Overall, 1,160 companies were approached with an overall response rate of 3.4%. Ten of the food and drink companies surveyed (25.6%) opted to participate in the waste audits.

4. Results

4.1 Questionnaire Survey of Food and Drink Companies

The 39 companies that completed the questionnaire were classified into 15 different types of products/services as follows:

- Bakeries and confectionery (5)
- Catering food and supplies (4)
- Alcoholic beverages (4)
- Fresh meat, poultry, eggs (4)
- Chilled/ frozen foods (4)
- Animal foods (3)
- Food import and retail (3)
- Soups, sauces, puddings (3)
- Health foods (2)
- Food flavours/ additives (2)
- Cereals (1)
- Bottled water (1)
- Fresh vegetables/ fruits (1)
- Coffee and supplies (1)
- Fruit juices (1)

The companies were mainly located in the East of England (59%) and Greater London (15.4%). Others were from the North East, East Midlands, West Midlands, and South East regions. The majority who answered the questionnaire (over 50%) were the companies' top management i.e. proprietors and directors. Other interviewees were managers/officers from different departments i.e. technical and engineering (12.8%), environment (7.7%), health, safety and environment (7.7%), quality assurance (7.7%), utilities management (5.1%), and production staff (5.1%).

Of the participating companies, approximately 69% were small and medium enterprises (SMEs). The survey results revealed that when compared to large enterprises, SMEs were reluctant to join a waste minimisation programme. Large enterprises were more likely to have an interest in participating in the further research phases, compared to SMEs. A number of family-run micro companies that did not participate in the survey reported that they considered their companies to be too small to benefit from waste minimisation.

Of the 39 companies surveyed, waste minimisation clubs (WMCs) and local environmental networks were used by only two large-sized companies. The company using a WMC was located in Greater London, whilst the company using an environmental network was located in Hertfordshire, the East of England.

Utility consumption and waste management costs for the participating companies accounted for up to £5 million per year, representing as much as 1.4% of annual turnover. Electricity consumption was the highest cost to the companies and solid waste management costs were higher than wastewater management costs. Waste contractors were largely used by the participating companies for dealing with their solid, liquid and hazardous wastes. 11.7% of the companies surveyed reused or recycled their wastewater, 37.8% reused or recycled some solid waste, and 25.6% recovered some solid waste.

Companies, both with and without waste minimisation strategies, were aware of 'inefficient energy consumption', 'inefficient paper and packaging use', and 'unnecessary waste sent to landfill' as their main sources of wastes. However, 'product loss', 'inefficient water consumption', and 'inefficient paper and packaging use' were ranked as the most important waste categories with a significant effect on the companies' planning for waste minimisation. Comparison between SMEs and large enterprises showed that SMEs were more likely to identify waste generation areas as 'overuse of wrapping film', 'poor insulation', and 'material spill through the production lines'. Companies with an existing waste minimisation strategy generally benefited from waste minimisation by less than 0.2% of their annual turnover. Opportunities for waste minimisation in those companies were mostly 'reducing utilities consumption' and 'reducing waste and emissions'. The questionnaire survey did not reveal any significant differences in environmental performance between companies with and without waste minimisation strategies.

4.2 Waste Audits in Food and Drink Companies

Of the ten food and drink companies that opted to participate in the waste audits, six were large-sized, two were medium-sized, and the other two were small-sized enterprises (Table 1). Of the ten companies, six had no explicit waste minimisation strategy. Nonetheless, waste minimisation options, e.g. reuse, recycling, sending waste as animal feed, or composting, were used as part of the companies' waste management strategies.

A waste minimisation audit report was produced for each company that participated in the audits. The report described the sources of waste observed, identified waste minimisation opportunities, and provided other information for waste minimisation awareness raising specific to the circumstances of each audited site.

Table 1
Business Overview for the 10 Audited Companies

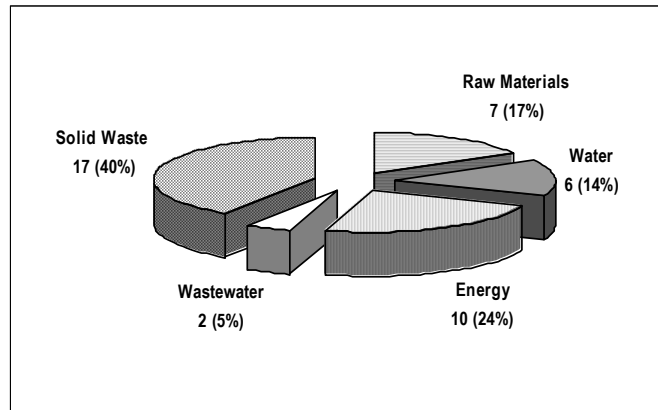
Type of Business	Employees Number	Annual Turnover (£)	County	Waste Minimisation Strategy
Airline catering	>=500	50m - 99.9m	Greater London	Not existing
Cereal manufacturer	>=500	>= 100m	Hertfordshire	Existing
Bottled spring water manufacturer	10-19	1m - 4.9m	Hertfordshire	Existing
Bakery	100-249	1m - 4.9m	Hertfordshire	Not existing
Soups, sauces, and puddings manufacturer	>=500	>= 100m	Norfolk	Not existing
Fruit juices manufacturer	250-499	10m - 49.9m	Northamptonshire	Not existing
Chilled/ frozen foods manufacturer	250-499	10m - 49.9m	Lancashire	Existing
Fresh frozen pizzas manufacturer	>=500	50m - 99.9m	Greater London	Existing
Pastry cases manufacturer	10-19	< 1m	Greater London	Not existing
Retail supplies manufacturer	50-99	10m - 49.9m	Greater London	Not existing

Note: The classification of company sizes is based on the SMEs definition used by the DTI for statistical purposes:
SME – with 0-250 employees (including self-employed businesses)
Large enterprise – with over 250 employees

From the results of the ten audited sites, it was found that: waste associated with solid (organic and packaging) waste sent to landfill and inefficient energy consumption were the most prevalent sources of waste. Moreover, the companies considered these waste categories as priorities for reduction (Figure 3). Financial benefits and supply chain pressures were found to be important influential factors for waste minimisation (Figure 4). Classic problems such as lack of awareness and understanding, and lack of good practice training were considered to be significant barriers for the implementation of waste minimisation (Figure 5). The other key barrier was poor management of packaging materials by suppliers.

The results indicate that successful waste minimisation initiatives within large companies depend on successful awareness raising among employees. On the other hand, SMEs depend on practical solutions that are appropriate to their circumstances i.e. they generate small quantities of waste and have limited resources available.

Figure 3
Priorities for Waste Reduction
 Based on Significant Wastes Identified from the 10 Waste Audits



Note: 60 significant waste issues identified in total

Figure 4
Drivers for Waste Minimisation in the 10 Audited Companies

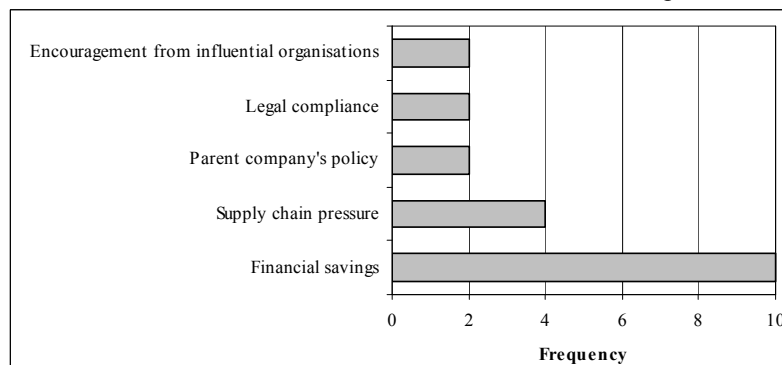
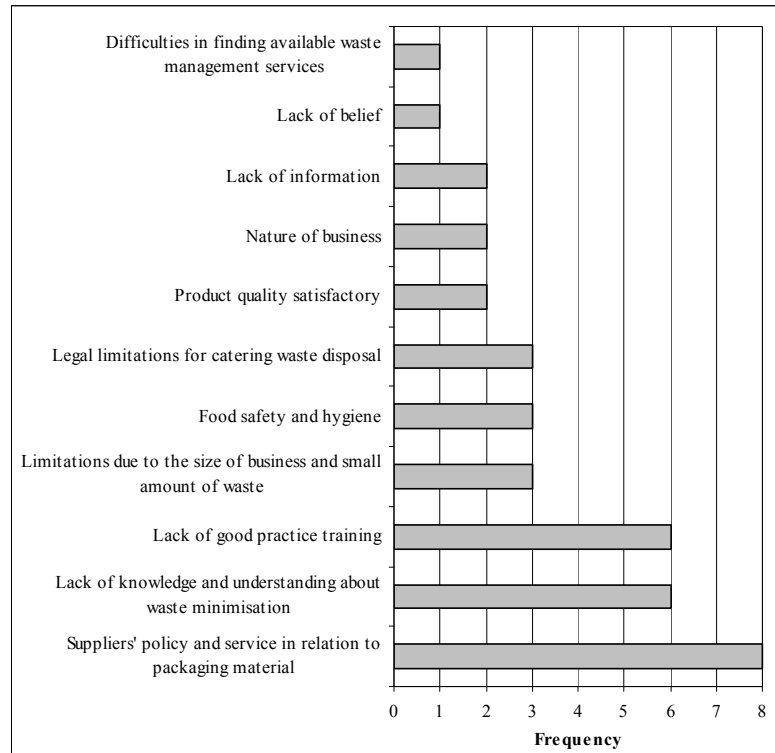


Figure 5
Barriers to Waste Minimisation in the 10 Audited Companies



4.3 Follow-up Interviews with Audited Companies

In depth interviews were undertaken with four audited companies: the airline catering, cereal manufacturer, sauces/soups manufacturer, and fruit juice manufacturer. The audit reports were presented to the companies' top management and waste minimisation recommendations were agreed by management and implemented by the relevant departments within the company. However, due to major restructuring within the airline catering company, the new management did not have the opportunity to view the report. Therefore, some recommendations in the report have not been implemented.

For the fruit juice manufacturer, the waste audit report was used as guidance for their waste minimisation programme. For the other companies, although the waste audit reports reflected problem areas that they were already aware of, they found that waste minimisation opportunities recommended by an independent third party received more attention, and hence stronger support, from senior management and staff.

Despite the differences in waste generation and management, the recommendations for the four companies were all related to food/packaging wastes and energy consumption including:

- Segregation of food and packaging wastes from the general waste stream;
- Increasing the amount and opportunities for packaging recycling;
- Challenging suppliers to take back their packaging or use recyclable materials ;
- Improved energy efficiency by replacing the cold temperature storage systems/equipments with the new systems; and
- Improved lighting systems.

Recommendations that were difficult to implement included the diversion from landfill of waste arising from personal protection equipment (i.e. hairnets, earplugs, gloves, etc.) and canteen food waste. This was due to the quantities of these wastes being very small compared to other types of waste.

Financial savings from waste minimisation for the companies mainly arose from the reduction of overall waste sent to landfill resulting in lower waste disposal costs (Table 2). The companies also generated revenue from selling some types of waste (Table 3). Most of the companies benefited through improved packaging (especially cardboard) and raw materials streams.

Table 2
Successful Waste Minimisation Initiatives within the Audited Companies

Company	Impact from Waste Minimisation
Airline Catering	<ul style="list-style-type: none"> - Overall food waste reduced from 20% to 10% of raw materials - Energy efficiency resulted by new installed freezers - Financial savings from waste segregation and sending packaging waste for recycling
Cereal Manufacturer	<ul style="list-style-type: none"> - Overall waste reduction - Financial savings from waste segregation and sending packaging/food waste for recycling/recovery
Soups/Sauces Manufacturer	<ul style="list-style-type: none"> - Overall packaging waste to landfill reduced by 50% - Diversion of food waste from landfill – to composting - Overall general waste reduced by 20% - Financial savings from waste segregation and sending packaging/food waste for recycling/recovery
Fruit Juice Manufacturing	<ul style="list-style-type: none"> - Overall general waste reduction - Financial savings from waste segregation and sending packaging/food waste for recycling/recovery - Improved efficiency by utility consumption surveys

Table 3
Financial Savings from Waste Minimisation for the Cardboard and Paper Streams
within the Audited Companies

Company	The Amount of Waste Reduction	Financial Saving
Airline Catering	720 tonnes/year – recycled	£30,200/year – saved from landfill charges £14,400/year – received as recycling revenues
Cereal Manufacturer	500 tonnes/year – recycled	£22,000/year
Soups/Sauces Manufacturer	360 tonnes/year (~100%) – recycled	£13,000/year
Fruit Juice Manufacturer	83 tonnes/year – recycled	£4,152/year – saved from landfill charges £1,660/year – received as recycling revenues

In addition to top management support and inclusion of waste minimisation in company policy, education was an essential tool to raise staff awareness and understanding of waste minimisation initiatives and to establish the waste minimisation concept as a part of company culture. The cereal, soups/sauces, and fruit juice manufacturers all confirmed that continual education of staff was an important factor for successful waste minimisation. For the airline catering company, the main factor resulting in large reductions in raw materials consumption and waste generation was an improved production policy which emphasised raw materials and utilities efficiency.

The investigation identified the major drivers for waste minimisation in the food and drink industry as:

- financial savings (for all the four companies);
- parent company support and policy for improved environmental performance (cereal manufacturer);
- regulatory pressure – mainly the IPPC Directive (for the soups/sauces manufacturer); and
- customer pressure – i.e. food retailers (for the fruit juice manufacturer).

A key barrier was found to be limitations in the management of packaging materials according to suppliers' policies and services.

Prior to the audits, only the cereal manufacturer had a waste minimisation strategy. After the waste minimisation audit reports were submitted to the companies, the sauces/soups and fruit juice manufacturers have included waste minimisation in their policy and staff education programmes. Organisational changes in the airline catering company reduced the priority for waste minimisation; however, significant financial savings through raw materials and utility were achieved through operational management.

4.4 Structured Interviews with Key Policy Makers and Influential Organisations

Structured interviews were undertaken with a number of government offices, business support organisations and environmental campaigns at national, regional, and local levels:

A. National level

- Department of Environment, Food and Rural Affairs (DEFRA): Waste Strategy Division Officer
- Envirowise: Environmental Advisor on Waste Minimisation in the Food and Drink Industry

B. Regional level

- Environment Agency (EA): Chair of Essex Waste Minimisation Business Club/ East of England Regional Manager
- East of England Development Agency (EEDA): Business Support Activity – Innovation and European Assistant
- The Government Office for the East for England (GO-East): Head of Sustainable Development Team
- Friends of the Earth (FoE): East of England Regional Campaigns Co-ordinator

C. Local level

- Bedfordshire County Council: (1) Senior Regeneration Officer/ Chair of Bedfordshire and Luton Sustainable Business Partnership/ Managers of business support activities, and (2) Sustainability Officer
- Cambridgeshire County Council: Recycling Officer
- Essex County Council: Waste Reduction Manager
- Hertfordshire County Council: (1) Head of Waste Management, and (2) WasteAware (Hertfordshire's waste reduction campaign) Officer for Welwyn Hatfield District Council
- Norfolk County Council: Business Waste and Environment Assistant
- Peterborough Environment City Trust (PECT): Project Manager for the Business and Environment Management Scheme/ Envirowise Regional Agent (East of England)

DEFRA Waste Strategy Unit provides guidance and financial assistance to local authorities in England and Wales to ensure that Waste Strategy 2000 is recognised and implemented. As the Waste Strategy has a major focus on municipal waste rather than on commercial and industrial waste, the main waste management issue for local

government is the diversion of municipal waste from landfill. Availability of budget was a significant factor for local government in providing support for waste minimisation activities within local businesses.

Some local authorities in the East of England have programmes that promote and support waste reduction and efficiency for businesses within their areas. These include waste minimisation clubs (WMCs), waste exchange information services, business training/guidance on waste minimisation and resource efficiency, etc. Partnerships for some of these programmes are with Envirowise, EA, and regional governments. For some local authorities, encouraging waste reduction in businesses could be justified in the context of their local waste strategy/policy, but there was no funding available in current plans to support implementation of waste minimisation by businesses.

Envirowise was cited by key policy makers and influential organisations at all levels as the key organisation promoting waste minimisation in businesses. Envirowise aims to ensure that waste minimisation concepts and practices are transferred to businesses of all sizes across the UK before its business support programme ends in 2007. Food and drink companies in the East of England were one of the key industry groups targeted by the Envirowise programme, due to the importance of this sector to the regional and the national economies.

The Environment Agency (EA) is the regulator with responsibility for ensuring regulatory compliance in the waste management chain of waste producers and waste operators. The EA indicated that they were concerned that waste recycling rates are compromised by conflict between recycling and other waste management options. The EA also provides guidelines and information to support businesses in regulatory compliance and improved efficiency. From the EA's point of view, waste minimisation case studies produced by Envirowise and WMCs were effective tools to help businesses adopt waste minimisation. However, the EA also noted that WMCs were not effective in reaching all the businesses due to the lack of engagement with business. They also pointed out that lack of information and an unstable recycling market were major barriers to businesses in diverting waste from landfill.

The Strategy for Sustainable Farming and Food (DEFRA, 2002) for England has identified particular themes considered to influence waste minimisation in the food and drink industry and related sectors in the food chain. The Delivery Plan for the National Sustainable Farming and Food Strategy (GO-East & EEDA, 2003), as set out for the East of England, identifies a number of high priority actions in the areas of Business Support and Agri-environment where the application of waste minimisation in food and drink manufacturing companies could be encouraged.

The Government Office for the East for England (GO-East) is responsible for ensuring that the national waste strategy is implemented at regional level, while the East of England Development Agency (EEDA) is responsible for promoting sustainable development and supporting business investment within the region. GO-East acknowledges that EEDA has the lead role in waste management. However, GO-East considered that regional food and drink companies need continued encouragement and support to ensure that waste minimisation is applied effectively across the sector.

Since the East Anglian Waste Minimisation in the Food and Drink Industry Project ended in 2000, there has been no other similar project supporting waste minimisation in the food and drink industry within the region. Although the food and drink industry is one of the major industrial sectors in the region, the sector is not well represented in other regional/local waste minimisation programmes for businesses. Food and drink companies participating in the Bedfordshire Waste Reduction in Industry Project (2002) represented 8% of overall companies from different sectors and in the PECT Business and Environment Management Scheme (2004), only 3% of participating companies were from the food and drink industry.

Friends of the Earth (FoE)'s mission is to challenge government and businesses on environmental issues. They consider 'legal requirements' to be the most effective tools to influence businesses to reduce waste at source. They identified 'concern about the cost of waste minimisation' as the major barrier to waste reduction by businesses.

5. Discussion

5.1 Questionnaire Response Rate

The response rate from the companies was highest where companies were contacted by telephone or in person and invited to participate in the project before the questionnaire was mailed out. However, this method of recruitment is very resource intensive. The overall response rate to the questionnaire survey was 3.4%, compared to mailing response rates in the UK which are typically around 3%, and 1% - 2% for UK industry (Mercer, 1999; Ackroyd *et al.*, 2003; Hyde *et al.*, 2003).

5.2 Position of the Researcher in the Investigation follow-up the Waste Audits

After the waste audit reports and opportunities were presented to the audited companies, the company was left to select and implement the recommendations. The follow-up interviews enabled the researcher to capture the subsequent response of the company to the recommendations in terms of both environmental benefits and cost savings. Although data related to material flows and financial benefits were limited, the results indicate that the waste audit reports and opportunities influenced the companies to implement both policy and practices to improve waste minimisation.

5.3 Requirement for Waste Exchange Information and Business Networking

Some audited companies intended to divert their waste from landfill, but they did not have a good access to waste recycling/recovery information. The companies confirmed that information on waste processors in the waste audit reports provided them with the opportunity to select better waste minimisation options. Moreover, it was found that companies gained more benefits from waste minimisation in areas where waste exchange activities were available and well recognised amongst businesses.

As acknowledged by previous studies (Christie *et al.*, 1995; Welford, 1996; Doniec, 1996; Montgomery, 1997; Phillips *et al.*, 1998; Ackroyd *et al.*, 2003; Hyde *et al.*, 2003), SMEs had insufficient resources for waste minimisation e.g. time, facilities, staff, etc. SMEs had difficulty finding recycling/recovery services that were willing to deal with the small amounts of waste that they generated. Some of the SMEs surveyed had attempted to establish waste minimisation initiatives where facilities and techniques could be shared within their industrial community, but these attempts failed. This reflected lack of awareness of the benefits accrued through sharing best practice via collaboration among small local businesses (Trathen *et al.*, 2002). It demonstrated that external support for local collaborative schemes is essential for the implementation of waste minimisation in small businesses.

Both waste exchange information and business networking, including WMCs, are promoted and supported by government and business support organisations. These include Envirowise and local business support partnership programmes in the East of England. However, the investigation has shown that these activities have yet to gain real traction within the food and drink industry, especially by SMEs. To overcome obstacles to waste minimisation

within the food and drink industry, such as lack of engagement/understanding/knowledge (Phillips *et al.*, 1998; Ackroyd *et al.*, 2003; Hyde *et al.*, 2003), a practical framework is needed that promotes and supports all sizes and types of company in the food supply chain.

5.4 Packaging Waste in the Food Supply Chain

The East Anglian Waste Minimisation in the Food and Drink Industry Project found that (1) the priorities given to food safety and hygiene criteria for food packaging design, and (2) retailers/supermarkets' different specifications on food product packaging were important obstacles for minimising packaging waste in the food and drink industry (Hyde *et al.*, 2001; Henningsson *et al.*, 2001a; Henningsson *et al.*, 2004). The waste audits undertaken in this project found that limited options for raw materials packaging was another major obstacle for minimising packaging waste by the food and drink companies surveyed and audited.

Retailers' differing specifications for food packaging were clearly identified as an obstacle to packaging waste recycling opportunities in one of the audited companies. On the other hand, in two of the audited companies, retailers' packaging waste management schemes assisted waste minimisation for the food producers and along the supply chain. Examples include: using reusable containers to transfer finished products from the factories to retailers and using recyclable product packaging materials specified by retailers. These examples demonstrate that technology and policy transfer or the 'pass it on' factor, according to Hyde *et al.* (2003), may be facilitating waste minimisation practices along the food supply chain.

The UK regulations influencing pollution prevention/reduction and natural resources consumption (such as pollution/resource taxes) have done little so far to stimulate producers, suppliers, and consumers to act on their conjunctive supply chain responsibilities (Hyde *et al.*, 2001; EEA, 2002b; Hogg & Hummel, 2002). The research suggests that pressure on suppliers to the food and drink industry should be increased, both through regulatory and voluntary approaches, in order to maximise the minimisation of packaging waste associated with their products and services. This may include refillable/returnable/reusable product containers, or recyclable/recoverable materials associated with supplied products and packaging.

The packaging from imported products has become a major problem for food producers. Audited companies had to keep a number of containers from imported raw materials on-site as they were non-returnable, non-recyclable, and unacceptable for landfill. The research also suggests that it is essential for the government to consider regulating packaging waste for imported products to allow the food and drink industry to manage packaging materials in a more effective way.

5.5 Waste-Means-Costs Concept

Supply chain pressure is considered as an essential factor in the implementation of waste minimisation in the food and drink industry and associated sectors (Henningsson *et al.*, 2001b; Hyde *et al.*, 2001). Regulatory pressure is another major factor. To ensure that supply chain and regulatory pressures are most effective in achieving waste minimisation throughout the food and drink industry, it may be necessary to integrate the concept that ‘waste means costs’ into both supply chain and regulatory programmes

The investigation found that once a type of ‘green tax’ for businesses comes in force, for example the Climate Change Levy (2001), the businesses affected by that regulation take action to ensure that the extra cost of the tax is minimal or avoidable and in the process, they adopt practices to minimise emissions. This illustrates how the ‘waste means costs’ concept, backed up by legislation, can affect businesses. Moreover, no matter what issue is the company’s top priority, recognition of the ‘waste means costs’ concept ensures that waste minimisation is embedded in the company’s operations and culture. This could encourage companies to adopt practices that integrate ‘waste reduction at source’ approaches into their business structure whilst maintaining their growth and earnings (Ackroyd *et al.*, 2003).

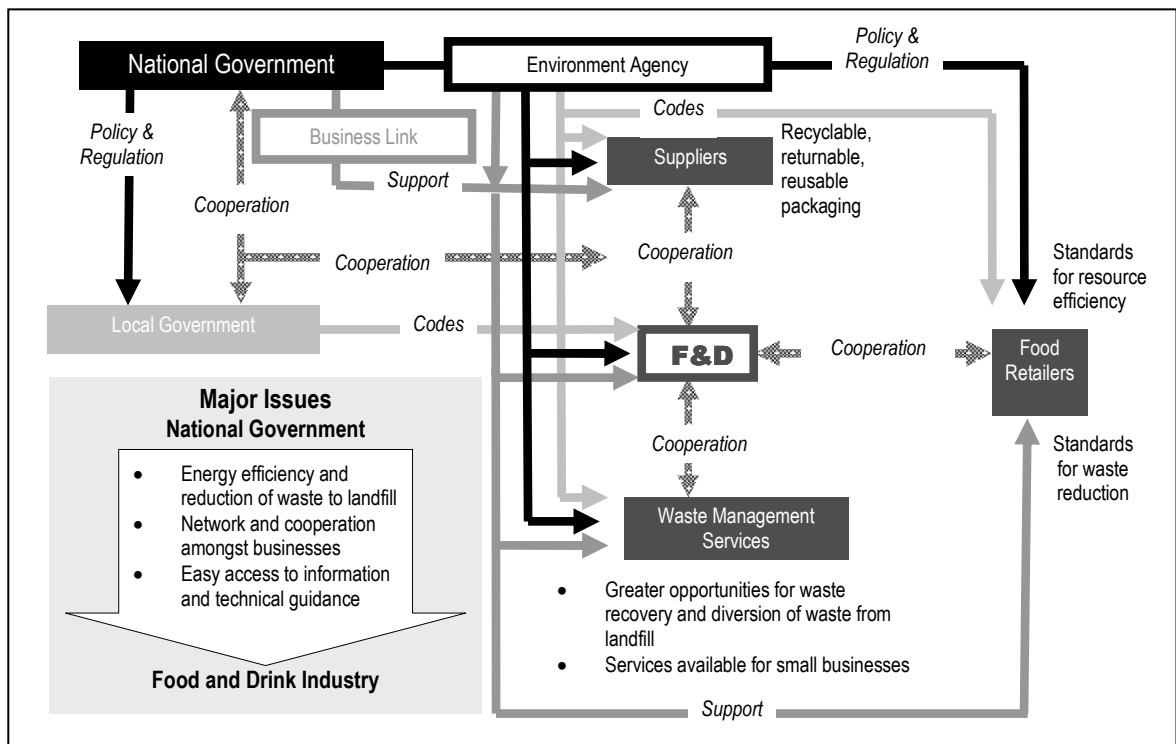
5.6 Proposed Framework for the Promotion of Waste Minimisation in the Food and Drink Industry

Based on the research findings, a framework for effective promotion of waste minimisation in the food and drink industry is proposed (Figure 6).

In summary, it is important that national policy and regulation, aimed at improving resource efficiency and reducing waste, addresses the following major issues for waste minimisation in the food and drink industry:

- Energy efficiency and reduction of waste to landfill;
- Networking and cooperation among food and drink businesses (especially SMEs); and
- Easy access to information and technical guidance.

Figure 6
Framework for the Promotion of Waste Minimisation in the Food and Drink Industry



Central government policy and regulation is delivered locally by local governments and enforced to relevant sectors by the EA. To achieve the government's targets for waste reduction, it is just as important to support regulated sectors as it is to enforce them. Business Link can be an important agent in promoting national government targets to relevant sectors through their business management advisory services.

There is obviously cooperation between the national and local government offices; however, improved cooperation between relevant sectors along the food supply chain (suppliers – producers – retailers – waste management services) and between government and the food supply chain is also required. This will ensure that the framework effectively supports the promotion and implementation of waste minimisation throughout the food and drink industry by delivering the following key improvements, at each step of the food supply chain:

- Suppliers: providing recyclable, returnable, reusable packaging to the food and drink industry;
- Retailers: passing pressures to establish the standards for energy efficiency and waste reduction onto the food and drink industry; and
- Waste management services: providing (1) greater opportunities for waste recovery and diversion of waste from landfill, and (2) services suitable for small businesses.

6. Conclusions

The findings suggest that successful waste minimisation programmes within the food and drink industry are dependent on government legislation and strategy and increased awareness of waste minimisation business benefits for the sector at both national and local levels. Introducing waste reduction requirements throughout the food supply chain and its related industrial community is considered necessary to ensure the adoption of practical waste minimisation measures. Improved markets for recyclable materials, increased cooperation between small food and drink companies to develop shared waste minimisation facilities, and greater involvement of suppliers in resolving packaging issues were found to be important factors in ensuring that the barriers to waste minimisation are reduced for the food and drink industry. Moreover, the investigation indicates that regulation based on the “waste-means-costs” concept is an effective approach to integrate sustainable waste minimisation into food and drink operations and business management.

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