

**WR1403: Business Waste Prevention
Evidence Review
L2m5-2 – Food & Drink Sector**



A report for
Defra

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Context of Project WR1403

Waste prevention is at the top of the waste hierarchy. A major priority of the coalition government is to move towards a zero waste economy, and an important element of this will be to encourage and increase waste prevention. This review aims to map and collate the available evidence on business waste prevention. It will help inform the preparation of England's National Waste Prevention Programme as required under the revised EU Waste Framework Directive (2008).

The focus is on aspects of waste prevention that are influenced directly or indirectly by businesses - it complements a previous evidence review, WR1204, which focused on household waste prevention. The definition of the term 'waste prevention' used here is that in the revised Waste Framework Directive:

'Prevention' means measures taken before a substance, material or product has become waste, that reduce:

- a) the quantity of waste, including through the re-use of products or the extension of the life span of products;*
- a) the adverse impacts of the generated waste on the environment and human health; or*
- b) the content of harmful substances in materials and products.*

Recycling activities or their promotion are outside the scope of this review.

Context of this module

This module is one of a number of Level 2 modules that contain analyses of Approaches, Interventions, Sector Issues and other aspects of the review. This module deals specifically with the aspect of waste prevention in the Food & Drink Sector.

A full map of the modular reporting structure can be found within **L1m2: Report Index**.

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Glossary

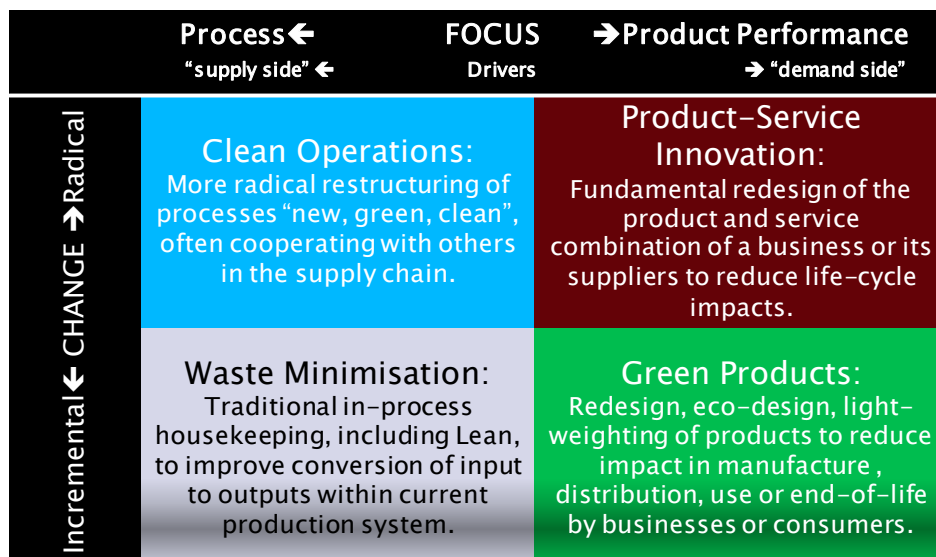
ABI	Annual Business Inquiry	ONS	Office for National Statistics
AD	anaerobic digestion	PET	polyethylene terephthalate
BIS	UK Department for Business Innovation and Skills	PRN	Packaging Recovery Note
CC	Courtauld Commitment	RTP	returnable transit packaging
C&I	commercial and industrial	SCP	sustainable consumption and production
CO ₂	carbon dioxide emissions	SIC	Standard Industry Classification (code)
CSR	corporate social responsibility	SME	small/medium-sized enterprise (EU definition)
Defra	Department for Environment, Food and Rural Affairs	TSB	Technology Strategy Board
EPR	extended producer responsibility	VMI	vendor managed inventory
FDF	Food and Drink Federation	WRAP	Waste & Resources Action Programme
NISP	National Industrial Symbiosis Programme		

Units Conventional SI units and prefixes used throughout: {k, kilo, 1,000} {M, mega, 1,000,000} {G, giga, 10⁹} {kg, kilogramme, unit mass} {t, metric tonne, 1,000 kg}

Language used in this report

This report has used a framework for evaluating both the actions a business takes to prevent waste (the Approaches), and the mechanisms that have catalysed the actions (the Interventions). The detailed description of Approaches and Interventions may be found within the respective modules **L2m2: Approaches** and **L2m4-0: Interventions Introduction**, but a brief reference outline to the Approaches is given here:

Positioning of approaches in response to business drivers including waste



Source: Oakdene Hollins/Brook Lyndhurst

1 The Food & Drink Sector in Context

1.1 Relevant SIC Codes and Gross Value Added

This report assesses waste prevention in manufacturers with Standard Industry Classification (SIC) Division Codes 10 (Food manufacture) and 11 (Beverage manufacture) (Table 1).

Table 1: SIC codes for the food and drink sector

SIC Code		Description
Division	Group	
10		<i>Manufacture of food products</i>
	10.1	Processing and preserving of meat and production of meat products
	10.2	Processing and preserving of fish, crustaceans and molluscs
	10.3	Processing and preserving of fruit and vegetables
	10.4	Manufacture of vegetable and animal oils and fats
	10.5	Manufacture of dairy products
	10.6	Manufacture of grain mill products, starches and starch products
	10.7	Manufacture of bakery and farinaceous products
	10.8	Manufacture of other food products
	10.9	Manufacture of prepared animal feeds
11		<i>Manufacture of beverages</i>
	11.0	Manufacture of beverages

Source: www.statistics.gov.uk

This report includes waste prevention measures taken by companies supplying food and drink products to the hospitality sector as well as retailers. Importantly, it includes actions taken by businesses which enable companies and individuals (including consumers) down the supply chain to reduce waste. The light-weighting of primary packaging implemented as part of the Courtauld Commitment is perhaps the most well-known manifestation. Here, the site of waste prevention is generally in the household, but results from a change in the behaviour of a manufacturer.

In 2009, the food and drink industry accounted for 3% of UK gross value added (GVA).^a The sector is dominated by a handful of big companies with the largest 3.8% of firms producing over 75% of all food manufactured in the UK (1).

1.2 Description of Sector and Recent Trends

Food manufacture is a complex process where production managers must satisfy retailer demands for product quality while complying with strict safety and hygiene standards. The perishability of the product, short lead times and strong dependency on the weather adds to the complexity. Until recently, resource efficiency has been viewed by the industry as an important but perhaps secondary issue (2 p. 54).

^a ONS: Annual Business Inquiry 2008

Major changes in the UK food production and supply chain in the last 30 years include (3 p. i):

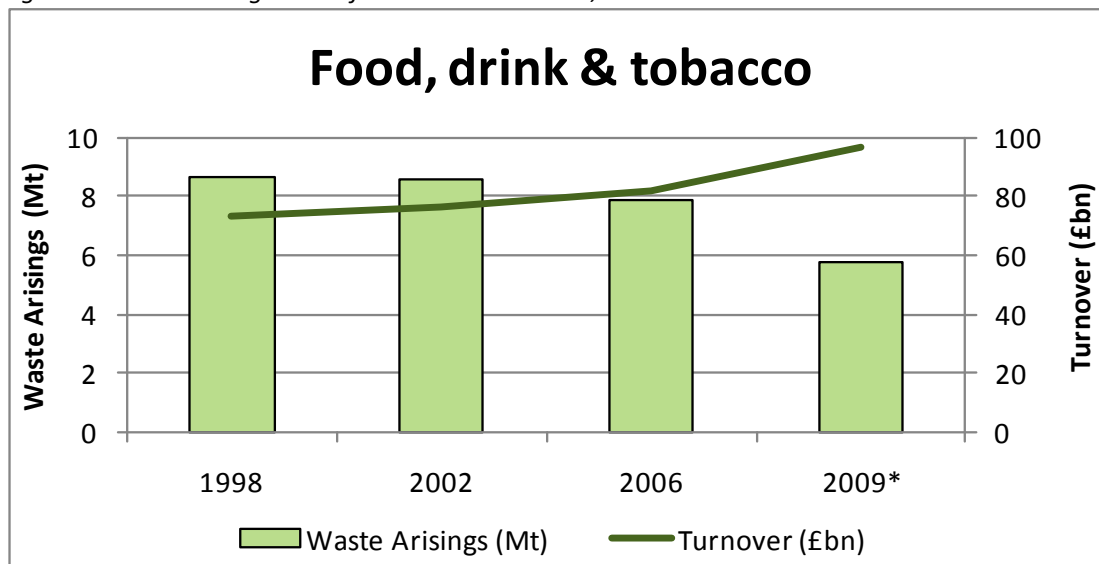
- an increase in international trade
- a consolidation and concentration of the food supply base with increased growth but declining employment^a
- changes in source and delivery patterns
- growth in the convenience and take-away food sector^b
- a shift from local to supermarket shopping.

Among the most important changes is the rise of a small number of powerful supermarket chains in the UK. Reasons for the growth of multiple retailers are complex, but likely factors include rising household incomes, urbanisation and technological advances. The growth in ownership of cars, fridges and freezers which allow bulk-buying and less frequent trips is also important (1 p. 49). Today, two-thirds of food bought from retailers comes from supermarkets (1 p. 45). The retail sector as a whole accounts for 75% of food manufacturers' sales, compared with 10% to caterers and 15% in exports (1 p. 54). Retailers, especially the large ones, are thus well-placed to influence suppliers' waste prevention activity – and, as this report makes clear, supply-chain initiatives are already being used with some success to boost resource efficiency in the sector.

1.3 Waste Arisings, Composition, Trends and Causes

Food and drink is recognised by the European Commission as among four product groupings responsible for 70 to 80% of environmental impact in the EU-25(4).^c Annual waste arisings for the sector are considerable but declining: from 7.9 million tonnes in 2006^d to 5.8 million tonnes in 2009 (Figure 1).

Figure 1: Waste arisings in the food and drink sector, Mt



Source: Defra

*Extrapolation of England survey

^a The UK Department of Trade and Industry predicted production in the food and drink sector would grow by 9.8% between 2002 and 2012 (3).

^b The convenience and take-away food sector has been predicted to grow by 70% between 2000 and 2015.

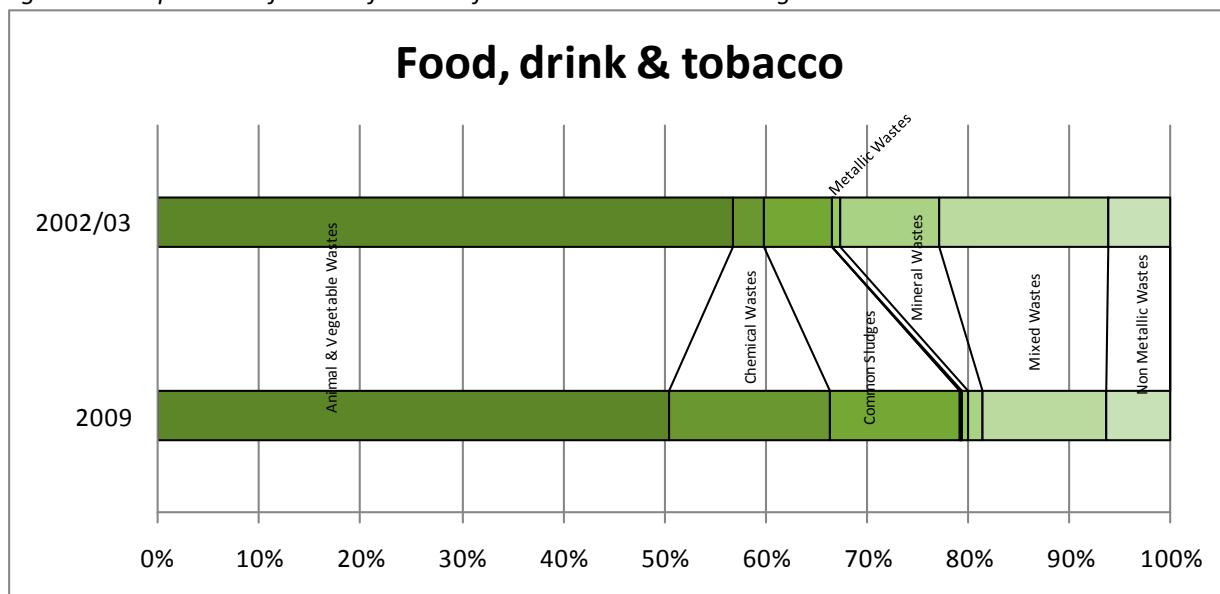
http://www.futurefoundation.net/press_releases/show/19

^c The other three are: passenger transport; housing (including buildings and the appliances in them); and clothing.

^d Defra's 2006 submission to Eurostat

Unsurprisingly, animal and vegetable wastes comprise a large fraction of the overall arisings; however their contribution seems to be declining while chemical wastes and sludges are becoming relatively more important (Figure 2). The reasons for this are unclear.

Figure 2: Composition of wastes from the food and drink sector in England



Source: Defra

According to 2002-3 data from the Environment Agency, the meat and poultry, fruit and vegetables, and beverages sub-sectors account for around half of the volumes of waste arising.^a More recent data were not, however, available. As expected, given consolidation in the food and drink sector, much of the waste arises from larger firms. 2009 data from Defra indicate that 92% of the waste is generated by companies with more than 50 employees, and companies with 250 or more employees are responsible for 60% of the arisings.

In England in 2009, 8% of arisings were sent to land disposal and 24% to land recovery. Other fates include recycling (36%), composting (6%), thermal and non-thermal treatment (10%), reuse (8%) and energy recovery (2.5%). A substantial proportion of the UK food and drink industry's arisings are sold or given away free as animal feed, the material in this context being termed by the industry as 'by-product'.^b By doing this, the sector avoids the normal costs of waste treatment and disposal. The proportion of the 2009 UK arisings sent to animal feed is not known^c, but a 2010 WRAP report (which worked with an earlier overall arisings figure of 7.1 million tonnes) estimated that 2.2 million tonnes of the industry's total arisings were diverted to animal feed (5 p. 31).^d The same WRAP report estimated that the remaining 5 million tonnes account for 27% of arisings in the supply chain (Figure 3) (5).

Due to the nature of food production, some wastes such as vegetable skins, animal carcasses, trimmings and excess fat are unavoidable (6 p. 23), but waste also arises in many avoidable ways (Table 2).

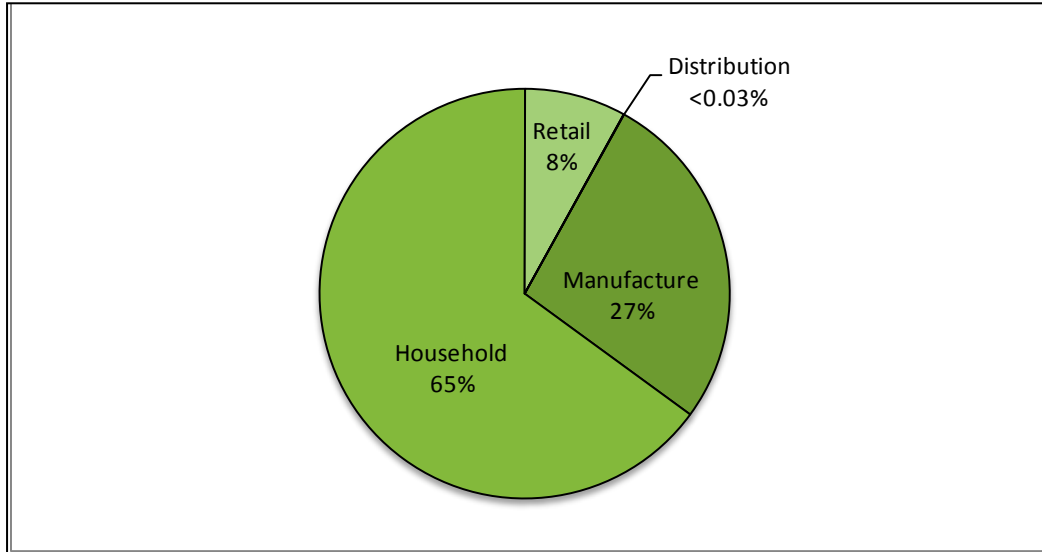
^a Environment Agency Commercial & Industrial Waste Survey, 2002-3

^b The term 'by-product' rather than 'waste' is used for material destined for animal feed because it is deemed by law not to have entered the waste stream. However, it should be noted that reprocessing food material unfit for human consumption as animal feed is 'prevention through reuse' rather than 'prevention outright'. The practice therefore occupies a 'grey area' on the waste hierarchy between prevention and reuse. In principle, better manufacturing practice should result in less 'by-product'. The opportunity to improve performance in this area should not be overlooked.

^c It is possible that material sent to animal feed is included in the 'recycling' figure.

^d In the 2010 WRAP report *Waste arisings in the supply of food and drink to households in the UK*, the figure of 2.2 million tonnes for arisings from the food and drink manufacturing sector re-directed to animal feed was extrapolated from data collected in the survey of Food & Drink Federation (FDF) member sites (*Mapping Waste in the Food and Drink Industry*) published in 2010 (10).

Figure 3: Where waste arises in the UK food and drink supply chain



Source: (5) Based on 2008 data.

Table 2: Causes of avoidable waste in the food and drink sector

Type of factor	Examples
Management factors	<ul style="list-style-type: none"> • Demand forecasting errors • Information sharing • Shelf life policies • Inventory management • Stacking and shelving • Penalties and availability targets • Lack of employee training & awareness • Corporate liquidations
Process factors	<ul style="list-style-type: none"> • Overfills or short fills • Operator error • Poor quality production (e.g. over- or under-baking) • Preparation waste (up to 50% of raw vegetable materials lost) • Inefficient dispensing of supplies waste (up to 5% of raw materials left in containers) • Over-ordering (up to 12% of raw materials lost as perished or out-of-date stock) • Line spillages (up to 0.5% of product) • Changeover or clean down waste
Product factors	<ul style="list-style-type: none"> • Product characteristics (e.g. rejections due to appearance and grading losses) • Over or under Packaging • Product damage • Product recalls • Poor conformity • New Product Development • Dropped products
Environmental and Consumer factors	<ul style="list-style-type: none"> • Customer trends • Weather and seasonality (especially for short shelf-life products) • Catastrophic failures • Cancelled promotions • Last-minute customer order cancellations

Sources: (6); (3); (7); (8); (9)

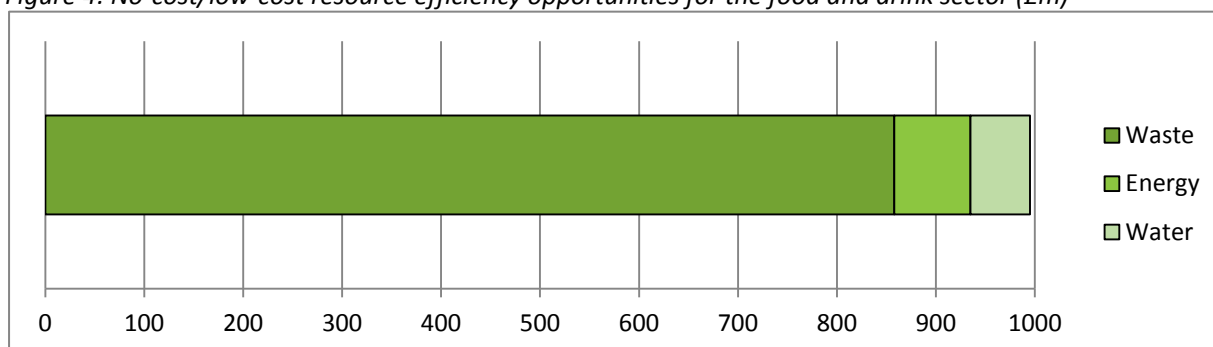
The levels of wastage can sometimes be surprising: one study revealed that, of a 100 tonne batch of biscuits, around 6 tonnes were lost through visible waste and give-away^a before the product left the factory gate(6). Meanwhile, recent reviews funded by WRAP in food and drink manufacturing plants suggested that around 16% of raw materials were wasted on a mass balance basis (5).^b

1.4 Resource Efficiency Savings Opportunity

The national decline in arisings is, perhaps, reflected in surveys of Food and Drink Federation (FDF) member companies. In 2006, for sites providing data, the proportion of waste sent to landfill was 16.5%, while in 2009 it was 9% (10).^c The same report reveals a modest de-coupling of waste generation from production with arisings per tonne of product dropping slightly for a sub-sample of sites.^d

Nevertheless, a huge opportunity to save money through waste prevention remains. Recent research puts economic costs associated with waste generated during food and drink manufacture at around £2.5bn^e. Eliminating all waste during manufacture may never be feasible for financial or technical (such as health, hygiene, safety) reasons, however the sector’s annual low- or no-cost waste saving opportunity is still considerable. For 2006 it was estimated at £858m based on case studies and the potential for “quick-wins”. This figure represents 86% of the sector’s overall resource efficiency savings potential of £995m (11) (Figure 4).

Figure 4: No-cost/low-cost resource efficiency opportunities for the food and drink sector (£m)



Source: (11)

Moreover, it has been estimated that every tonne of food waste prevented can save 4.2 tonnes of CO₂e accounting for emissions released during food manufacture, and those released during decomposition in landfill (12 p. 54).

^a Give-away occurs when, due to filling or measuring inaccuracy, the mass of product exceeds the specified weight resulting in loss of revenue to the producer.

^b Waste Reviews undertaken by Oakdene Hollins at specific plants in the food and drink manufacturing sector. These may not be representative of the whole industry.

^c Some caution should be exercised when comparing data between 2006 and 2009, because respondents to the 2009 survey were not exactly the same as those responding to the earlier one.

^d Total production in 115 sites rose 3% from 5.2 to 5.4 million tonnes per annum between 2006 and 2009, while waste arisings decreased by 16.5%.

^e The total economic cost of waste in the UK food and drink supply chain, and households was estimated at some £17bn (manufacture £2.5bn, distribution £0.11bn, retail £2.35bn and households £12bn).

1.5 Current Waste Management Options

Low- or no-cost interventions suggested in recent reports for Defra (9), BIS (13) and WRAP (5) include:

- quantifying, identifying and challenging absolute raw material wastage (e.g. driving down waste allowances)
- implementing contingency planning for production line stoppages (e.g. developing systems for integrating rework back onto the line)
- reviewing customer quality requirements
- reviewing equipment settings, (e.g. removing subjectivity from production line set up)
- improving operator awareness)
- reviewing and optimising transit packaging (e.g. switching to reusable multi-trip and/or bulk packaging)
- improving storage and stock management systems
- optimising ingredient pack sizes
- improving ordering, forecasting and working with suppliers
- tailoring batches to full stock units
- identifying and preventing spillages
- improving training and internal communications to effect behaviour change (e.g. communicating best practice)
- using multi-trip rather than single-trip packaging where possible.

1.6 Government and Industry Initiatives

Defra's 2007 *Waste Strategy for England* prioritised action in both food and drink and retail, because the sectors are large and growing, an original source of nearly half of all household waste, and have considerable scope for diverting more waste from landfill. To this end, the Food Industry Sustainability Strategy was launched in 2006, with its 'waste champions group' identifying an opportunity of a 15-20% reduction in annual food manufacturing waste arisings by 2010(14).

A high-profile initiative involving both food and drink manufacturers and retailers is the Courtauld Commitment (15), driven in part by public concern over the volume of packaging householders are left to dispose of.^a Phase 1 of this voluntary agreement launched in 2005 with support from WRAP and local authorities had three targets for 2010:

- to design out packaging waste growth (achieved)
- to reduce food waste by 155,000 tonnes per year (achieved)
- to reduce the total amount of packaging waste (not achieved).^b

Phase 2 of the Courtauld Commitment which runs from March 2010 until December 2012, builds on Phase 1 and introduces secondary and tertiary packaging, and supply chain waste. The three targets (measured against a 2009 baseline) are^c:

- to reduce the weight, increase recycling rates and increase the recycled content of all grocery packaging, as appropriate. Through these measures, the aim is to reduce the carbon impact of this grocery packaging by 10%

^a Consumers dispose of around 8.3 million tonnes of food waste and 3.6 million tonnes of associated packaging annually(5).

^b Zero growth in packaging waste growth was achieved in 2008; 270,000 tonnes per year less food waste was generated in 2009/10 than in 2007/08; total packaging consistently remained at approximately 2.9 million tonnes between 2006 and 2009. WRAP suggests that increased sales volume of packaging-rich beer, wine and cider was among factors responsible for the failure to achieve the third target.

^c http://www.wrap.org.uk/downloads/CC_Info_Sheet_23_sept_2010_final.88134f93.9220.pdf

- to reduce UK household food and drink wastes by 4%
- to reduce traditional grocery product and packaging waste in the grocery supply chain by 5%. This includes both solid and liquid wastes.

WRAP is commissioning several research projects to support Phase 2 including:

- identifying ‘hotspots’ where supply chain efficiencies can be made
- conducting selected company waste prevention reviews to develop sectoral good practice
- mapping out the reasons for waste arising
- reviewing sector work programmes to help reduce supply chain packaging and developing more accurate forecasting around product demand.

At the time of writing, WRAP was mapping food and packaging waste arisings in the fruit and vegetable, meat, fish and pre-prepared food supply chains (16). These are likely to provide valuable insights on the potential for waste prevention in both the retail and food and drink sectors, but data were not available within the search timeframe.

Several industry bodies are also encouraging their members to target waste. The FDF, for example, has a target to send zero food and packaging waste to landfill from 2015 as part of its “Five-Fold Ambition”. In its 2010 Environmental Report (17), the FDF now pledges to align the scope of wastes covered in this target with those covered by Phase 2 of the Courtauld Commitment and to make “a significant contribution to ... reduce product and packaging waste in the supply chain by 5% by end of 2012 against a 2009 baseline ... [including] manufacturing waste sent to sewer or controlled water course.” (See module **L2m4-4: Commitments** for more information). FDF members are also participating in a project to promote the optimisation of goods in packaging, known as “production-ready packaging” and are aiming for a 1,000 tonne reduction in goods-in packaging waste by May 2011. To date, 17 FDF members are working with the food charity FareShare to redistribute surplus, fit-for-purpose food and drink products (see Section 3.2). More information on progress towards FDF’s Five-Fold Ambition is available in *Five-fold Environmental Ambition: Progress Report 2010 Building on Success* (17) and in Box 1.

Box 1: The Food & Drink Federation's Five-fold Ambition

In, 2007 FDF (the Food & Drink Federation), the leading trade association for the UK's food manufacturing industry, launched its Five Fold Ambition covering key environmental themes including greenhouse gas emissions, waste and transport. Three years later the body updated its targets, making some more challenging:

- Raising its 2020 CO₂ reduction target from 30% to 35%.
- Accelerating progress to its 2015 zero waste to landfill target and contributing for the first time to a supply chain waste prevention target: namely to reduce waste in the supply chain by 5% by the end of 2012 against a 2009 baseline.
- Adopting WRAP's Courtauld 2 Commitment as the basis of a packaging target with a new aim to engage with consumers.
- Building on the Federation House Commitment on water efficiency to develop guidance on water use and management in the supply chain.
- Continuing to embed environmental standards through its 'fewer and friendlier' transport commitment and contributing for the first time to IGD's Sustainable Distribution initiative.

To meet their commitments, members have trialled and adopted a range of waste prevention measures such as investment in new technology to improve the efficiency of food preparation, returnable and bulk transit packaging for raw ingredients, and the light-weighting of primary packaging.

Business Benefits

- While the FDF's waste target focuses on landfill diversion, data from 2009 data suggests a modest decoupling of waste generation from production with arisings per tonne of product dropping slightly at some FDF member sites. This could signify less wasteful processes and that true waste prevention is happening.

Drivers

- The UK's landfill tax escalator is likely to have been a driver for the Zero Waste to Landfill commitment.
- While cost-saving is a motivating factor, the PR value of improving the environmental reputation of its members is also a consideration for FDF which in 2010 published *Building on Success*, a glossy report detailing progress towards the five goals.
- The opportunity to contribute to society - as well as to save on disposal costs - may have encouraged 17 FDF members to work with the FareShare to redistribute surplus, fit-for-purpose food and drink products to disadvantaged people.
- WRAP's Courtauld Commitments have provided extra impetus for FDF ambitions on waste and packaging reduction.

Key Elements for Success

- FDF members are now working to optimise goods in packaging, known as 'production-ready packaging' and are aiming for a 1,000 tonne reduction in goods-in packaging waste by May 2011.
- Unilever, a high prominent FDF member, trialled new technology at a plant in Essex aimed at tackling the waste generated when a process line switches. 'Sensory analysis' equipment identifies ingredients left over in the production of one low-fat spread brand for re-inclusion in a different brand.

2 The Nature of the Evidence

Studies have emphasised the paucity of data with which to map resource flows. For instance, a 2007 report for Defra on the opportunities to reduce waste in the food production chain found that it was “difficult to obtain robust data on resource consumption (especially from SMEs – which make up a large part of the industry)” (2 p. 6). Much of the evidence available for review on UK based waste prevention has been published by just two delivery bodies: WRAP and Envirowise. Within the food and drink production sector, the Environment Agency’s Commercial and Industrial (C&I) Waste Survey 1998/9, considered the best available at the time, sampled only 3% of food and drink businesses, although recent C&I surveys have been more robust. Given the main sources of the evidence reviewed, results will tend to emphasise the role of external business support in enabling waste prevention. With the exception of the Courtauld Commitment and similar initiatives coordinated by these organisations, their evidence tends not to identify or emphasise voluntary initiatives. Although this mapping exercise has tried to identify examples of failure, the evidence which is published by public sector bodies understandably focuses on the positive exemplars in their mission to encourage other participants and demonstrate progress.

Efforts have also been made to draw evidence from other sources including companies’ own Corporate Social Responsibility (CSR) reports although again these are unlikely to be impartial. Moreover, as noted by a 2008 study for Defra on the retailer-food supplier trading relationship, “many organisations do not collect waste data systematically and others are not willing to share this data openly” (6 p. 89). This view is reinforced by the observation that some member firms declined to provide data for the FDF 2009 waste survey. Where companies have developed new systems for reducing wastage, they may be reluctant to divulge information which they consider gives them a competitive advantage. Our ranking criteria for the evidence we have reviewed placed papers in peer-reviewed academic journals as the most independent of sources but, in practice, few of them separate the results of waste prevention activities from more general environmental measures.

The metrics for waste prevention used are usually financial savings per year (£/yr) or material savings per year (t/yr). Carbon dioxide savings are also sometimes reported (tCO₂/yr).

This review strictly focuses on waste prevention behaviour in the food and drink manufacturing sector. The growth in alternative models of food distribution and consumption, for example, the home delivery of organic vegetables, farmers markets, home-growing of food in allotments, and so on, is important and are briefly discussed in Section 3.5. Such developments can be viewed as a pushing of food processing all the way down the supply chain to the end-consumer and certainly result in packaging reduction. In addition, consumers may be less likely to reject food sourced in this way for cosmetic reasons – a significant source of waste in the food and drink manufacturing sector. These alternative models have not been considered here however as (a) waste prevention evidence is slim and (b) they should be considered under either Agriculture (not in scope) or Retail (**L2m5-4: Retail Sector**). In a similar vein a restaurant is a well-established product/service innovation for food delivery, and would be covered under Hospitality (**L2m5-3: Hospitality Sector**).

3 Evidence of Waste Prevention

3.1 Introduction

Policy and corporate emphasis in this sector has until recently focused on landfill diversion rather than on true waste prevention. Collections of food waste from households and businesses for treatment by in-vessel composting and anaerobic digestion is a favoured management option. Reliance on such 'end-of-pipe' solutions may be misplaced though: reduction of waste at source can offer far greater savings. This would also apply to the redirection of by-products as animal feed^a (which is within the strict definition of waste prevention). The selling of by-products as animal feed saves approximately £85/t (assuming £30/t revenue and £55/t landfill cost), but the true cost in wasted raw materials, energy, labour and inputs before retail is at least £500/t(5).^b Thus, waste prevention could save at least £555/t.

Such savings are typically achieved by simple housekeeping improvements. Larger savings may be possible where the focus falls outside the boundaries of a specific firm and rests instead on the transactions along an entire supply chain, often as a result of voluntary agreements (Section 4.4).

3.2 Waste Minimisation

Evidence of waste minimisation in the food and drink sector was rare. One reason for this may be that the majority of activity in this area is considered as normal business practice and therefore not reported. Where details are available, evidence centres on the implementation of waste monitoring and auditing at all stages of a production process which can realise considerable savings (8 p. 1280). Better staff training is also seen in some cases.

As Table 3 shows, precise details of the approach may not always be available. Examples include:

- A 2009 study on waste prevention in an unnamed convenience food manufacturer found that "constant monitoring of production wastes led quickly to considerable reductions of weekly waste costs from £35,000–40,000 per week to around £15,000–£20,000 per week" (8 p. 1280). Building on the success of the Courtauld Commitment, in 2009/10 WRAP signed up 81 flagship food and drink manufacturing sites in the UK to complete on-site waste and packaging audits (9).
- With Envirowise support, Norfolk-based Fisher Foods solved the problem of excessive trimming of raw materials by improved training of staff, combined with photographs of best practice and supervision. The scheme cost £30,000 to implement, but resulted in cost savings of £100,000/yr (18 p. 15).
- The ENWORKS-run North West [of England] Waste Minimisation Project between 2004–8 resulted in average annual savings of £37,941 per business across 112 food and drink companies in the North West - more than treble the opportunity from better diversion of waste from landfill diversion (approximately £10,500 annual savings per business based on 18 companies) (13 p. 24).
- The 1997-2000 East Anglian Waste Minimisation in the Food and Drink Industry Project (see Box 2) involving 15 independent companies achieved net annual savings (from waste, water and energy efficiencies) of £1.1m from a total capital investment of £726,000. Raw materials use and solid waste production was reduced by 1,370 t/yr (19).

^a Animal By-Products Regulations (introduced in following the BSE outbreak) exclude certain materials being diverted to animal feed including animal by-products and all catering waste from domestic and commercial kitchens.

^b WRAP estimates the value of a tonne of food unnecessarily wasted at around £2,000 - an average based on different values for public sector, retail, hospitality (Defra, personal communication).

Box 2: East Anglian Waste Minimisation in the Food and Drink Industry Project

Running between 1997 and 1999, the East Anglian Waste Minimisation in the Food and Drink Industry Project was a partnership between ten public and private sector organisations. The aim was to help 13 independent food and drink manufacturers to prevent waste in their operations by support in the form of a prescribed training programme with distinct learning outcomes. Topics ranged from mass balance and material loss calculations through project management skills. Members contributed to the programme design and were supported in workshops and training on specific technologies.

Business Benefits

- Solid waste production was reduced by 1,370 tonnes per year.
- The East Anglian Project achieved net annual savings from waste, water and energy efficiencies of £1.1m from a total capital investment of £726,000. These savings represented an average of 0.4% of company turnover.

Drivers

- Food and drink companies were motivated to participate in the East Anglian Project by potential to save money.
- The opportunity to receive collaboratively funded training and consultancy support was another driver.
- Regulations apparently did little to stimulate producers, suppliers and consumers to act on their collective supply chain responsibilities.

Key Elements for Success

- Reduction in the use of raw materials use through simple procedural changes such as input changes, product modification, and good housekeeping were very important, representing £350,000 of total annual savings, with an average payback of less than one month. However, these measures required intensive staff and management time to change current practice.
- While investment in new technology yielded the greatest financial savings, such measures were among the most costly. However, payback on these investments was typically less than 8 months.
- Participants found that the progress-sharing/workshop approach was especially valuable.
- The East Anglian Project engaged and fostered a champion in each company; the same person who attended training events was then responsible for training colleagues.

The following savings in the food and drink sector through waste prevention have been claimed by Envirowise (3):

- Baked bean production - £86,000/yr savings through improved maintenance and process modifications
- Baking - £56,700/yr savings achieved with a further £14,300/yr identified
- Brewing - £300,000/yr savings identified
- Distilling - £1.2m/yr savings identified
- Soup production - £100,000/yr savings achieved through procedural changes and reduced raw material rejection
- Various processed foods - £618,000/yr savings achieved with payback time of less than six months, 70% of savings were from 'no-cost/low-cost' measures.

Table 3 summarises evidence for waste minimisation approaches to waste prevention in the food and drink sector.

Table 3: Summary of waste minimisation evidence

Category	Supported	Description	Outcomes	Ref ID
Better staff training	Envirowise	Fisher Foods solved problem of excessive trimming of raw materials by improved training of staff, combined with photographs of best practice and supervision	cost savings of £100k/yr; scheme cost £30k	(18)
Monitoring & audits	No	Unnamed convenience food manufacturer introduced constant monitoring of production wastes	weekly waste costs reduced from £35-40k to £15-20k	(8)
	WRAP	WRAP funded 81 flagship food and drink manufacturing sites complete on-site waste and packaging audits	n/a	(9)
Process modifications	Envirowise	Baked bean manufacturer improved maintenance and process modifications	£86k/yr savings achieved	(3)
	Envirowise	Waste prevention in soup producing company	£100k/yr savings achieved through procedural changes and reduced raw material rejection	(3)
Unspecified	Various	East Anglian Waste Minimisation in the Food and Drink Industry Project – 15 companies	£1.1m/yr in total resource efficiency savings from investment of £726k; raw materials use and solid waste production reduced by 1,370 t/yr	(19)
	ENWORKS	North West Waste Minimisation Project – 112 food and drink companies	£37,941/yr per business (average)	(13)
	Envirowise	Waste minimisation in baking company	£56.7k/yr savings achieved with further £14.3k/yr identified	(3)
	Envirowise	Waste minimisation in brewing company	£300k/yr savings identified	(3)
	Envirowise	Waste minimisation in distilling company	£1.2m/yr savings identified	(3)
	Envirowise	Waste minimisation in various processed foods companies	£618k/yr savings	(3)
Reuse of surplus food by charities	FareShare scheme	Nestlé redirected 523,820 surplus meals to the charity	In 2008, 1.3kt waste and surplus saved; 5,826 tCO ₂ (e) saved	(5)
	FareShare scheme	Total diversion of surplus food from UK retail, manufacture and hospitality sector through FareShare	3kt of food waste saved in 2009-10	^a

The donation of surplus food to charitable organisations, a different form of waste minimisation, is regarded as waste prevention rather than landfill diversion because the product is used for its intended purpose (i.e. human consumption) which is a goal of food waste prevention policy. FareShare, a national charity that redistributes food in the community, is well known for its participation with leading retailers and food and drink manufacturers. For instance, Nestlé is notable in helping to establish FareShare 1st as a “one stop shop” for handling surplus food from the industry. In 2008, surplus food from Nestlé provided 523,820 meals. In the same year “1,294 tonnes less waste and surplus went to landfill, saving 5,826 tonnes of CO₂ emissions” (20). Overall, the tonnages diverted through FareShare are still relatively small at around 3,000 tonnes in 2009-10, although this equates to some 6.7 million meals. Food and drink manufacturers account for 61% of the food redistributed by FareShare in 2009-10, while 31% comes

^a Fare Share’s Marketing & Communications Manager, personal communication, January 2011

from retailers and 8% from the hospitality sector. The charity reports: *“The most successful partnerships we have are the ones where FareShare has been fully integrated into a company’s business processes, and all levels of the company are aware and it is an organisational priority to work with FareShare to ensure that surplus food is identified as early on as possible to give us enough time to redistribute it to our community members and for them to provide it to their clients within the life of the products.”*^a

Box 3: Surplus food redistribution by FareShare

FareShare is a national charity redistributing surplus arisings from the UK’s food industry to homeless hostels, breakfast clubs, women’s refuges and other good causes. The charity works with many big names including Sainsbury’s, Nestlé, Sodexo and Brakes and operates 15 depots including two in London. The most recent was opened in Llandudno, North Wales. In 2009/10, FareShare estimates that around 3,000 tonnes of surplus - the equivalent of 6.7 million meals - were redistributed. 29,000 people a day benefited from FareShare food. This is food that would otherwise have been disposed of, often to landfill. Food and drink manufacturers accounted for 61% of the food redistributed in 2009-10, while 31% came from retailers and 8% from the hospitality sector.

Business Benefits

- Assuming it can be done efficiently and safely, redistributing surpluses to charity not only helps vulnerable people but saves food businesses significant disposal costs; however, not producing the waste in the first place would, theoretically, save companies far more money.
- The PR value of giving food to charity rather than dumping it is likely to be considerable.
- Preventing food waste also reduces greenhouse gas emissions.

Drivers

- The CSR agenda is an important motivator; many participating businesses publicise their involvement with FareShare in their CSR reports.
- For some businesses, procurement pressure may have driven participation. According to FareShare, many food and drink manufacturers got involved after being encouraged to do so by their retailer customers. The manufacturers’ own trade body, the Food & Drink Federation, is also a strong supporter of the scheme, with 17 members now collaborating with FareShare.

Key Elements for Success

- Timing is key. The surplus food often has a short shelf-life so partnerships are most successful when FareShare is integrated into a company’s business processes, all levels of the company are aware, and surplus food is identified as early on as possible.
- FareShare focuses its efforts on handling food from further up the supply chain as surpluses available at store level are small compared to those available at warehouse or manufacturer level. However, the charity does collect from a limited number of stores, for example, when stores are conveniently located on the way back from a delivery to a Community Member.
- FareShare has enjoyed the support of the UK Government. For example, a past Secretary of State wrote to retailers encouraging them to work with the charity. FareShare has also been referenced in the former Labour administration’s food strategy ‘food2030’ and is promoted by WRAP.

^a Fare Share’s Marketing & Communications Manager, personal communication, January 2011

3.3 Clean Operations

Clean operations in the food and drink sector typically centre on:

- returnable transit packaging (RTP)
- bulk supply of ingredients
- investment in new technology
- improved demand forecasting.

As discussed in Section 1, alternative models of food distribution and consumption such as the home delivery of organic vegetables can also, arguably, be viewed as a clean operations approach in the food and drink sector. However, these have been excluded from the present review.

Returnable transit packaging (RTP)

Evidence exists for waste prevention resulting from the use of returnable and reusable secondary (i.e. transit) packaging. Examples of RTP systems include:

- The Tesco 'green tray' system which, according to the retailer's website, saved 132,000 tonnes of cardboard packaging in 2007/08.^a
- The Swedish 'Eurocrate' system, introduced in the mid-1990s with funding from EU's LIFE programme, wherein single-trip wooden packaging for food and drink products was replaced with reusable plastic pallets and crates. By 2004, 1,753,000 crates were in circulation resulting in annual packaging waste savings of over 28,000 tonnes (21). Other estimated savings included reductions in: lorry transports of 260,000 km/yr (equal to 180 tonnes of carbon dioxide); energy consumption by 52 million KWh/yr; the volume of damaged goods by at least 20%; and transportation costs by 25% (22 p. 15).
- The 'CPR system' in Italy, also funded by the LIFE programme (in 1999), wherein producers switched to reusable plastic transit boxes for fruit and vegetables. By 2002 over 3 million boxes were in circulation. The "waste produced by packaging was reduced dramatically" (21) (22 p. 12).
- An investment of £630,000 by frozen food manufacturer (and Courtauld Commitment signatory) *apetito* in reusable plastic transit crates to replace corrugated cardboard boxes for its products (see Box 4). This "avoided the need for production and disposal of around 1,200,000 cartons a year" and annual savings amounted to an estimated 112 tonnes of carton board and 230 tonnes of CO₂ (23) (24 p. 7).
- Britvic saving approximately 70 tonnes of corrugated board and 89 tonnes of shrink film "by using returnable-use trade-ready display units and semi-pallets" (25 p. 10).

Bulk supply of ingredients

By receiving and dispatching materials and products in bulk, food and drink companies can reduce packaging, avoid wastage of raw food materials and make significant labour savings and improvements in productivity (11 p. 95).

Examples of bulk supply systems include:

- Food processor Pasta King negotiated with its supplier to buy tomato sauce in 195 kg steel drums saving £33,100 in the first year from reduced sauce wastage (26 pp. 22-23); and Cornish baker Ginsters which switched to the use of bulk re-usable containers with a one tonne capacity for margarine (27).
- Miller Brewing Company in North Carolina, USA '[w]orked with suppliers to implement materials delivery in 500-gallon reusable totes and 1,000-pound reusable synthetic cloth bags instead of 1-

^a http://www.tesco.com/greenerliving/greener_tesco/what_tesco_is_doing/eco_friendly_packaging.page

and 5-gallon pails and 50-pound paper and plastic bags” which saved 41.7 tons (38 metric tonnes) of paper and plastic containers and bags annually (28).

Box 4: Waste reduction by apetito

Based in Wiltshire, apetito provides frozen food and catering solutions to care homes, local authorities and hospitals, and offers a frozen meal delivery service to the public via its Wiltshire Farm Foods franchise and a private hot meal delivery service through local authorities via apetito Services. In 2009, the company invested £630,000 in a new reusable plastic transit crate system to replace the single-trip corrugated cardboard boxes previously used to supply hospital and care home clients with multi-portion and twin-portion meals. The new crates work well with apetito’s existing processes and are easy to fill up, handle, transport, store and wash. They also proved surprisingly robust, better protecting apetito’s products and expected to last for up to five years. Following advice from WRAP, apetito also eliminated “low-sales-volume products” from its inventory to further reduce waste and started directing 3,000 tonnes of food waste to an anaerobic digestion plant in Devon.

Business Benefits

- Switching to the new crates enabled apetito to avoid the costs associated with procuring and disposing of around 1,200,000 cartons a year, saving some 112 tonnes of carton board and 230 tonnes of greenhouse gas emissions. Although apetito has not published the financial savings realised from this measure, the company “is confident that the investment will pay back financially in the longer-term”.
- With the new plastic crates, customers are left with less waste to deal with and can more quickly access the contents than was the case with the cardboard boxes.
- Each crate can contain several meals with different recipes, whereas in the previous carton system, each case would contain identical meals. Individual products can now be ordered and are packed on the day of delivery offering flexibility to customers who need to serve varied or special menus.

Drivers

- Although apetito was keen to reduce the transit packaging waste, some pressure also came from its customers.
- apetito was motivated in part by its being a signatory to the Courtauld Commitment, a voluntary agreement hosted by WRAP aimed at reducing food waste and associated packaging.

Key Elements for Success

- One-to-one assistance in the form of a waste prevention review undertaken by WRAP helped apetito achieve its goals. The review was one a series of visits to members of the Food and Drink Federation in support of the trade association’s “Five-Fold Environmental Ambition” and the Courtauld Commitment.
- Registration to ISO 14001 in 2009 helps apetito in achieving its environmental objectives.

Sources

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<http://www.apetito.co.uk/Documents/Care%20Homes%20-%20Why%20Choose%20apetito.pdf>

Investment in new technology

A common approach for preventing food waste has been to invest in better equipment in order to reduce wastage of raw materials. However, while the savings can be considerable, the approach is costly. The East Anglian Waste Minimisation in the Food and Drink Industry Project which ran between 1997 and 2000 showed that while technological changes gave the greatest results in financial savings, however, such measures resulted in the highest expenditure.(29)

Wastage often occurs when a process line switches between different products; any raw materials which are left over are frequently disposed of. In a presentation to the FDF in 2007, Unilever, a manufacturer of

numerous food and drink brands, reported trials of a new technology designed to tackle the problem. The company installed 'sensory analysis' equipment at a plant in Essex which allows any ingredient left over in the production of one brand of low fat spread to be re-included in the correct proportions into the manufacture of a new brand. The company claims that, when the technology is working optimally, 'zero waste' can be achieved as well as significant but unspecified financial savings (30).

Envirowise has reported on several instances of food and drink companies investing in new equipment and saving money:

- Cambridgeshire vegetable producer G's Marketing Ltd installed a multi-head weighing machine at a cost of £100,000 saving £110,000/yr thanks to more accurate product weighing (18 p. 13)
- Norwich-based Broadland Wineries saved £7,700/yr in material and labour costs through the introduction of the shrink-wrap machines with a payback period of about two years (31)
- Organic dairy Yeo Valley installed a machine that pre-stretches pallet-wrap up to three times its original length. The machine paid for itself within 12 months and saves customers 24 tonnes of waste per annum (32).

In the Yeo Valley example, Envirowise provided advice, but in the other two cases, the level and nature of support, financial or otherwise, offered by the delivery body is unknown.

Other examples of capital investment:

- In the mid-2000s, with the support of the National Industrial Symbiosis Programme (NISP), an unnamed food manufacturer in the northwest of England identified and rectified significant losses of vegetable matter by installing a new water fluming system. An estimated 400 tonnes of vegetable waste were eliminated at source with cost savings amounting to £88,000/yr and CO₂ savings of 6.84 t/yr (33).
- A private brewery in Germany, Strate Detmold GmbH & Co KG, reduced its beer waste by 110,000 litres per annum by installing an automated pipe cleaning system using CO₂ instead of water. The original system, in which water was used, wasted product. The company invested €6,000 and saves €60,000 each year. Whether Strate Detmold received public sector support for the investment is unclear (34).

Improved demand forecasting

Overproduction waste due to mismatching of forecasting to demand is one of the industry's costliest sources of waste (8 p. 1279). Despite this, little evidence has been found of savings won through attempts by food and drink companies to tackle the problem. Some approaches involve re-directing unwanted ingredients, products or offcuts into new products (8 p. 1279). For example, Cambridgeshire vegetable producer G's Marketing Ltd started selling good quality broccoli offcuts which had previously been fed to animals (18 p. 10). More promising are initiatives focusing on collaboration and trust between partners in the supply chain such as Collaborative Planning, Forecasting and Replenishment; Efficient Customer Response; and Vendor Managed Inventory (VMI). These have been trialled, mainly in the USA, since the 1990s and aim to improve forecasting accuracy, reduce reactive production and optimise replenishment of stocks (6 p. 40).

A UK example of VMI is included on the website of logistics analysts IGD. The food giant Nestlé decided to move to VMI for its confectionary products, working closely with its distributor Booker "to gain better insight and expand to the next level of collaboration to help with the 'up stream' ordering of product. This was with the aim of reducing inventory, improving availability and minimising obsolescence/waste." From August 2010, a Nestlé employee started spending "two days a week in Booker" to be trained on Booker's ordering systems which allowed the manufacturer to gain "clarity and insight into promotion forecasts, out of stocks and availability". From 2011, Nestlé plans for all its business to be VMI managed with Booker (35). No quantified evidence of savings is offered, however.

Nestlé also appears in another case study on the IGD website concerning a product whose demand is extremely weather-dependent: namely, bottled water. With the help of a 'specialist company', Nestlé loaded new software into its sales forecasting systems which calculate the impact of weather, based on short-term forecast, on sales of bottled water products. Although no evidence of savings is provided, "Nestlé was able to sustain an improvement in short term (weekly) forecast accuracy of up to 6% as well as a more modest improvement of around 2%" for longer forecasts (up to 4 weeks) (36).

Table 4 summarises evidence for clean operations approaches to waste prevention in the food and drink sector.

3.4 Green Products

Product redesign is among the most common interventions seen in the food and drink sector with packaging light-weighting a key focus^a.

Packaging light-weighting

The aim of light-weighting is to reduce the quantities of packaging waste arising, hence reducing material requirements, as well as fuel consumption associated with distribution of products. A 2007 report for the Resource Efficiency – Knowledge Transfer Network identifies three main types of packaging light-weighting (Table 5).

Where a light-weighting approach is taken to primary packaging, the impact will be on household waste arisings, but since the agency in the decision-making lies with business, packaging redesign is included within this review.

Light-weighting is not new, indeed the average weight of glass containers in the UK has reduced by around 30% since 1980 (37 p. 11). Similarly, the weight of material used in aluminium, steel and plastic food and drinks container has fallen (38). Nevertheless, efforts have recently been stepped up. Some of the impetus for packaging re-design has come from *Making the Most of Packaging*, the former Government's 2009 Packaging Strategy (39), which contains measures aimed at promoting eco-design in packaging, as well as boosting recycling rates. In addition, the Courtauld Commitment has driven numerous light-weighting and other packaging reduction initiatives. (See **L2m4-4: Commitments**). Spin-off savings also result from more efficient packing of the now packaging-reduced products. For example, as a result of the WRAP-supported initiative to reduce the thickness of Heinz easy open cans, 18% more of the redesigned cans could fit on each pallet during distribution (40).

WRAP has also supported a number of separate glass 'rightweighting'^b projects involving entire supply chains including ContainerRite and GlassRite which by 2010 had achieved a reduction of 133,000 tonnes in glass use (41 p. 10).

^a Some would argue that packaging should not be classified as a 'product', however for convenience packaging re-design is considered in this Section.

^b Rightweighting involves packaging design and production to optimise packaging weight, whilst taking into account the requirements of all stakeholders in the supply chain, including manufacturers, brand owners, fillers, retailers, consumers and the environment.

Table 4: Summary of clean operations evidence

Category	Supported	Description	Outcomes	Quality	Ref ID
Bulk supply of raw materials	Envirowise	Pasta King negotiated with its supplier to buy tomato sauce in 195 kg steel drums.	£33.1k saved in first year from reduced sauce wastage	**	(26)
	Envirowise	The baker Ginsters switched to the use of bulk re-usable containers (1 tonne capacity) for margarine.	n/a	*	(27)
	No	Miller Brewing Company: switched to bulk reusable containers for raw materials	38 t/yr saved	**	(28)
New technology	Envirowise	Cambridgeshire vegetable producer G's Marketing Ltd installed a multi-head weighing machine for more accurate product weighing.	£110k/yr savings for £100k investment	**	(18)
	Envirowise	Norwich-based Broadland Wineries installed shrink-wrap machines.	£7.7k/yr in material and labour cost savings with approx. 2 yr payback period	**	(31)
	Envirowise	Organic dairy Yeo Valley installed a machine that pre-stretches pallet-wrap up to three times its original length.	24 t/yr savings in pallet-wrap; 1 yr payback period	**	(32)
	No	Private brewery in Germany, Strate Detmold GmbH & Co KG, installed automated pipe cleaning system using CO ₂ instead of water.	110k litres/yr beer waste eliminated; €60k/yr saved for €6k investment	**	(34)
	No	Unilever: trialed new sensory equipment enabling re-inclusion of left-over low fat spread ingredients into new brands	n/a	*	(30)
	NISP	Unnamed food manufacturer in NW England installed a new water fluming system.	400 t vegetable waste eliminated; £88k/yr saved; 6.84 tCO ₂ /yr saved	**	(33)
Returnable transit packaging	EU LIFE	'CPR system' in Italy wherein producers switched to reusable plastic transit boxes for fruit and vegetables	Over 3 million boxes in circulation by 2002, unspecified waste reduction	**	(21); (22)
	No	Britvic started using returnable-use trade-ready display units and semi-pallets	70 t/yr cardboard, 89 t/yr shrink-wrap film saved	**	(25)
	WRAP	Frozen food manufacturer apetito replace corrugated cardboard boxes with reusable plastic transit crates	1.2 M/yr cartons saved; 112 t/yr cardboard and 230 t/yr CO ₂ saved (£630k investment)	**	(24)
	EU LIFE	Swedish 'Eurocrate' system: single-trip wooden packaging for food and drink products replaced with reusable plastic pallets and crates.	28kt/yr wooden packaging waste saved; lorry transports reduced by 260k km/yr; 180 tCO ₂ /yr; energy consumption reduced by 52 million kWh/yr; volume of damaged goods reduced by 20%; transportation costs reduced by 25%	**	(21); (22)
	No	Tesco introduced its 'green tray' system for suppliers to use	132kt cardboard packaging saved in 2007/08	**	^a
Improved demand forecasting	No	Nestlé: introduced VMI for confectionary with its distributor Booker	n/a	*	(35)
	No	Nestlé: introduced software to predict impact of weather on bottled water sales	n/a	*	(36)

^a http://www.tesco.com/greenerliving/greener_tesco/what_tesco_is_doing/eco_friendly_packaging.page

Table 5: Approaches to packaging light-weighting

Approach	Example(s)
Change packaging design	Concentration of products e.g. laundry liquids. De packaging e.g. toothpaste tubes stand up in polystyrene stands rather than in cardboard tubes
Substitute materials	Plastic for glass as in ketchup bottles Aluminium for steel in drinks cans
Change manufacturing techniques	Thinner walled cans and using two pieces rather than three.

Source: (38)

WRAP and other delivery bodies such as Envirowise have also worked on a one-on-one basis with food and drink companies to achieve light-weighting designs. For example:

- WRAP worked with Heinz, its can end supplier Impress, and steel supplier Corus to reduce the thickness of Heinz's 'Easy Open' can ends by 10%. As a result of the trial, 1,400 tonnes less steel was used annually saving Heinz £404,000/yr. Some cost savings came from the fact that 18% more of the redesigned cans could fit on each pallet during distribution (40).^a
- WRAP worked with Birds Eye to trial reductions in the use of cardboard in the cartons used for Birds Eye's frozen product range. Annual savings amounted to 54 tonnes, equivalent to 1.5% of one of its factories' total board usage (42 p. 1).
- With WRAP support, Asda and Kane salads have trialled thinner film on salad bags with 10-15% material savings (43 p. 6).
- With Envirowise support, Norwich-based Broadland Wineries reduced film use with an £8,000/yr saving. The company also standardised to one type of self-erecting cardboard tray (£26,000/yr saving) and started to re-use packaging spacers (£3,400/yr saving) (31).
- With Envirowise support, a pet food company redesigned transit trays using less cardboard and saved £100,000 per annum (44 p. 10).
- With Envirowise support, Devon-based snack manufacturer Burts Potato Chips redesigned its transit packaging in order to increase the packing density of boxes on a pallet by 147%. This reduced handling, fuel and time costs. In addition, use of thinner cardboard in the boxes reduced the weight of packaging waste generated by the end-user (45).

Some examples of UK and overseas companies redesigning both primary and secondary transit packaging to reduce weight *without* apparent external support include:

- Riverford Organic Vegetables, which runs a vegetable box home delivery scheme, redesigning its packaging to use less material and to use pallets more efficiently, reducing emissions and costs (46 p. 31).
- Packaging design changes, in France, resulting in a 23% weight reduction of Choco BN biscuit packages and 50% weight reduction of "Carte Noire" coffee filter sachets^b.
- The replacement in the 1990s of "Clorox" glass sauce and dressing bottles in the USA with plastic and light-weighting by 15% resulting in an increase in market share. Procter and Gamble redesigned one of its product bottles, the 30% reduction in plastic weight saving 1,250 tons of plastic and 750 tons of related cardboard carton weight per year for that product alone (37 p. 19).
- In its Corporate Citizenship Report 2009 the multinational drinks company Diageo lists changes including: removing dividers from cases of bottles (740 t/yr cardboard annual saving), supplying wine on draft (225 t/yr glass saving), switching from bottles to cans (630 t/yr glass saving), light-weighting cans (187 t/yr aluminium saving), light-weighting bottles and using thinner shipping

^a WRAP received some criticism for using public funds to support Heinz since the steel packaging industry had already been working on light-weighting projects before the delivery body's involvement. In its defence, WRAP argued that funding the trials 'had the dual benefit of bringing them forward in time and, more importantly, putting the results into the public domain.'

http://www.letsrecycle.com/do/ecco.py/view_item?listid=37&listcatid=240&listitemid=7305&Section=materials/packaging

^b <http://www.ecoemballages.fr>

canisters (97 t/yr glass and paper saving), a redesigned returnable beer bottle for Africa (3,000 t/yr glass saving) (47 p. 23).

In rare cases, primary packaging has been designed to be more robust in order to enable transit packaging to be lighter – and also to reduce food waste in transit. An example of this is the redesign of the ‘Goodfellas’ pizza box by Northern Foods as part of the Courtauld Commitment whose packaging weight increased by four per cent. According to a case study published on the IGD.com website, Northern Foods was “able to reduce the total weight of packaging used on this product by 4,000 tonnes per year.” In addition, the pizza boxes now stack better which has “cut the number of pizzas damaged before they reach the consumer by 75%”. Finally, more efficient stacking on each pallet has enabled the company “to achieve a reduction of one million transport miles annually” (48).

A different Green Products approach to improve the resource efficiency of packaging has been developed by the Basingstoke-based company Valueform Ltd with support from the Technology Strategy Board (TSB), Reading University and others. Valueform has developed a new “biocomposite materials using ... maize straw and plant waste” for use in primary and secondary retail food packaging. The company claims that the biocomposites “are more resource efficient than plastics, biopolymers & starch-based alternatives currently available on the market. The packaging products will be biodegradable, compostable & post-use re-cycled for other uses such as medical and other non-food applications.”^a However, no quantitative evidence of savings has been published.

Other Green Products

In very limited cases, the product itself has been redesigned to save waste.^b As part of the Courtauld Commitment, retailer Tesco worked with Princes, its supplier of squash drinks, to produce a double concentrated product resulting in reduced packaging. A bottle weight saving of 35g (46%) was achieved by replacing 3 litre bottle sizes by 1.5 litre bottles. The 1 litre bottle was “replaced by a 750ml super concentrated bottle, representing a 17% (1,229 tonne) packaging reduction” (24 p. 43). In addition to the material savings, the initiative saved approximately 470 tonnes of plastic per year (25).

Food2030, the former UK Government’s food supply chain strategy published in 2010, called for the industry to re-design portion sizes to reduce household waste, but evidence of this was lacking. (12 p. 58) One exception was the development by the baker Warburtons (a signatory to the Courtauld Commitment) of a new 600g-sized loaf. The company ‘believed that it could help to reduce food waste by expanding pack size choice. The new ‘mid-sized’ loaf has been made possible due to a change in European law enabling bread to be baked in different sizes from the traditional 800g and 400g packs.’ Quantified savings from this approach are not yet available, however (24 p. 49).

Table 6 summarises evidence for green products approaches to waste prevention in the food and drink sector.

^a This biocomposite project received grant-funding by the TSB in its November 2005 Sustainable Products call, coordinated by Oakdene Hollins Ltd. Further information on Valueform is available here: <http://www.the-sbp.co.uk/UploadedFiles/Valueform.pdf>

^b The concentration of non-food products, especially detergents, in order to save packaging is more established. Manufacturers taking this approach include Procter & Gamble, Ecover and Unilever. For example, Unilever claims that its Persil Small & Mighty laundry detergent ‘can use over 60% less packaging than normal Persil liquids.’ (<http://www.persil.com/CleanerPlanet.aspx>)

Table 6: Summary of green products evidence

Category	Supported	Description	Outcomes	Ref ID
Concentrated product	WRAP/CC	Princes & Tesco: designed a double-strength squash drink to reduce packaging	470 t/yr plastic saved	(25)
Light-weighting (Primary & transit packaging)	No	Drinks company Diageo: lightweighted bottles and used thinner shipping canisters	97 t/yr glass and paper annual saved	(47)
	No	Procter and Gamble reduced the weight of one of its product plastic bottles by 30%.	1,250 t/yr plastic saved; 750 t/yr cardboard saved	(37)
	TSB	Valueform and Reading University undertook a research project to produce a more resource efficient packaging material based on waste vegetable matter	n/a	^a
Light-weighting (Primary packaging)	WRAP/CC	Britvic: J20 Soft drink packaging reduction	4k t/yr glass saved	(24)
	WRAP/CC	Britvic: Robinsons soft drink packaging reduction	1,670 t/yr plastic saved	(24)
	WRAP/CC	Burtons: Cookies	32% reduction in plastic	(24)
	WRAP/CC	Cadbury: Easter Eggs packaging reduction	Medium egg range: 220 t/yr plastic saved; 250 t/yr carton board saved; 90 t/yr less transit & display packaging Large egg range: 108 t/yr plastic saved, 65 t/yr carton board saved; 44 t/yr corrugated cardboard saved	(24)
	WRAP/CC	Coca-Cola: Soft drink can packaging reduction	15kt/yr aluminium saved (projected across EU)	(24)
	WRAP/CC	Coca-Cola: Soft-drinks bottle packaging reduction	3.5kt/yr glass saved	(24)
	WRAP	ContainerLite project (2005-6)	7,781 tonnes glass saved (during trial period); 36.5kt saved (within 12 months of project end)	(49)
	No	Drinks company Diageo: lightweighted cans	187 t/yr aluminium saved	(47)
	No	Drinks company Diageo: redesigned a returnable beer bottle for Africa	3kt/yr glass saved	(47)
	WRAP	Duchy Originals: Biscuits box reduced	9 t/yr carton board saved	(43)
	WRAP	GlassRite: Beer, Cider & Spirits (2007-8)	32.3kt/yr glass saved	(49); (50); (51);
	WRAP	GlassRite: Food, Soft Drinks & Ready-to-Drinks (2006-8)	21,415 t/yr glass saved; 14,447 tCO ₂ /yr	(52);
	WRAP	GlassRite: Wine (2006-8)	11,397 t/yr glass saved; 11,400 tCO ₂ /yr saved	(53); (54)
	WRAP/CC	Greencore: Bottled water packaging reduction	110 t/yr plastic saved	(24)
	WRAP/CC	Greencore: Yorkshire puddings packaging reduction	115 t/yr plastic saved	(24)
WRAP/CC	Heinz: Ketchup plastic packaging reduction	340 t/yr plastic saved	(24)	
WRAP	Heinz: thickness of Easy Open' can ends reduced by 10%. Some cost savings due to more efficient packing of lighter cans.	1.4kt/yr steel saved; £404k/yr savings (45).	(40)	

Category	Supported	Description	Outcomes	Ref ID
	WRAP/CC	Innocent: Kids smoothie packaging reduction	90 t/yr paper saved	(24)
	WRAP	Kane Salads: Salad bags with thinner film	10-15% material savings	(43)
	No	Kraft Foods: Change from an aluminium foil wrapper with paper envelope to plastic flow pack for chocolate bars	6.3kt/yr aluminium and paper saved globally	(55)
	WRAP/CC	Mars: Celebrations chocolates packaging	720 t/yr unspecified packaging material saved	(24)
	WRAP/CC	Mars: Easter Eggs packaging reduction	Medium eggs: 200 t/yr cardboard saved; plastic insert weight reduced by 35%	(24)
	WRAP/CC	Mars: Uncle Ben's sauce bottles packaging reduction	450 t/yr glass saved	(24)
	No	Miller Brewing Company, North Carolina, USA: lightweighted its glass bottles by 1 ounce and the size of aluminium can lids from 2.375 inches to 2.25 inches.	1.36kt/yr aluminium and 1kt/yr glass saved	(28)
	WRAP/CC	Müller: Dairy Vitality yoghurt drink packaging reduction	Bottle: 167 t/yr plastic saved Shrink sleeve: 126 t/yr plastic film saved Carton sleeve: 68 t/yr cardboard saved Tray: 35 t/yr cardboard saved	(24)
	WRAP/CC	Müller: Dairy yoghurt pots plastic packaging reduction	1.8kt less unspecified packaging material (2009 vs.2006)	(24)
	WRAP/CC	Nestlé: Easter eggs packaging reduction	784 t/yr various packaging materials saved	(24)
	WRAP/CC	Nestlé: Quality Street chocolates tin packaging reduction	237 t/yr steel saved	(24)
	No	Packaging design changes, in France, resulting in a 23% weight reduction of Choco BN biscuit packages and 50% weight reduction of "Carte Noire" coffee filter sachets.	n/a	(37)
	WRAP/CC	Premier Foods: Bread packaging reduction	1.2kt plastic total saving (2005-8)	(24)
	WRAP	Radnor Hills: Plastic bottle packaging thinner	3.4kt PET savings (projected)	(43)
	WRAP/CC	Robert Wiseman Dairies: Milk packaging reduction	340 t/yr plastic saved	(24)
	WRAP	Sheepdrove Organic Farm: Meat box packaging reduced	7 t/yr cardboard saved	(43)
	No	The replacement in the 1990s of 'Clorox' glass sauce and dressing bottles in the USA with plastic and light-weighting by 15% resulting in an increase in market share.	n/a	(37)
	WRAP/CC	United Biscuits: Jacob's Biscuits for Cheese. Plastic cartons replaced with cardboard of a lighter weight	4kt/yr plastic saved	(24)
	WRAP/CC	Weetabix: Cereals packaging reduction	103 t/yr cardboard saved	(24)
	WRAP	WRAP worked with Birds Eye to trial reductions in the use of cardboard in the cartons used for Birds Eye's frozen product range.	54 t/yr cardboard savings (equivalent to 1.5% of one factory's total board usage)	(42)
	WRAP/CC	Young's Seafood: Admiral's fish pies packaging reduction	242 t/yr cardboard saved	(24)
	WRAP/CC	Young's Seafood: Chilled raw fish packaging reduction	80 t/yr mixed packaging material saved	(24)

Category	Supported	Description	Outcomes	Ref ID
Light-weighting (Transit packaging)	Envirowise	A pet food company redesigned transit trays using less cardboard	£100k/yr saved	(44)
	No	Drinks company Diageo: removed dividers from cases of bottles	740 t/yr cardboard saved	(47)
	WRAP/CC	Northern Foods: 'Goodfellas' pizza box redesigned– primary packaging made 4% heavier enabling reduction in transit packaging and improved stacking	4kt/yr cardboard saved overall; number of pizzas damaged in transit cut by 75%; more efficient pallet stacking reduced transport miles by 1 million/yr	(48)
	Envirowise	Norwich-based Broadland Wineries reduced film use, standardised to one type of self-erecting cardboard tray and started to re-use packaging spacers	Film: £8k/yr saving Tray: £26/yr card saving Spacers: £3.4k/yr unspecified material savings	(31)
	No	Riverford Organic Vegetables, which runs a vegetable box home delivery scheme, redesigned its packaging to use less material and to use pallets more efficiently, reducing emissions and costs	n/a	(46).
	Envirowise	Snack manufacturer Burts Potato Chips redesigned its transit packaging in order to increase the packing density of boxes on a pallet by 147%. Thinner cardboard boxes used.	Unspecified savings in handling, fuel, time and material costs	(45)
Packing efficiency	WRAP/CC	United Biscuits: Hula Hoops multipacks redesigned to allow excess air to be squeezed out enabling more efficient packing	400 t/yr cardboard saved	(24)
Portion re-sizing	WRAP	Warburtons: Introduced a 'mid-sized' loaf to reduce food waste. Part of Courtauld Commitment.	n/a	(24)

NB: CC stands for Courtauld Commitment

3.5 Product/Service Innovation

Very few examples of product/service innovation were found in the food and drink sector, and none were accompanied with quantified savings. One exception is the Dutch company Odin which “supplies organically grown food to consumers by subscription”. The consumer receives a paper bag weekly with assorted vegetables and accompanying recipes, delivered from a store in the neighbourhood. This reduces packaging waste (37 p. 39). Similar examples of home delivery of vegetables (normally organic) are seen in the UK (such as Able & Cole, Riverford Organics, Rod & Ben’s): here the delivery boxes are sturdy and returnable, and insulation and coolpads to preserve the life of produce are sometimes provided. Evidence of waste prevented through these initiatives was not available in the search time frame. As discussed in Section 1, these alternative models of food distribution and consumption are growing in importance and should be the subject of further research.

Table 7 summarises evidence for product/service innovation approaches to waste prevention in the food and drink sector.

Table 7: Summary of product/service Innovation evidence

Category	Supported	Description	Outcomes	Ref ID
Home delivery of food	No	Odin, The Netherlands: supply of ready-to-cook vegetables with recipes to reduce packaging waste	n/a	(37)
	No	Various UK companies supplying fruit, vegetables and other food and drink products to households in returnable, reusable boxes	n/a	n/a

3.6 Mixed Approaches

The WRAP-supported 2006-8 GlassRite: Wine project is a rare example of a mixed approach to waste prevention in the food and drink sector. The project explored the environmental advantages of bulk importing of foreign wine for bottling in the UK. Typically, this enables 24,000 litres of foreign wine to be carried to the UK in each shipping container as against only 14,400 litres when the wine is bottled in the country of origin. This approach not only improves transport efficiencies but, importantly, allows lighter bottles to be used since they do not have to endure the rigours of shipping. In addition, lead times can be reduced further preventing wastage due to incorrect forecasting; when bottling in the country of origin the decision on what blend of wine to produce requires the use of long-term demand forecasting because of the time incurred shipping the wine. In effect, this technique combines a clean operations approach (bulk supply) with a green product (lightweighted glass bottles). A report for Defra estimates cost savings per bottle ranging from 2-13 pence depending on the country of origin (9). Bulk importation of wine has yet to be widely adopted by the industry, although the retailer Tesco has now adopted this practice for all its own-label wine.^a

Table 8 summarises evidence for mixed approaches to waste prevention in the food and drink sector.

Table 8: Summary of mixed approaches evidence

Category	Supported	Description	Outcomes	Ref ID
Bulk supply & Lightweighting	WRAP	2006-8 GlassRite: Wine project: Investigation into the benefits of importing wine to the UK in bulk containers rather than in bottles.	Cost savings per bottle of 2-13 pence (projected)	(9)

^a Dr Peter Lee, Oakdene Hollins, Personal Communication

3.7 Hazard Reduction

Recent data on the composition of food and drink waste arisings suggest an increasing proportion of chemical wastes and sludges (Figure 2). The reasons for this are unclear, however it does not necessarily follow that this represents an increase in hazardous waste arisings; for obvious reasons, dangerous chemicals tend not to be used in food manufacture (8 p. 1274). Little evidence exists of hazard reduction in the sector over and above general waste reduction. The following examples were however found:

- In its 2009 Corporate Citizenship Report, the multinational drinks company Diageo describes its investment in new technology for recovering caustic soda – a hazardous material used in cleaning which was formerly disposed of. The new recovery plant at its brewery in Ireland annually saves “30 cubic metres of caustic soda, 130 tonnes of steam and 1,350 cubic metres of water”. (47 p. 23) Diageo does not however identify the driver for this innovation.
- According to a 1995 case study, hazard reduction was also achieved by Coastal Dairy Products in North Carolina, USA which manufactures and distributes ice cream and frozen yogurt. Among a range of “raw material reduction, reuse, and recycling programs”, Coastal Dairy Products modified its automated system used to clean the ice cream manufacturing equipment to allow “a more concentrated cleaning solution to be utilized” decreasing cleaning chemical use. The installation cost \$22,367 with avoided costs from reduced water usage and chemical consumption of \$4,163/yr (56).
- In California, concerns over the lead content in metal foil wraps on the tops of their wine bottles led most of the state’s wineries to switch to aluminium poly laminate foil (57 p. 14).

In none of these examples are the motivating factors clearly evidenced. It is conceivable that changes in the law may have been a driver (such as regulation might have required Diageo to reduce the wastes discharged to sewer) in which case these examples would fall outside the scope of WR1403 which focuses on voluntary rather than mandatory actions to prevent waste.

Please refer to module **L2m6: Hazard Reduction** for more information.

3.8 Marginal Scope Examples

Several examples of waste reduction lie just outside the scope of this review but are nevertheless instructive.

For instance, a move towards upstream processing of raw materials is a promising approach taken by some manufacturers. In the UK, Northern Foods^a now requires suppliers to perform much of the vegetable preparation work.^b Yield losses in vegetable preparation can be high due to poor quality and the losses incurred in the skinning process. Preparing raw materials earlier in the supply chain has a great potential for reduction of bulk organic wastes (such as peelings, husks, etc.) and also for the economic transfer of wastes to recycling outlets such as animal feed, anaerobic digestion or composting (8 p. 1279). Such approaches have the potential to reduce vehicle movements between growers and food manufacturers and reduce transport packaging. Importantly, manufacturing lead times can be lowered reducing the risk of wastage due to incorrect demand forecasting (9).

Another initiative just beyond the scope of waste prevention concerns Wiltshire-based frozen food manufacturer apetito. Following advice from WRAP, this signatory to the Courtauld Commitment eliminated ‘low-sales-volume products’ in order to reduce waste (58 p. 7)

^a In November 2010, Northern Foods announced its merger with Irish-based food company Greencore

^b <https://www.fdf.org.uk/events/Gus%20Atri%20%20-%20Presentation.pdf>

4 Behavioural Aspects

4.1 Attitudes

Notwithstanding evidence considered in this report, waste prevention culture has yet to take root in the bulk of the food and drink sector. A 2010 report for WRAP notes that:

“waste allowances [or shrinkage rates] remain unchallenged by companies as they are embedded into existing budgets ... [and] can contribute significantly to the overall amount of waste” (5).

This assertion is supported by a 2009 survey in the North West of England which found that while 85% of food and drink businesses rated resource efficiency as ‘important’, only 30% had taken action, of which 55% had invested “less than £2,000 in making improvements”. Despite mounting evidence for the financial benefits of investment in resource efficiency, the report found that companies continue to perceive such investments as having either a “negative cost to the business or, at best, break even” (59 p. 9).

Similarly, a 2005 study on eight chilled food manufacturing sites found that “inadequate problem solving and a weak continuous improvement culture” was responsible for “half of organic waste”. People “were focussed on achieving the day’s production volumes, not minimising waste” (7 p. 3). Given that product losses are inherent in food manufacturing, and products yield considerably below the amount of raw material used, some have argued that the culture of the food industry is antithetical to the principle of waste measurement and minimisation (8 p. 1274).

4.2 Motivators

As the examples in this report show, substantial savings are available to food and drinks businesses through simple waste prevention measures. Although cost savings will, of course, motivate behaviour change, little explicit evidence for this was found in the material reviewed.

When waste prevention does occur in the sector, motivation appears to come instead from the following factors:

- customer and procurement pressure
- compliance with legislation.

Customer and procurement pressure

Customers, especially large retailers, are seen as “crucial” to changing the food sector (7 p. iii). For example, a 2005 study of the food and drink sector in the East of England revealed that pressure from food retailers was among the major drivers of waste minimisation practice in suppliers (29 p. 17). Similarly, a 2004 survey of food manufacturers in London found that companies would only strive to meet “new/higher environmental (or ethical) requirements” when specified by major supermarkets (60 p. 27). FareShare also points to the role of procurement pressure reporting that many food and drink manufacturers started to collaborate with the food redistribution charity; various retailers wrote to their supplier base encouraging them to work with FareShare and to authorise the redistribution of their own-brand products to FareShare.^a Procurement pressure is also increasingly working in concert with commitments and voluntary agreements (see Section 4.4, and also modules **L2m4-3: Procurement** and **L2m4-4: Commitments**).

^a FareShare’s Marketing & Communications Manager, personal communication, January 2011

Compliance with legislation and extended producer responsibility (EPR)

Several instruments designed to protect the environment, and mostly emanating from the European Commission may have driven limited waste prevention activity in the UK. For example, Pollution Prevention and Control Regulations (1999-2000) prompted Cornwall-based food manufacturer Ginsters to assess its environmental impacts, and take steps to better manage its waste (61). Other laws with a potential impact include the Animal By-Products Regulations (1999-2005) and Landfill Regulations (2002) which restrict the disposal options for certain waste types (3 pp. 41-2).

However, the evidence for the role of regulations in waste prevention is not entirely convincing. For instance, the Landfill Tax introduced in 1996 has seemingly driven recycling rather than waste prevention (2 p. 7); a 2003 study found little evidence that the Landfill Tax had motivated waste minimisation since the cost of disposal was generally less than 1% of turnover, and the Landfill Tax itself only a fraction of a percent (62 pp. 683-4). In addition, a 2004 paper reviewing the 1997-2000 East Anglian Waste Minimisation in the Food and Drink Industry Project concluded that regulations “have done little so far to stimulate producers, suppliers and consumers to act on their collective supply chain responsibilities” (19 p. 506).

Over the last 20 years or so, many EPR instruments - some voluntary, some mandatory - have been implemented by governments across Europe and beyond. EPR is an environmental policy approach where a producer becomes physically or financially responsible for the post-consumer phase of a product’s life cycle. If designed well, EPR can provide producers with incentives for product redesign and stimulate innovation and some schemes do indeed appear to have motivated waste prevention, including in the food and drink sector. Among the best known of EPR schemes is that introduced in Germany’s 1991 Packaging Ordinance which stipulated that manufacturers had to organise packaging take back and arrange for its reuse or recycling. A system of graded levies on packaging material funded the scheme while at the same time incentivised producers to reduce packaging use, or to choose materials which could more be easily recycled or reused. By 2000, the scheme had seen the avoidance of an estimated 1.6 million tonnes of packaging material^a; the increased adoption of returnable transit packaging (RTP) systems for many products including food was notable.^b

In the UK, too, the adoption of RTP (see Section 3.3) may also have been a result of EPR. In this case, the instruments used are tradable Packaging Return Notes (PRNs) introduced along with the 1997 Producer Responsibility Obligations (Packaging Waste) Regulations and the 1998 Packaging (Essential Requirements) Regulations.^c These rules were intended to stimulate packaging reduction, re-design and reuse (46), but the input cost of materials cannot be ruled out as a more important motivator.^d Compliance could also be an issue. The 2007 Early Day Motion on excessive packaging tabled in the UK Houses of Parliament by the Jo Swinson MP highlights the example of over-packaging of chocolate Easter eggs. Swinson argued that the Packaging (Essential Requirements) Regulations were not being enforced with “just four cases of prosecutions resulting from excess packaging” since their introduction the previous year.^e Although Swinson’s Bill was defeated, her campaign was partially successful in that several signatories to the Courtauld Commitment went on to include Easter eggs in their packaging reduction initiatives (see Section 3.4). The module **L2m4-6: Incentives** considers EPR and waste prevention in more depth.

^a Quoden J. In OECD (2004), Economic Aspects of Extended Producer Responsibility

^b Jaeckel U. In OECD (2001), Extended Producer Responsibility: A Guidance Manual for Governments

^c The rules state: ‘Packaging volume and weight must be the minimum amount to maintain necessary levels of safety, hygiene and acceptance for the packed product and for the consumer’.

^d Defra, Personal Communication

^e <http://www.joswinson.org.uk/resources/sites/217.160.173.25-4064151b9ce785.55373887/Easter+egg+packaging+report+2010.pdf>

4.3 **Barriers**

Despite the considerable reported savings to be won from waste prevention, a number of barriers have been identified including:

- waste prevention viewed as low priority
- cultural resistance and conservatism
- financial and time constraints
- consumer perceptions and branding
- information barriers.

Waste prevention viewed as low priority

A significant barrier to waste prevention in the food and drink sector may be the perception that waste has a minimal impact on turnover and it is thus not worth devoting resources to preventing it. Some have argued that a “credibility gap” may even exist between the savings opportunities publicised by delivery bodies and the business audience. A recent study for WRAP found that “waste allowances” or “shrinkage rates” remain unchallenged by companies because they are embedded into existing budgets (5). Production managers are under pressure to meet retailer demands, while complying with strict health and safety regulations. For instance, a 2005/06 resource efficiency pilot project in London found that “compliance with Health & Safety regulations was of greatest interest to the businesses involved” (63 p. 12). Waste prevention is a secondary concern, relegated to a facilities or environmental manager typically without the power to effect the required changes. For this reason, most of the emphasis remains on landfill diversion rather than true waste prevention.

Cultural resistance and conservatism

Several studies reveal that the food and drink industry can exhibit a “reluctance to change” (2 p. v). The 1998 Aylesbury Vale Industrial Waste Reduction Project concluded that companies most in need of waste reduction advice are least likely to take up the assistance [from external business support agencies]. Poor manufacturing systems are closely associated with weak and defensive management (64 p. 2). Similarly, the Defra 2007 study quantifying the business benefits of resource efficiency found that it is the better performing companies that often seek advice rather than the neediest (11 p. 77). Even the collection of waste data can be problematic, as noted by a 2009 study on the UK’s convenience food production sector (8 p. 1280).

Financial and time constraints

Even though waste prevention does not have to be expensive, a minimum investment is required in staff time if not in capital. For example, a 2007 study for Defra found that SMEs in particular did not have the manpower to investigate let alone have time to implement water-, energy- or waste-related saving opportunities (2 p. 6). Similarly, in the WRAP-supported 2007/8 GlassRite: Beer, Cider and Spirits project, low run numbers on many of the premium brands meant that residual mould costs for existing designs represented “a significant cost barrier” (51 p. 4).

Consumer perceptions and branding

Where waste prevention affects product design, consumer perception of the product risks being damaged. For example, some manufacturers and retailers have resisted reducing the size of cereal packets due to the perception that customers “would select larger boxes over smaller equivalents containing the same amount of product, as they felt they were getting better value for money” (65). Similarly, the GlassRite projects found that consumers were sensitive to changes in container shape (66 p. 19), and sometimes could associate lighter glass bottles with lower wine quality (53 p. 48). Trialling new packaging and products designs is costly and time-intensive, so such initiatives are unlikely when budgets are tight, external funding is not available and there is no guarantee of consumer acceptance.

On the other hand there are multiple examples of brand owners making a successful transition to products that offer improved waste prevention and stable perceptions of product quality. For example the continuing transition from traditional washing powders to concentrated tabs and liquids. And, despite the perceived problem discussed above of marketing cereals in smaller cartons, the retailer Sainsbury's successfully reduced the volume of its own brand packs by 24% saving 7.2 tonnes of cardboard annually. Also, more units could be packed per case saving transport costs (65 pp. 41-2). Similarly, as part of the Courtauld Commitment, Young's Seafood reduced the size of their Admiral's fish pies packaging (24).

Information barriers

A 2007 study for Defra on the opportunities to reduce waste in the food production chain found that it was "difficult to obtain robust data on resource consumption (especially from SMEs – which make up a large part of the industry)" (2 p. 6). Similarly, "lack of information" was cited as a barrier to waste minimisation in 10 food and drink companies audited for a study in the East of England (29 p. 15); and a 2008 study on the retailer-food supplier trading relationship found that "poor information sharing and lack of trust among supply chain partners can lead to waste" (6 p. 87).

Other barriers

Waste prevention may not occur due to a lack of skills and expertise among staff (29 p. 15). In addition, lengthy and international supply chains hinder efforts to avoid packaging associated with raw materials (29 p. 23) or reclaim refillable packaging from customers (67).

4.4 Enablers

Success factors identified as enabling waste prevention in the food and drink sector include:

- external business support
- commitments and voluntary agreements.

External business support

Judging from the number of examples highlighted in this report, support and encouragement from public sector delivery bodies and non-governmental organisations (such as WRAP, Envirowise, NISP, regional development agencies, waste minimisation clubs) appear to play a role in enabling pro-environmental behaviour, including waste prevention, in the food and drink sector. Evidence suggests that to be effective, resource efficiency projects "need to be offered and delivered over an extended period, typically more than two years" (64 p. 2). However, caution should be exercised. Further research may be required to establish the effectiveness of business support compared with other interventions – especially in changing behaviour. Also, some types of business support may work better than others. For example, there has been a trend away from business support designed to achieve, identify and report on savings derived from in-house process improvements. Instead, the best recent examples of enablers intervening are where they facilitate companies to identify waste prevention activities that lie partly or mostly outside the boundaries of the individual firm (i.e. WRAP's Courtauld Commitment – see below). It seems much less likely that these waste prevention activities would occur at all without such facilitation. There remains a question over how best to facilitate such outcomes. Modules **L2m4-7: Waste Minimisation Clubs** and **L2m4-8: Other Business Support** have more information.

Commitments and voluntary agreements

Some of the most convincing evidence for waste prevention in the food and drink sector appears in the context of commitments and voluntary agreements. Examples include both sector-wide agreements (such as the Courtauld Commitment) and supply chain initiatives taken unilaterally by larger retailers as an extension to their normal contractual relationships with suppliers (such as Marks & Spencer, Tesco, etc.). Commitments and voluntary agreements act both as a motivating factor, from the point of view of signatories, but also as an enabler when seen from the perspective of policy makers. The pressure for

change is especially strong when a food company's customers are themselves signatories to a commitment (such as Courtauld). An important example of the food sector making its own commitment is the FDF target of zero waste to landfill by 2015. Although focused on landfill diversion, the commitment has also spurred waste prevention measures such as packaging reduction or reuse^a, which, as noted in a recent survey of FDF members, may partly be responsible for de-coupling of waste generation from production between 2006 and 2009(10). Module **L2m4-4: Commitments** has more information.

^a FDF website

5 Conclusions

5.1 Learning

- **Waste arisings in the UK food and drink sector are reported to be declining, possibly at an accelerating rate.** Major preoccupations of the sector are in satisfying retailers and complying with food safety and hygiene regulations. Waste reduction efforts are largely focused on landfill diversion (such as recycling, AD, composting, animal feeds) rather than waste prevention. As hazardous wastes are a minor feature of the sector, there is limited evidence of their reduction.
- In the context of the positive improvements in waste generation **there are several examples of waste prevention that could be more widely adopted.** These include:
 - reuse initiatives which have been restricted to transit packaging (controlled within the supply chain)
 - light-weighting approaches which have been applied to primary packaging (which is unlikely to be returned to manufacturers).
- **True product re-design was rarely evidenced,** the closest examples being the development by Tesco and its supplier, Princes, of double-strength squash drinks to reduce plastic bottle packaging and Kenco's use of "eco refill" packages to replace glass jars.
- In terms of behavioural aspects, on the basis of evidence reviewed, **a waste prevention culture is not yet embedded in the food and drink sector.** Nevertheless, the engagement of some leading trade associations – such as the Food & Drink Federation – is helping to address this shortcoming.
- **Where progress towards waste prevention has been evidenced (mainly in packaging reduction), the change has apparently stemmed from voluntary agreements.** The Courtauld Commitment, in particular, has been successful because it has engaged the Retail sector to apply pressure on suppliers. To a lesser extent regulation has played a role. In addition to cultural resistance to change, barriers include financial and time constraints, consumer perceptions, information gaps and the complexity and length of supply chains.

5.2 Insights

The emphasis on landfill diversion rather than waste prevention has seemingly been encouraged by the Landfill Tax escalator, Government support for anaerobic digestion and trade association commitments (such as FDF's Zero Waste to Landfill). Waste prevention could, however, save the industry far more money than does landfill diversion. As noted in Section 3.1, the true cost in wasted raw materials, energy, labour and other inputs before retail is at least £500/t (5).

The recent reduction in overall waste arisings from the industry demonstrates a move in the right direction. However, it is impossible to say whether the apparent downward trend is due to manufacturers making conscious decisions to waste less or is the unintended result of slowly improving production, packaging and distribution technologies.

Efforts focused on larger companies seem to be productive: 75% of waste arisings are from companies with more than 100 employees (5). The value of harnessing entire supply chains in voluntary agreements is clear. The success of the approach can largely be attributed to the fact that a small number of large retailers and producers dominate the market, and might be productively applied to other sectors and products where similar structural conditions prevail. Larger players seem more inclined to act in unison

as they have greatest power and opportunities to cut waste in their own operations and elsewhere in the supply chain.

Much of the emphasis to date has been on Clean Operations and Green Products, particularly with a view to reducing packaging waste. Other approaches (as defined for this project) have been less in evidence and are largely inappropriate for the bulk of businesses in this sector given the nature of food itself and the position of operators within supply chains.

Process waste audits, improved demand forecasting, switching to bulk supply of raw materials and moving preparation of raw materials up the supply chain are also commonly reported techniques. In addition, as part of Phase 2 of the Courtauld Commitment, WRAP is working with the IGD, retailers and suppliers to address the issue of incorrect demand forecasting.^a This project will conclude in March 2011.^b

5.3 Research Gaps

The following areas of research have been identified:

- Anecdotal evidence shows a trend away from identifying in-house process improvements toward identifying waste prevention opportunities that lie outside the boundaries of an individual firm. **Future research could investigate which, if any, of the voluntary frameworks** (such as commitments and voluntary agreements) **to address these opportunities are most effective** since this appears to be a growing area of opportunity to achieve larger scale waste prevention.
- **The importance of unchallenged 'shrinkage rates'** (a reduction or loss in inventory due to shoplifting, employee theft, paperwork errors and supplier fraud) **as a cause of waste in the sector could be further investigated.**
- Despite the large body of published evidence that considerable financial savings are available through simple and low-cost waste prevention measures in the food and drink sector, **managers in these businesses appear unwilling to act. Future research could investigate the reasons for this.** Is it that managers simply do not believe the publicised claims? Or perhaps where managers have been in post for some time a degree of self-criticism is implied in accepting such evidence. On the other hand, perhaps this reported management inertia is based on a skewed sample of such managers. Or perhaps there have been failures of commission, such as inadequate training resulting in poor and unreported outcomes. Has the work of trade associations in promoting waste prevention and landfill diversion helped to lessen this apparent inertia?

^a http://www.wrap.org.uk/downloads/CC_Info_Sheet_23_sept_2010_final.88134f93.9220.pdf

^b WRAP, Personal Communication

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