Working together for
a world without waste

Business Resource Efficiency Guide

Self-assessment Review for Food and Drink Manufacturers

Working together for a world without waste

Our vision is a world without waste, where resources are used sustainably.

We work with businesses and individuals to help them reap the benefits of reducing waste, develop sustainable products and use resources in an efficient way.

Find out more from the WRAP Resource Efficiency Helpline on 0808 100 2040 or at www.wrap.org.uk

Contents

Summary

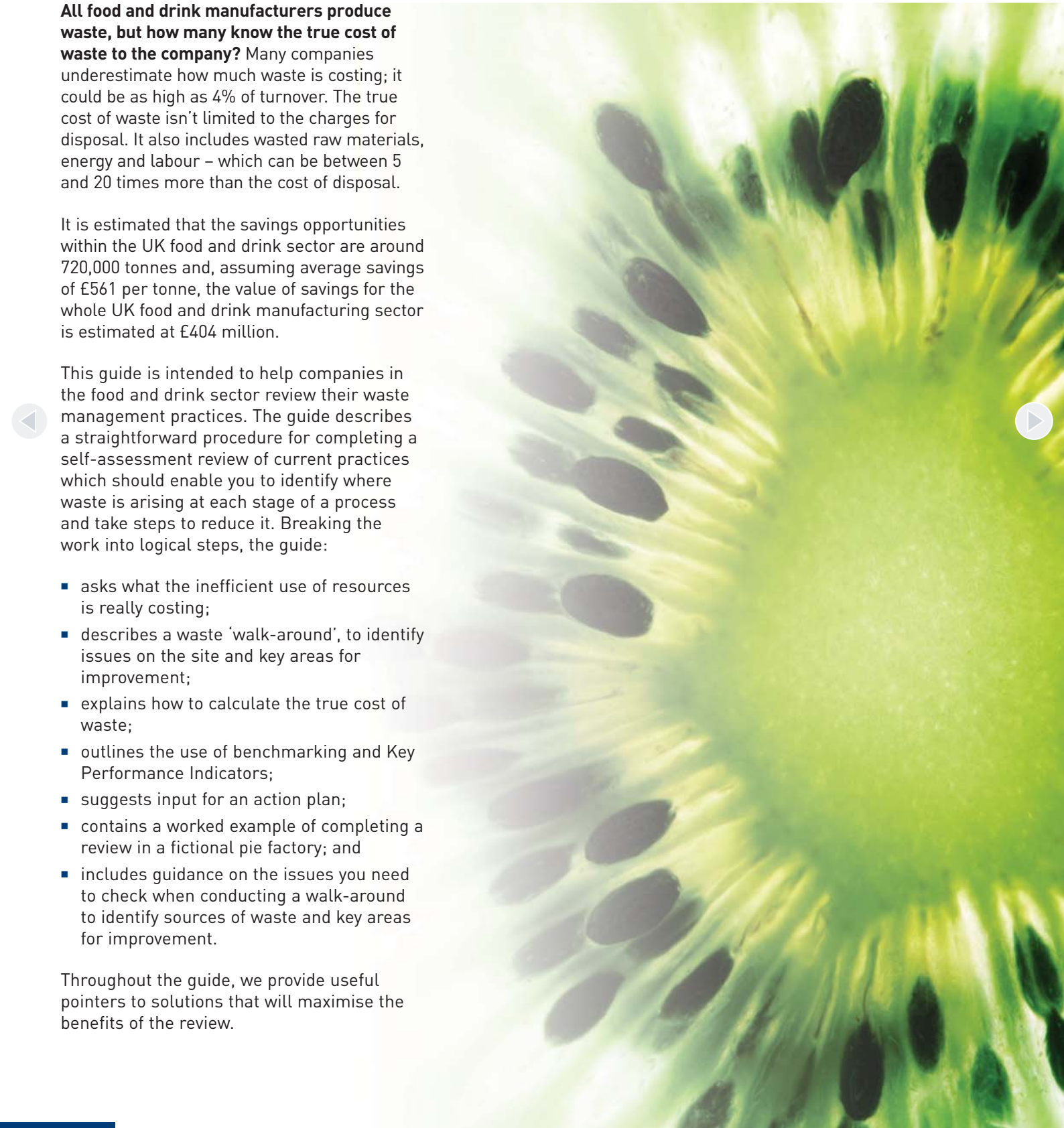
All food and drink manufacturers produce waste, but how many know the true cost of waste to the company? Many companies underestimate how much waste is costing; it could be as high as 4% of turnover. The true cost of waste isn't limited to the charges for disposal. It also includes wasted raw materials, energy and labour – which can be between 5 and 20 times more than the cost of disposal.

It is estimated that the savings opportunities within the UK food and drink sector are around 720,000 tonnes and, assuming average savings of £561 per tonne, the value of savings for the whole UK food and drink manufacturing sector is estimated at £404 million.

This guide is intended to help companies in the food and drink sector review their waste management practices. The guide describes a straightforward procedure for completing a self-assessment review of current practices which should enable you to identify where waste is arising at each stage of a process and take steps to reduce it. Breaking the work into logical steps, the guide:

- asks what the inefficient use of resources is really costing;
- describes a waste 'walk-around', to identify issues on the site and key areas for improvement;
- explains how to calculate the true cost of waste;
- outlines the use of benchmarking and Key Performance Indicators;
- suggests input for an action plan;
- contains a worked example of completing a review in a fictional pie factory; and
- includes guidance on the issues you need to check when conducting a walk-around to identify sources of waste and key areas for improvement.

Throughout the guide, we provide useful pointers to solutions that will maximise the benefits of the review.



1 Introduction

This process should form part of a wider project which looks at waste across your supplier chain, identifying how your process, product and packaging affect waste in your customers' and final consumers' operations.

This guide will help companies in the food and drink sector review their waste management practices in terms of:

- identifying the true cost of waste;
- measuring waste;
- understanding processes from a mass balance perspective;
- identifying key projects and setting up Key Performance Indicators (KPIs);
- completing an overall mass balance and calculating the cost of waste; and
- identifying key issues affecting resource efficiency.

This process should form part of a wider project which looks at waste across your supplier chain, identifying how your process, product and packaging affect waste in your customers' and final consumers' operations.

This guide splits the work involved in a self-assessment review into five sections:

- Section 2 asks what waste is really costing you, and explains why you should find out! It also leads you through a 'walk-around', which should help you identify issues on your site and find out where you can make improvements.
- Section 3 shows how you can use data from the walk-around and other sources to calculate the true cost of waste in your company.
- Section 4 outlines benchmarking and the use of KPIs, enabling you to find out how your waste performance compares with that of your competitors.
- Finally, Section 5 takes you through creating an action plan based on your findings.

If you get stuck at any point, Section 6 contains a case study detailing the assessment process for a fictional pie factory. Each stage of the work is fully explained, and tables and graphs are included, which you can modify to accommodate the data collected in your walk-around.

Got a problem? Find the appropriate skills

The review must be carried out by people with appropriate skills and knowledge. To get the most from reviewing your site, you don't need to be a resource efficiency expert, but you do need to have a good understanding of the site's processes and access to financial, production and ordering information. If you find that the necessary skills do not exist within your organisation, contact WRAP's Resource Efficiency Helpline on 0808 100 2040 or visit the website (www.wrap.org.uk) for more advice.

2 What is waste really costing you?

Through simple, no-cost or low-cost measures, companies can identify where waste is arising at each stage of a process and take steps to reduce it.

Do you know what your true waste costs are and how they affect your competitiveness and profitability?

Many companies underestimate how much waste is costing; it could be as high as 4% of turnover. The true cost of waste isn't limited to the charges for disposal. It also includes wasted raw materials, energy and labour – which can be between 5 and 20 times more than the cost of disposal. It could cost more to throw resource away than to purchase it in the first place.

Through simple, no-cost or low-cost measures, companies can identify where waste is arising at each stage of a process and take steps to reduce it. This will help your environmental performance, reduce your carbon footprint and help to build brand value.

A recent WRAP report[1] estimates that the savings opportunities within the UK food and drink sector are around 720,000 tonnes and, assuming average savings of £561 per tonne, the value of savings for the whole UK food and drink manufacturing sector is estimated at £404 million.

2.1 Understanding the waste hierarchy

In order to improve resource efficiency, first of all it is necessary to understand how inefficiencies occur. Often the main sources of wasted resources are inefficient systems and poor working practices. The best way of reducing wasted resources is to prevent waste occurring in the first place.

Waste can be dealt with in a number of ways, but the most effective is by following the waste hierarchy[2] which ranks waste management options in terms of sustainability; this is shown in Figure 1.

All organisations should aim to prevent waste from the outset wherever possible. However, if this is not possible, then consider re-using, recycling or recovering other value (e.g. energy). Not all wastes can be prevented, re-used, recycled or used for the recovery of other values, so you will need to dispose of them in a responsible manner. Waste disposal has the greatest impact on the environment and is typically the least cost-effective waste management solution. Therefore, it is best to aim to 'move up' the waste hierarchy so that you can save money, raw materials, water and energy – as well as improving your environmental reputation.

Figure 1: The waste hierarchy

[1] Opportunities for resource efficiency in the food and drink sector (WRAP, 2011).

[2] The waste hierarchy has been transposed into UK law through the Waste (England and Wales) Regulations 2011.

The WRAP Waste Hierarchy Guide is designed to help you understand the waste hierarchy and allow you to select the information on the wastes your business produces and what measures are available to you in applying the hierarchy.

2.2 Identifying your wastes

Most of the costs associated with waste and the inefficient use of resources such as water, energy or materials are hidden and companies simply do not consider them as real costs.

As a business looking to establish and operate an effective waste management and resource efficiency programme, it is essential that you are able to identify the various solid and liquid wastes within your organisation.

Any inputs or outputs in the production process that do not make it into the final product or service can be classified as waste. Food or food processing by-products make up 4.1 million tonnes of waste every year. The majority of food waste returns to the supply chain for further processing, but about 1.9 million tonnes of the sector's waste goes directly to landfill[3]. If you re-use half of your food waste and dispose of the other half to landfill or as effluent you're on a par with the rest of the industry... but what's so good about being average? Reducing waste will increase profits and put you ahead of the game.

2.3 Waste mapping

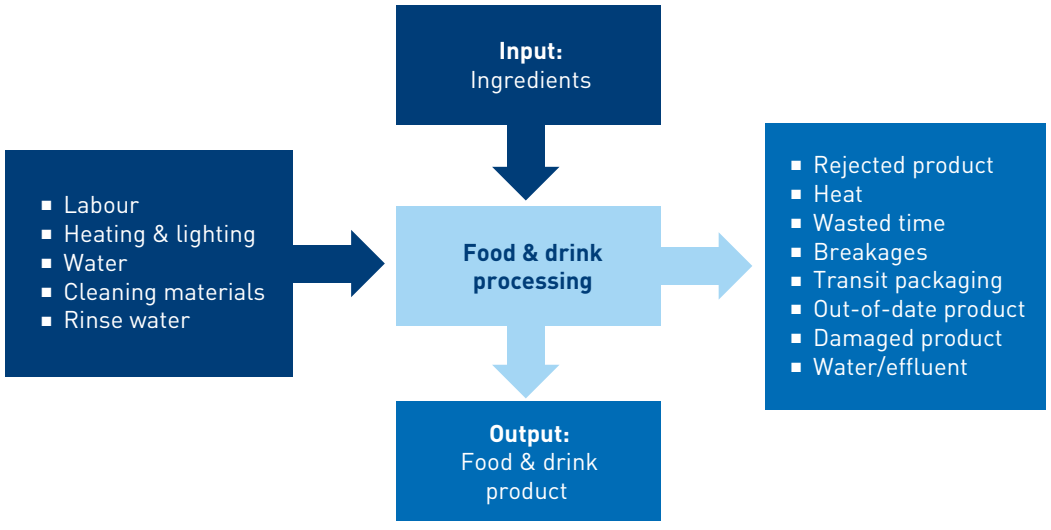
The process flow chart is an important tool for helping to detail the inputs and outputs of any manufacturing process, and in so doing establish where wastes are created. Figure 2 shows a process flow chart for a typical food and drink production process.

A good basic principle to adopt is the mass balance approach, identifying and quantifying the process inputs and outputs, such that all inputs are accounted for as outputs in the form of product or waste. Once you know where wastes are created, you can begin to collect data and assign figures to each stage.

The cost of waste is defined as the cost of purchasing, processing and disposing of all the non-product outputs. Improvements in resource efficiency will reduce waste and costs.

Completing this self-assessment review will help you to identify potential savings from improvements in the underlying process. More information on waste mapping is available from WRAP in the guide 'Waste Mapping: Your Route to More Profit', available from www.wrap.org.uk

Figure 2: Process flow chart for a typical food and drink production process



[3] Waste Strategy for England 2007, Defra.

2.4 The walk-around

The first step towards improved resource efficiency is to identify the waste currently being generated as part of your business's activities, and the best way to do this is to carry out a waste 'walk-around'.

A walk-around will allow you to gain an overview of the main processes, and will probably identify areas in which rapid, no-cost or low-cost improvements can be made to increase resource efficiency and subsequently save money.

Don't put off the walk-around. Waste is happening now and is costing your business money now. Take an unannounced walk around the site mid-shift. It may also be worth touring the premises when no production is being carried out. Always look in skips as a first step – they are an excellent starting point for locating waste and the source of waste can also usually be identified.

The walk-around sheets in Appendix C offer guidance, listing key issues to check when thinking about all the waste produced on your site. Not all of these issues will be relevant, but where they do apply to your business, do you know the answer? If not, why not and who might know? Try to be objective about the issues and, where you can assign figures, mark whether they are absolute or realistic estimates. Remember, the aim is to identify where waste is occurring so that you can move on to look at quantities, costs and cost-effective solutions.

2.4.1 Gaining commitment

You may find it difficult to gain commitment from senior management within the organisation. Try to explain that the review is not just paperwork that you plan to complete and file away, simply to be able to say you have looked into resource efficiency: it provides a reliable indicator of the effectiveness of your waste management system and, as such, requires reliable data and a commitment to change. Mention that the review will probably identify and bring about realistic changes that will save both resources and money.

2.4.2 Time constraints

Shifting production deadlines and time constraints may mean frequent breaks in the reviewing procedure, to maintain adequate production levels. To optimise the process, try to plan the review in advance, aiming to complete it during a steady production run, but be prepared to be flexible.

2.4.3 Lack of staff commitment

Staff may feel that the review is aiming to catch them at fault and may try to conceal problems. In most factories, staff are unlikely to look upon a review as a fact-finding exercise designed to foster a culture of improvement. By planning ahead, you should be able to tell staff when you will be in their area, which is common courtesy, and to publicise what you are really trying to do. As a result, you should find people more open and welcoming. Make sure you also publicise any improvements, to motivate staff to be receptive to future reviews.

Have a look at the WRAP guide, 'Resource Efficiency for Managers', at www.wrap.org.uk for more ideas on motivating and training staff for your resource efficiency programme.

3 Calculate the cost of waste

Calculating your current waste costs will give you a baseline figure that you can use for benchmarking and against which you can compare future performance. The procedure should also identify key areas for improvement, allowing you to prioritise actions and maximise savings.

3.1 Map out the process

Start by trying to map out the information you gathered on the walk-around sheets for your process, creating a mass balance process flow chart that identifies all the inputs and outputs, both solid and liquid, where they occur, and how to measure them.

Figure 3 shows an example of a more detailed process flow chart, with inputs on the left and solid and liquid waste products on the right. Product flows from top to bottom.

The mass balance study can take place at different levels of detail. A good place to start is the whole process, to gain a sense of the overall costs and savings potential. The study can then be reworked in greater levels of detail, looking at individual processes, production lines or even products, to identify specific opportunities.

3.2 Create waste-tracking sheets

From the process flow chart, you should be able to create a waste-tracking sheet for each individual step. These sheets list, quantify and assign a cost to each waste occurring, and also provide an accurate picture of the total cost of waste for the step.

Figure 3: Food and drink manufacture: process flow chart

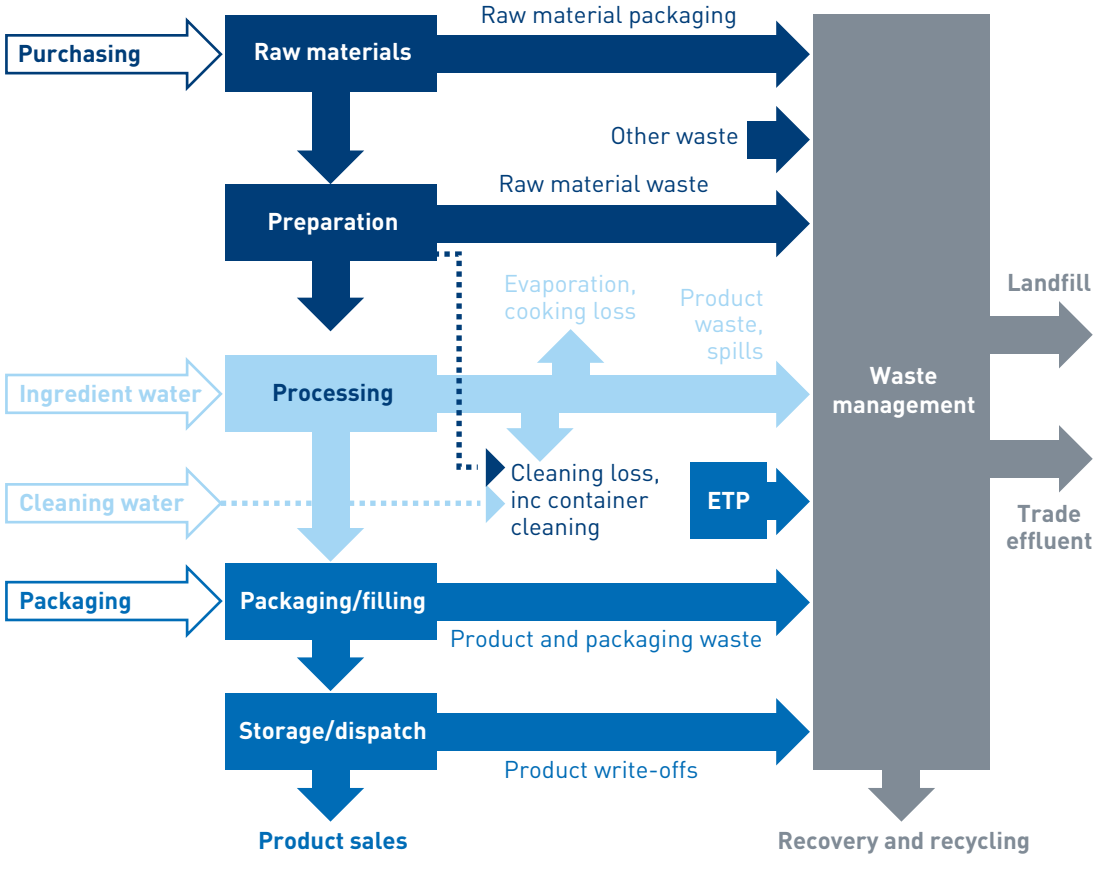


Table 1 shows an example sheet. Where waste costs are high, there is most opportunity for improvement. The 'resource/material/utility' column contents will change depending on the process, what was seen during the walk-around, and the level of detail at which you are examining the process or process step.

Combining the details for the individual steps will give you the overall cost of waste to the company. The results can also be used to see if there are any discrepancies in overall values, (i.e. between the identified and actual values for raw material and energy consumption, and water usage). You can then investigate further if there are major discrepancies.

Try to note where the inputs, outputs, wastes and transfers between processes occur. For example, where applicable, can you identify:

- Whether the amounts of inputs, outputs, wastes and transfers are being measured?
- Where ingredient water is entering the process and whether it is metered?
- Whether and where cooking or evaporation losses are occurring?
- Washing losses to drain from vessel cleaning, cleaning-in-place (CIP) systems, mobile tank washing, etc, and where they are going, as liquid waste (sludge), direct to drain or to the effluent treatment plant (ETP)?
- Whether the load (input to the ETP from the process) is being measured?

Appendix A contains a table you can use to record your findings, and some hints on how to estimate missing data.

True cost of waste = Cost of wasted raw materials + lost time + cost of utilities used + waste treatment costs + disposal costs.

3.3 Collect data

Data can be collected from many sources, including production records, bills and the finance, quality control and waste management departments.

By this stage you should have a good idea of what is available. Choose a suitable base period, usually a year. If data are available for part of a year, annualise them based on a suitable ratio, as shown in Table 2.

Table 1: Example waste-tracking sheet

Process description:			
Resource/material/utility	**Quantity wasted**	**Cost**	**Notes**
Wasted time			
Transit packaging			
Breakages			
Heat			
Spilt product			
Out-of-date stock			
Wasted water			
Effluent or cleaning by-product			
Total:			
Next process:			

Table 2: Using a base period to collect data

Basis	Base period	Full year	Multiply data by
Number of working days	227	365	1.60
Production (tonnes)	1,208	2,054	1.70
Number of months	8	12	1.50

Remember: if you don't measure it, you can't manage it!

The information needed should be easy to obtain.

- Use existing accounts records for raw material purchases.
- Use production records to find out how much raw material is actually used, rather than how much is ordered and delivered. If more than one type of raw material is used, add more lines to the tracking sheet.
- For the main production process wastes, include trimmings, damaged finished product, etc.
- Use waste transfer notes (a legal requirement) to find out how much solid waste has left the site and inspect invoices for waste disposal costs.
- For packaging, companies or suppliers covered by the packaging waste regulations will already have data on packaging use.
- Use utility bills to assess and record energy and water usage.

If you do not have all the data to complete the tracking sheet, approach the accounts department: accounts should be able to provide details of materials and services bought, product sold and waste disposal costs. If in doubt, estimate the appropriate number; it is better to have an informed estimate than no data at all.

If your accounts department sits remotely from the production site, ensure someone at the actual production facility monitors the utility bills. Any anomalies will be picked up more quickly on site than in a remote accounts department.

Create a final report

After the review has been completed and you have identified areas for improvement, it is a good idea to create a report. This does not necessarily have to be lengthy, but it should convey a balanced summary of the status of the organisation reviewed.

Lack of information?

Are the data available for collection? Can your suppliers help you to calculate your waste disposal costs? Companies covered by the packaging waste regulations will have data on the packaging sold to the company.

Waste transfer notes (a legal requirement) will contain data on how much solid waste has left the site. Use existing accounts records for raw materials purchases, services bought and products sold, and waste disposal costs. If in doubt, estimate the appropriate number.

3.4 Estimate missing data

With a mass balance approach, missing input or output data can be estimated from knowledge of the other inputs and outputs.

- If you know Gross and Net production in kg, you can calculate the packaging yield (Yield = Gross – Net). If you know the packaging usage in kg, then you can calculate packaging loss (Loss = Usage – Yield). This will indicate if packaging loss is an issue, and will prompt you to take a more detailed look at packaging waste, to determine the causes and potential savings.
- If you know the quantity of ingredients purchased in kg (in a process where ingredient water is metered and the product is uncooked so there are no cooking/evaporative losses) and the number of each stock keeping units (SKUs) produced, then you can calculate net production based on the product weight. From this you will be able to calculate ingredient loss (Loss = Purchases + Ingredient water – Net production (Number of SKUs x Standard Product weight)).

4 Benchmarking and Key Performance Indicators

Benchmarking is an excellent way to assess where you stand, by comparing your utility usage and waste generation levels with those of other businesses in your sector.

Benchmarking and Key Performance Indicators (KPIs) are valuable components of any waste management initiative.

4.1 Benchmarking

Benchmarking is an excellent way to assess where you stand, by comparing your utility usage and waste generation levels with those of other businesses in your sector. When you have compiled your list of wastes, you can use the data to gauge your performance relative to other businesses and set realistic targets for improvement.

4.2 Key Performance Indicators

KPIs are a broadly accepted financial and non-financial monitoring tool which reflects manufacturing efficiency. They are a set of measurements deemed essential to understanding an organisation's operational health, and can help you to measure progress towards your organisational goals, particularly for difficult to quantify, knowledge-based processes.

Some commonly used KPIs in the food and drink industry are listed in Table 3. The nature of the food and drink sector makes it difficult to provide a set of indicators that fits the whole sector. The suggested KPIs will give you a useful starting point, from which you can develop indicators suited to your organisation.

Table 3: Commonly used KPIs in the food and drink industry

KPI	Units	What is it?	What does it reflect?	What is a good result?
Water consumption	m^3/tonne of product	Total water use on site, excluding cooling water extracted and returned to source	Total volume of water consumed in any given time period (week, month or year)	Low levels
Process water	m^3/tonne of product	Water used in processing operations, including that used as a raw material (ingredient)	Volume of water used in any given time period to produce a normalised unit of production	Dependent on the particular product
Product rework	% (by number of items)	Percentage of finished goods (number of items) that have to be reprocessed in some way (if applicable) one or more times. % 'first time best' = 100 – product rework	Level of rework – related to inefficiency or very high quality standards	Low levels
Total product yield	% (by weight)	100 x tonnage of saleable goods divided by total tonnage of all goods produced	Overall effectiveness in making saleable product	High levels
Process energy (specific activities)	kWh/tonne of product	Amount of energy used in separate specific manufacturing processes (e.g. bottling lines, ovens, mixing vessels) per unit of production	Process energy use by different activities (allow this to be tracked independently) requires high levels of process control and monitoring equipment	Low levels
Total raw material use	Tonnes/tonne of product	Relative quantity of raw material consumed in a given time period (normally a year), including all packaging but excluding fuel and water (unless water is also a main ingredient/ raw material)	Allows raw material consumption to be tracked over time, regardless of the level of production output	Low levels are generally good, but varies according to product

5 Make an action plan

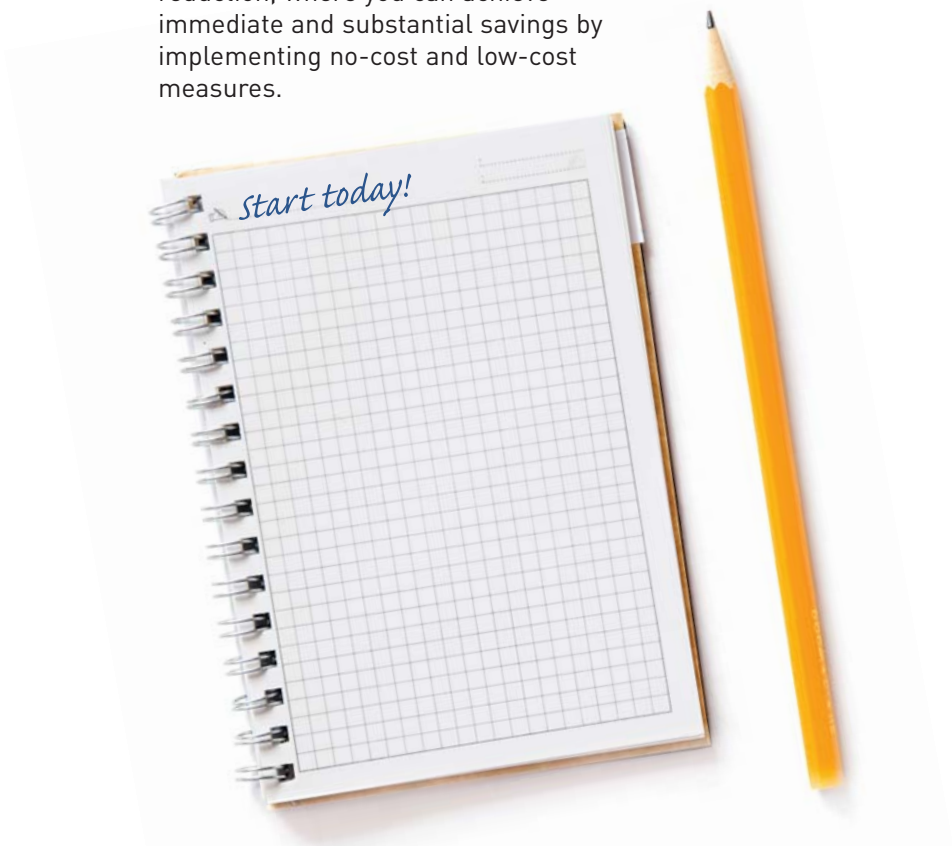
Your action plan can take the form of a written document or a table; make sure it is clear what is to be done, who needs to do it and what you aim to achieve.

To start seeing improvements in your waste management practices, you need to take all the information gathered so far and turn it into an action plan. It is important that the action plan is agreed, written and recorded, and that it is actually used to drive actions and deliver cost savings and environmental benefits.

Your action plan can take the form of a written document or a table; make sure it is clear what is to be done, who needs to do it and what you aim to achieve. There is an example plan at the end of the case study in Section 6 which will give you ideas on what to include and a possible layout.

The following pointers may help you when drafting your plan.

- Find out where and why waste is being created.
- Prioritise your actions into those options which will save you the most money. Start by identifying obvious areas for waste reduction, where you can achieve immediate and substantial savings by implementing no-cost and low-cost measures.
- Calculate the true cost of all your waste streams: you could represent the cost of waste as a percentage of turnover or per employee (for an example, see the 'key statistics' table in Section 6).
- Record the starting position and publicise improvements.
- Use the waste hierarchy, waste-tracking sheets and process flow diagrams to assist in identifying savings.
- Take into account KPIs and consider benchmarking.
- Appoint a resource efficiency champion.
- Ensure senior management is committed to the whole process.
- Carry out regular and focused staff training.
- Ensure your action plan covers all relevant issues. For example, begin to monitor utility and packaging usage, if this has not been done before, and look at your use of refrigeration and at your product movement and materials management.



6 Cost of waste case study

The methods used are applicable to a wide range of food processes, although the issues, costs and opportunities will be different in each case.

This example case study describes the review procedure for a fictional frozen pie factory. The factory has a turnover of £2.5 million and employs 18 people.

Each stage of the review is examined, including calculating the cost of waste for the factory, deeper investigations to identify savings and calculating potential savings for the projects identified (see Figure 4).

The methods used are applicable to a wide range of food processes, although the issues, costs and opportunities will be different in each case.

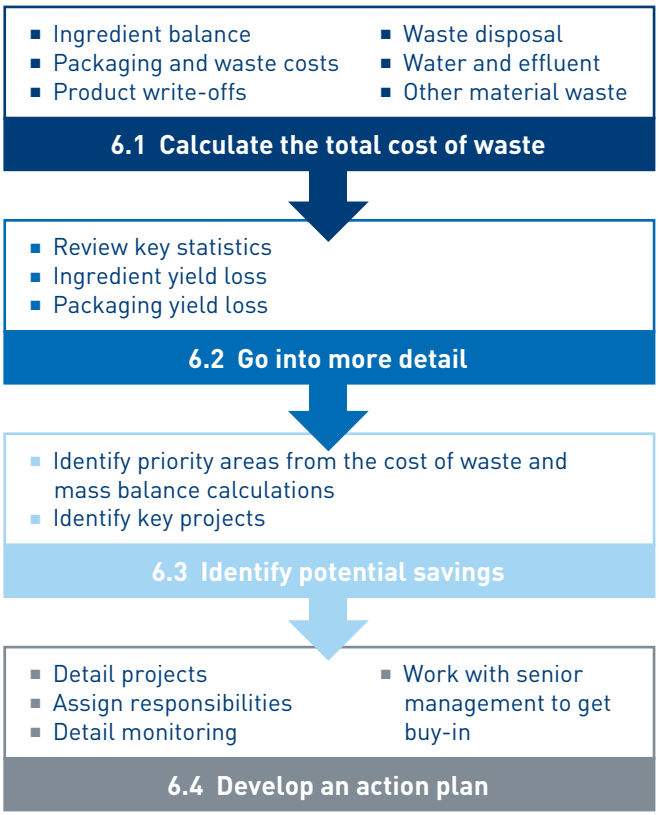
6.1 Calculating the total cost of waste

The total cost of waste is built up from a number of elements.

Data are entered into the coloured boxes in Table 4 and the remaining figures are calculated from these. The ingredients data are taken from production or purchasing records. The net production figure is also taken from the Management Information System production records.

Ingredient water is added to the pie fillings; this is metered and the meter is read daily. The figure is taken from the meter readings for one year, and the cost per litre is found from bills.

Figure 4: Steps involved in review procedure



Steam is lost during the cooking process. The amount has been estimated from the recipes, which shows that 25% of ingredient water is lost in cooking. As a loss, the amount is entered into Table 4 as a negative figure.

Process energy, production labour and overhead figures are taken from management accounts. These are included to reflect the cost of inefficiency in the process. The actual process losses will depend on a number of factors and are heavily influenced by the nature of the product. Losses ranging from 5.6% up to 31% have been reported. Lower losses occur where ingredients are dry or pasty, and where production runs are long.

Higher losses generally occur with viscous materials, short production runs, or where raw material preparation is involved, such as peeling or washing.

The average cost of ingredients per tonne of product is also calculated. It may be useful to know this when looking at process losses in more detail. The average ingredient cost per tonne will depend on the type of products being processed and can range from as little as £30/tonne (potato peeling) to £2,350/tonne (salmon smoking). Typical costs for meal products range between £500 and £900/tonne.

Table 4: Ingredient balance

Ingredient	Units (e.g. kg) per year	Cost £	Notes
Flour	453,192	88,752	From usage records
Meat	258,439	533,073	From usage records
Seasoning	12,985	45,654	From usage records
Vegetables	94,031	63,459	From usage records
Margarine	93,075	205,963	From usage records
Other	442,633	455,376	From usage records
Ingredient water	444,006	666	From meter or recipes, cost/litre from bills
Cooking loss/evaporation	–112,700		Enter as negative quantity, from meter or recipes
Process energy cost		20,000	From accounts (optional)
Production labour		50,000	Optional
Production overheads		15,000	Optional
Net inputs	[A] 1,685,661	[D] 1,477,943	Sum of above
Net production	[C] 1,522,200		From production records, amount in kg
Ingredient loss	[B] 163,461	143,318	Net inputs minus production, cost pro rata
Ingredient loss (%)	[B]/[A] x100 = 9.7%		As a % of net inputs
Average ingredient cost per tonne		[D]/[C] x 1,000 = £971	**Total cost of ingredients/ net production**

Table 5 shows packaging waste and costs; data should be entered in the coloured cells. The amount of packaging material used and the associated cost need to be noted. The packaging usage is from the accounts data and if data are available, each type of packaging could be entered separately. The difference between gross production and net production allows the yield to be calculated, and the loss is then the difference between usage and yield. The cost of wasted packaging materials is calculated, as is the cost per tonne.

Higher costs per tonne are observed for specialised materials, such as printed, metallised plastic film and complex, folded presentation boxes, while lower costs are observed for plain cardboard outers and plastic film.

Packaging losses generally range between 2% and 10%, depending on the efficiency of the packaging process and the length of production runs. Packaging losses above 5% usually indicate potential for process improvement.

Table 5: Packaging waste and costs

Packaging usage	Amount per year kg	Cost £	Notes
Packaging	214,500	137,898	Enter data from usage records
Total inputs	214,500	137,898	Sum of above
Gross production	**1,719,540**		**From production records, amount in kg**
Net production	**1,522,200**		**From production records, amount in kg**
Packaging yield	**197,340**		**Gross production less net production**
Packaging loss	**17,160**	**11,032**	**Packaging usage less packaging yield**
Packaging loss (%)	**8.0%**		**As % of packaging usage**
Average cost per tonne		**643**	**Total cost of packaging/ total amount of packaging x1000**

Product write-offs include items such as out-of-date stock, cancelled orders, raw materials which are scrapped owing to date issues, or product returns. Table 6 shows that in this case, data about the amount of out-of-date stock that was written off are available from accounts. This table must not include anything counted under ingredient usage, or it would be double-counted.

Table 7 includes all the waste streams from the site. The 'product with packaging' skip includes pastry waste and finished product waste, in its packaging, mixed together. Where wastes are mixed, it may be necessary to look at them in more detail to see where savings can be made. In this case, cardboard is being recycled and the revenue from this (after compactor hire costs) is shown as a negative cost.

Table 6: Product write-offs

Write-offs	Amount	£ in the last year	Notes
Out-of-date stock		20,000	From accounts
Raw material write-offs			
Total		**20,000**	**Sum of above**

Table 7: Waste disposal

Waste disposal costs	Kilograms or litres	Disposal cost/ revenue £	Notes
Food waste disposal			
General waste disposal	52,000	3,120	From accounts/bills
Product with packaging	102,700	7,514	
Plastic for recycling			
Cardboard for recycling	12,000	–480	Revenue
Wood/pallets			
Empty raw material containers			
ETP sludge			
Metals			
Used cooking oil	240	90	
Disposal [D]	**154,940**	**10,724**	**Disposal costs**
Sales of waste [R]	**12,000**	**480**	**Total revenue from sales of waste**
Net disposal	**142,940**	**10,244**	**[D-R] Net disposal costs** (costs less revenue)

Water, sewerage and effluent costs in Table 8 are entered from the bills. The effluent treatment plant (ETP) chemical costs are taken from the accounts. Other costs which could be included are the costs of water treatment and heating, if these are relevant.

Other material waste (Table 9) includes any other materials which are purchased and used in the process, but not included in ingredients or packaging.

Table 8: Water and effluent

Water and effluent	Amount	Cost £	Notes
Water from mains m^3	11,500		From bill
Water fixed cost		2,350	From bill
Water variable cost		10,225	From bill
Sewerage amount m^3	2,350		From bill
Sewerage fixed cost		960	From bill
Sewerage variable cost		1,058	From bill
Trade effluent volume m^3	9,150		From bill
Trade effluent fixed cost		2,504	From bill
Trade effluent charge		7,196	From bill
Cost of water treatment			For example, reverse osmosis (RO) or softening
Cost of water heating			Energy use for hot water
ETP costs		2,580	Chemicals/labour etc
Total cost		**26,873**	**Total**

Table 9: Other material waste

Other resource waste	Amount	Cost £	Notes
Chemicals for cleaning station	150	200	As required, where not included in the above
Total cost		**200**	**Total**

The pie factory has a total cost of waste estimated at £211,667/year (see Table 10). From this figure, it is possible to calculate some key statistics (see Table 11).

Table 10: Cost of waste summary

Estimated cost of waste		
Resource	**£ per year**	**Basis**
Ingredient loss	143,318	Based on mass balance of ingredients and production
Packaging loss	11,032	Based on usage less packaging yield
Product write-offs	20,000	From accounts
Sales of waste	–480	Revenue from sale of waste
Disposal costs	10,724	Disposal costs
Water and effluent	26,873	Water supply, treatment, effluent and ETP costs
Other material waste	200	If relevant (e.g. chemicals)
Total cost of waste	**211,667**	**Sum of above**

Table 11: Key statistics

Key statistics	Data	Statistic	Notes
Cost of waste **[C]**	£211,667		From Table 10
Turnover **[T]**	£2,500,000		Enter figure into coloured box
Cost of waste as % turnover		8.5%	**[C/T x 100]** How does this compare with profit margins?
Employees **[E]**	18		Enter figure into coloured box
Cost of waste per employee		£11,759	**[C/E]** The cost of waste is this much for each employee
Net waste disposal cost	£10,244		From waste disposal Table 7.
Cost of waste: disposal costs		20.7 : 1	Ratios of 5-20 are the norm, use to estimate your cost of waste
Tonnes of waste **[W]**	167		See waste disposal Table 7.
Cost of waste per tonne waste		£1,267	**[C/W]** The cost of waste is this much for each tonne of waste generated

The cost of waste (see Figure 5) amounts to 8.5% of turnover. How does this compare with profit margins? Waste disposal costs are shown to be a minor element of the total; the overall cost of waste is almost 20 times the disposal costs. The cost of waste for companies in the UK can be as high as 4% of turnover. However, it is not uncommon for this figure to be higher in food processing.

Another interesting statistic is the cost per tonne of waste identified in this case study. Each tonne of waste avoided has the potential to save £1,267.

It is a good idea to start with the overall picture and then zoom in to specific issues following a top-down approach. For this pie factory, the main waste costs arise through ingredient losses, with water and effluent costs and product write-offs much less important in cost terms.

6.2 Going into more detail

Once the overall costs have been estimated, it is time to go into more detail and look at which areas have the most potential for savings.

Ingredient losses (Table 12) account for the largest part of the waste costs and, in a walk-around, the four main sources of ingredient loss have been identified as ingredient preparation, changeovers, cleaning losses and checkweigher rejects.

6.2.1 Ingredient preparation

Bins of waste from the food preparation area are placed in a separate skip from the main production waste. Using data for this skip, it is possible to estimate the annual waste tonnage at 9,000kg, which is 2% of raw materials.

Figure 5: Cost of waste

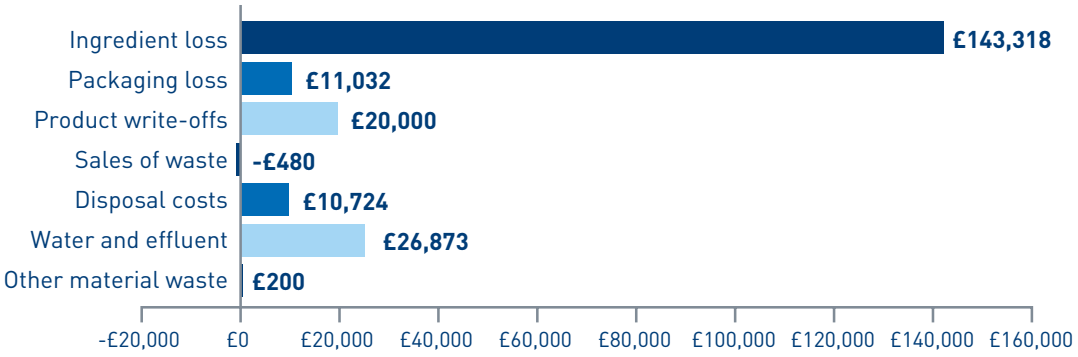


Table 12: Ingredient yield loss

Loss	Estimated %	Cost £	Notes
Drain loss (load on ETP)	4.0	59,118	Enter % loss, calculate cost pro rata
Ingredient waste	2.0	29,559	Enter % loss, calculate cost pro rata
Changeover waste	1.0	14,779	Enter % loss, calculate cost pro rata
Checkweigher rejects	2.0	29,559	Enter % loss, calculate cost pro rata
Metal detector rejects	0.5	7,390	Enter % loss, calculate cost pro rata
Unaccounted (calc)	0.2	2,913	Ingredient loss less sum of above
Total cost of waste	**9.7**	**143,318**	**From ingredient balance (Table 4)**

6.2.2 Changeovers

When there is a changeover on the pie filling line, the practice is to use up all the filling and then scrap any pastry left in the line. The amount of reject pastry is recorded for a week and from that data, annual pastry waste is estimated at 4,500kg or 1% of raw materials.

6.2.3 Cleaning losses

The load on the ETP is sampled regularly using an automatic sampler. Based on the average suspended solids content and the total volume of effluent, the total suspended solids are estimated at 18,000kg or 4% of raw materials. The solids are reaching the ETP from the various equipment washing stations (mobile tanks, cookers and mixers).

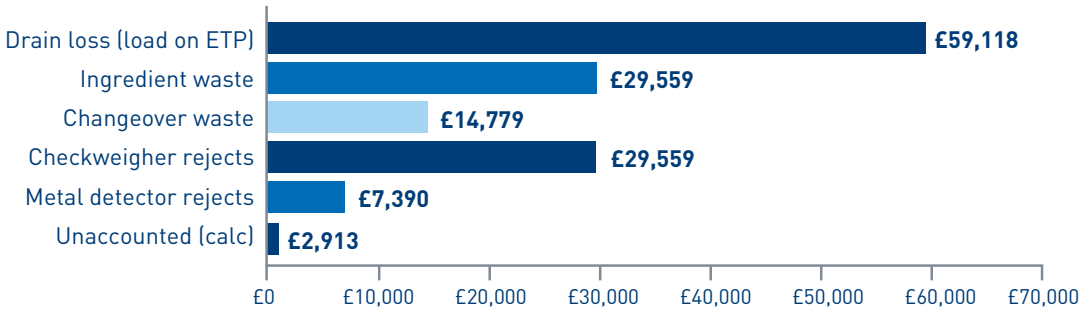
6.2.4 Checkweigher rejects

Rejected product levels are examined using records from the Quality Control department. These show checkweigher rejects are running at 2% and metal detector rejects at 0.5%.

These data can then be used to calculate ingredient yield loss. Based on the data available, there is an unaccounted loss of just 0.2%, which is very acceptable. In general, a good mass balance will result in unaccounted losses of less than 1%.

These new data in Table 12 and Figure 6 reveal drain loss to be a priority, especially when coupled with the cost of water and effluent treatment.

Figure 6: Cost of ingredient yield losses



Another walk-around is carried out to look for sources of drain loss. This reveals that filling is left in the mobile tanks used to transfer filling from the cookers to the pie filling lines, so some tanks are weighed before and after washing. Based on the amount of product left in the tanks, it is possible to estimate the amount and cost of this loss.

If unaccounted losses were higher, overfill might be the cause. Overweight product is an 'invisible' loss of ingredients. Checkweigher data will reveal the average product giveaway.

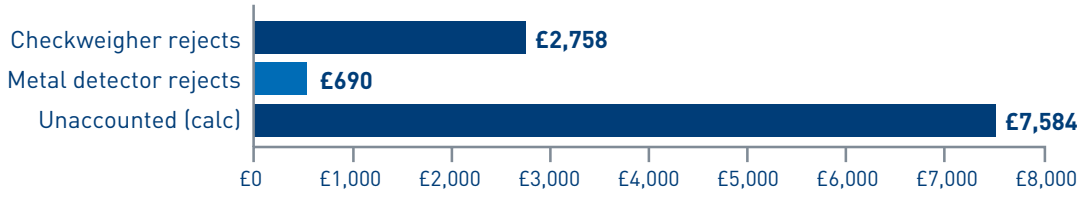
Product rejects are running at 2.5%, and yet packaging losses are running at 8%. These data are entered into the packaging yield loss table (Table 13), revealing an unaccounted loss of 5.5%. Such a high unaccounted loss suggests that packaging data and the packaging lines need to be re-examined (see Figure 7). A walk-around reveals large amounts of packaging waste going into the general waste bins from setting up the packaging lines. This cost can be estimated at 5.5%, or £7,584.

When you are conducting a review, you will need to keep going, collecting more data and refining your understanding of the overall situation, until you are satisfied that you have a good feel for where all the waste is coming from and going to.

Table 13: Packaging yield loss

Loss	Estimated %	Cost £	Notes
Checkweigher rejects	2.0	2,758	Enter % loss, calculate cost pro rata
Metal detector rejects	0.5	690	Enter % loss, calculate cost pro rata
Unaccounted (calc)	5.5	7,584	Packaging loss less sum of above
Total cost of waste	**8.0**	**11,032**	**From packaging waste and costs (Table 5)**

Figure 7: Cost of packaging yield losses



6.3 Identifying potential savings

Once the priority areas have been identified from the cost of waste and mass balance calculations, it is time to identify some projects.

6.3.1 Drain loss: 4.0% at a cost of £59,000/year

The remains left in mobile tanks amount to around 2kg/tank per week. Around 400 tanks are used each week, resulting in 800kg of waste. Based on £877/tonne (average ingredient cost), this loss amounts to £700/week. After discussing the situation with a team of operators and supervisors, it is decided to install a mangle at the transfer point and to use a plastic liner in the mobile tanks. The operator can use the mangle to empty the liner, and trials show a reduction in waste of 1.5kg/tank. The tank cleaning operation is speeded up and the load on the ETP is reduced by 300kg/week. After allowing for the additional cost of liners and waste disposal, the potential saving is £480/week or £24,000/year. This new approach also has an additional benefit, as the effluent from the ETP had been exceeding discharge consents and the upgrade that was being considered may no longer be needed.

The remaining area of drain loss is in the cookers and pipework used to transfer the product into the mobile tanks. A project team is set up to look at this in more detail, including cooker operators, supervisors, quality control staff and laboratory technicians. The potential savings are unknown, so a target cannot be set at this stage.

To track drain loss in the future and monitor improvements, a KPI is established based on the load on the ETP. A sample of the effluent before the ETP is taken daily and suspended solids are measured in the laboratory. The data are entered into a spreadsheet and the ETP load (expressed in kg of suspended solids) is calculated, based on the monthly effluent volume. The KPI used is ETP load in kg/Net production in kg, expressed as a percentage.

6.3.2 Ingredient waste: 2.0% at a cost of £30,000/year

Observations of the bins revealed that about half of the ingredient waste is vegetable peel, which is unavoidable. It may, however, be worth investigating whether there is a market for this peel.

In a walk-around, the way in which chicken pieces are delivered is examined and it is noticed that some chicken pieces are left in each bag. The bags are slit down one side, but the cut does not go all the way to the corner and some pieces are trapped.

Twenty chicken bags are collected and 50g of waste is found in each 10kg bag, a loss of 0.5%. Based on the amount of chicken bought, this loss costs £3,000/year. By changing the cutting method to remove the entire edge of the bag, no pieces are trapped.

A KPI for this area of ingredient waste is set up as kg waste/kg production.

6.3.3 Changeover waste: 1.0% at a cost of £15,000/year

Changeover waste occurs because the filling has run out and any surplus pastry is then scrapped. During a walk-around, it is noticed that a part-filled container is always used at the end of each batch, making it hard to predict when the filling will run out. Sequencing is changed so that the part-filled container is used earlier on, and each run is then finished with a full container.

As it is known exactly how many pies can be filled from a full container, pastry mixing can be adjusted such that there is a minimum surplus for scrapping. This production change could save £10,000/year.

A KPI is set up as kg pastry waste/kg of production.

6.3.4 Checkweigher rejects: 2.0% at a cost of £30,000/year

A technical team is set up to look at the checkweigher rejects, working with supervisors and operators in the packing room. One of the checkweighers is found to have the wrong settings and is falsely rejecting good product. This accounts for around one-third of the rejects and can be eliminated by changing the settings, saving £10,000/year. Another third of the rejects arise on one particular product, where fill levels are variable because the filling is highly viscous. The team shifts focus to work on improving the capability of the volumetric dispenser.

A KPI is set up as checkweigher rejects as a percentage of production.

6.3.5 Metal detector rejects: 0.5% at a cost of £7,500/year

The checkweigher team also looks at these and identifies one product with high rejection rates. The problem is found to result from the packaging: this is proved by removing the product from the rejected packs and putting it through again. This problem is referred to the technical manager, who is targeted to come up with a design that eliminates the problem. This redesign could save £5,000/year.

6.3.6 Packaging rejects: 5.5% at a cost of £7,500/year

Previous detailed investigations had revealed that large amounts of packaging were being lost in setting up the packing machines, and part rolls were being dumped at the end of a run. A team is set up to investigate the reasons, involving packaging technicians, operators and a supervisor. They set themselves a target of saving £5,000/year by standardising machine settings, and using part-rolls for set-up. One operator takes responsibility for setting up a part-roll re-use area.

6.3.7 Water and effluent: £27,000/year

A reduction in effluent charges should result from the projects to reduce drain losses. A team is set up to look at where water is used, with a view to implementing efficiency measures and saving £10,000/year.

A KPI is set up as water use in m^3/kg of production.

6.3.8 Product write-offs: £20,000/year

Investigations reveal that this was due to two batches returned from a customer because of poor packaging seal integrity. This should be investigated further to identify whether this is an on-going issue that needs to be resolved.

6.3.9 Waste disposal costs: £11,000/year

Product waste at £7,500/year is the largest element of these costs and, by reducing checkweigher rejects and avoiding product write-offs, savings of £3,000/year are anticipated here.

Looking at the cardboard collection operation reveals that cardboard is collected from the raw material preparation area, but not from the filling area where the packaging is unpacked. By setting up cardboard collection from this area, and also from the canteen, general waste will be reduced by some 30%, saving £1,000/year.

About half of the general waste comprises various forms of raw material packaging, plastic drums, plastic bottles and bags. It is difficult to find recyclers that will take plastic that has been in contact with food. The purchasing department is asked to review all raw material packaging to see if re-usable or returnable alternatives are available and to work with suppliers to ensure that what is not returnable or re-usable is recyclable.

Plastic drums are used to transfer part-processed material to another site. There is potential for these drums to be washed and re-used with a liner, potentially saving up to £3,000/year on purchases of new drums.

Implementing these projects has the potential to save £74,000/year, around 35% of the total cost of waste. Experience shows that when the cost of waste is analysed in this way, potential savings of between 20% and 40% are the norm, and can be higher.

6.4 Developing an action plan

The identified projects and potential savings can now be incorporated into an action plan. The plan needs to detail projects, assign responsibilities and detail monitoring. At this stage, it is important to work with senior management, to get buy-in to the plans and ensure accountability.

The action plan for the pie factory is shown in Table 14. It lists the resources required, the benefits, both financial and non-financial, the actions and responsible persons. The plan can also be used to monitor completion and the savings achieved.

Completing a review and drafting an action plan are just the start of the process.

- Review your action plan regularly.
- Continue to monitor progress.
- Communicate results and celebrate successes.
- Keep looking for new opportunities to make savings.
- Calculate the true cost of waste on a regular basis, and report your findings as part of Board level reporting.

Table 14: Example action plan

Projects identified with scope to save					Action plan		Monitoring		
	Project	Scope to save £	Resource or cost required	Benefits	Actions	Responsibility	% complete	Savings achieved	Next review
1	Mobile transfer loss	24,000	Staff training on mangle, liners	Reduced load on ETP; potential avoided investment and improved compliance with consent	Install mangle, purchase liners; staff training on use of mangle	Production manager	30		
2	Cooker losses	?	Technical team	Reduced load on ETP; potential avoided investment and improved compliance with consent	Investigate product losses in transfer from cookers to mobile tanks; identify improvement potential	Cooker team	10		
3	Chicken bags	3,000	Staff team to investigate improved method	Reduced waste	Devise improved method of cutting bags to avoid loss of materials	Production manager	20		
4	Check-weigher losses	10,000	Technical team	Improved checkweigher reliability; avoid potential false positives (underweight products) reaching market	Change settings on checkweigher 3 to avoid false negatives (unnecessary rejects)	Technical manager	10		
5	Volumetric filler	?	Technical team	Reduced product variation leading to checkweigher rejects	Investigate fill variation on filler 4 and propose actions to improve process capability	Technical manager	10		
6	Changeover waste	10,000	Staff team to investigate improved method	Reduced waste, reduced clean-up/changeover time	Trial of changed sequencing of filling mixes to ensure run ends on full container. Establish maximum WIP for pastry to ensure coordination of end of run	Production manager	0		
7	Metal detector losses	5,000	Product design team	Improved productivity	Investigate why packaging on product x is rejected by metal detector; identify redesign options to eliminate rejects	Technical manager	10		
8	Packaging waste	5,000	Staff team: technicians, operators, process engineer	Reduction in waste to landfill	Team has set its own targets and expects to develop an action plan in the next two weeks	Production manager	30		
9	Water and effluent costs reduction target	10,000	Staff team: technicians, operators, process engineer	Reduced load on ETP; potential avoided investment	Team has set its own targets and expects to develop an action plan in the next two weeks	Environmental manager	20		
10	Waste disposal costs target	4,000	Additional bins; staff training	Reduction in waste to landfill	Implement cardboard recycling for canteen and filling area; monitor waste volumes to ensure reductions are achieved	Waste manager	20		
11	Drum re-use	3,000	Drum liners; washing capacity	Reduction in waste to landfill	Investigate potential for re-use of raw material drums for internal transport	Purchasing manager	20		
12	Raw materials and packaging	?	Staff team: buyers, operators, purchasing manager	Non-financial benefits (e.g. reduction in waste to landfill, improved brand perception, enhanced corporate social responsibility)	Review all raw material packaging to identify options for return, re-use or recycling	Purchasing manager	10		
Total scope to save		**74,000**							

7 Further information

Useful sources of information

WRAP guides and tools

- Saving Money Through Resource Efficiency: Reducing Water Use.
- Tracking Water Use to Cut Costs.
- Reducing Your Water Consumption.
- Finding Cost Savings: Resource Efficiency for SMEs.
- Resource Efficiency for Managers.
- Environmental Strategic Review Guide.
- Waste Mapping: Your Route to More Profit.
- Workforce Partnerships for Resource Efficiency.
- Green Office: A Guide to Running a More Cost-effective and Environmentally Sustainable Office.
- Your Guide to Environmental Management Systems (EMS).
- WRAP Waste Hierarchy Guide.
- Opportunities for Resource Efficiency in the Food and Drink Sector (2011).
- Lightweighting the Can Pack.
- Lightweighting Carbonated Soft Drinks Bottles.

Useful links

- Reports and research – grocery sector.
- **Carbon Trust**: Visit www.carbontrust.co.uk or call 0800 085 2005.
- **Water Technology List**: Visit www.hmrc.gov.uk/capital-allowances/fya/water.htm or call 0844 875 5885.
- **Defra**: Mapping Waste in the Food and Drink Industry (2010).
- **Defra**: Waste Strategy for England 2007.

WRAP

WRAP (Waste & Resources Action Programme) works in England, Scotland, Wales and Northern Ireland to help businesses and individuals reap the benefits of reducing waste, develop sustainable products and use resources in an efficient way.

Since its creation WRAP has funded projects that will, over their lifetimes, deliver over 120 million tonnes of waste diverted from landfill and over 20 million tonnes of CO_2 equivalent greenhouse gases saved. Visit www.wrap.org.uk for more information on all of WRAP's services.

What support can you get from WRAP?

UK businesses could save £23 billion per year and help create and protect jobs by improving the way they use resources.

WRAP provides a range of free resource efficiency support for organisations including:

- WRAP Resource Efficiency Helpline on 0808 100 2040;
- online tools and guidance;
- online training initiatives;
- tailored business support for recycling companies;
- case studies; and
- guides.

Visit www.wrap.org.uk to find out more.

Appendix A Data locator

The following table suggests where you are likely to find the information needed to complete your review.

Raw materials			
Inputs	**Data available from**	**Units of measure**	**Notes**
Gross weight of raw materials purchased	Purchasing	Kilos, tonnes, drums, litres, sacks	Can be calculated if ingredient usage and raw material packaging are known
Outputs	**Data available from**	**Units of measure**	**Notes**
Packaging waste	No data unless some types of packaging waste are segregated for recycling	Drums, containers, IBCs, bags, pallets, kilos, litres	Can be estimated from gross/net weight of typical ingredients
Raw materials left in packaging	No data	Kilos, litres	Can be estimated from sampling some 'empty' containers

Preparation			
Inputs	**Data available from**	**Units of measure**	**Notes**
Ingredient usage	Material usage reports	Kilos, drums, litres, sacks	
Outputs	**Data available from**	**Units of measure**	**Notes**
Raw material waste (peel, trimming, bones)	Solid waste data	Kilos	

Processing			
Inputs	**Data available from**	**Units of measure**	**Notes**
Ingredient water	Meter readings	Litres	Can also be estimated from recipes
Outputs	**Data available from**	**Units of measure**	**Notes**
Gross production	Management reports	Kilos	
Cooking loss	No data	Kilos	Can be estimated from recipes
CIP wash to ETP	CIP records		See load on ETP
Failed batches	Waste or quality data	Kilos	
Samples	Waste or quality data	Kilos	
Product left in transfer containers	No data	Kilos	Can be estimated from sample weighing and data on number of containers washed

Packaging			
Inputs	**Data available from**	**Units of measure**	**Notes**
Gross packaging	Purchasing	Kilos/units	
Outputs	**Data available from**	**Units of measure**	**Notes**
Saleable product	Production data	Kilos/units	
Product rejects	Quality data	Kilos/units	
Packaging rejects	No data	Kilos	Use mass balance

Storage/dispatch			
Outputs	**Data available from**	**Units of measure**	**Notes**
Product write-offs	Accounts	£	

Effluent treatment			
Inputs	**Data available from**	**Units of measure**	**Notes**
Treatment chemicals	Purchasing records	Kilos	
Load	No data	Kilos of solids	Use mass balance
Outputs	**Data available from**	**Units of measure**	**Notes**
Screening sludge	Waste management	Kilos	May have high water content; adjust if using for mass balance
ETP sludge	Waste management	Kilos	
Suspended solids (S/S) and chemical oxygen demand (COD) to trade effluent	Effluent bills or monitoring data	Kilos	Calculate total load as average solids x effluent volume in litres (m^3 x 1,000)

Waste management			
Inputs	**Data available from**	**Units of measure**	**Notes**
Waste from each process	No data	Kilos	Can be sampled by segregating wastes from an individual process
Non-production waste	No data	Kilos	
Outputs	**Data available from**	**Units of measure**	**Notes**
Waste to landfill	Waste invoices	Kilos, tonnes or volume	Convert volume to kilos based on bulk density
Waste to recovery	Waste invoices	Kilos, tonnes or volume	
Waste to recycling	Waste invoices	Kilos, tonnes or volume	
Liquid waste	Waste invoices	Litres	May have high water content; adjust if using for mass balance
Food waste for rendering	Waste invoices	Kilos, tonnes	

Appendix B Conversion factors

Volume conversion factors

To convert from	to	multiply by
cubic inch (in^3)	cubic metre (m^3)	0.00001639
cubic foot (ft^3)	cubic metre (m^3)	0.02831685
cubic yard (yd^3)	cubic metre (m^3)	0.7645549
gallon (gal)	cubic metre (m^3)	0.004546
gallon (gal)	litre (l)	4.546
fluid ounce (fl oz)	cubic metre (m^3)	0.00002841
fluid ounce (fl oz)	millilitres (ml)	28.41

Area conversion factors

To convert from	to	multiply by
square foot (ft^2)	square metre (m^2)	0.09290304
square inch (in^2)	square metre (m^2)	0.00064516
square yard (yd^2)	square metre (m^2)	0.83612736
acre (a)	hectare (ha)	0.4047

Length conversion factors

To convert from	to	multiply by
mile	kilometre (km)	1.609347
inch (in)	millimetre (mm)	25.4
inch (in)	centimetre (cm)	2.54
inch (in)	metre (m)	0.0254
foot (ft)	metre (m)	0.3048
yard (yd)	metre (m)	0.9144

Pressure or stress conversion factors

To convert from	to	multiply by
kip per square inch (ksi)	megapascal (MPa)	6.894757
pound per square foot (psf)	kilogram per square metre (kg/m^2)	4.8824
pound per square foot (psf)	pascal (Pa)	47.88
pound per square inch (psi)	pascal (Pa)	6,894.757
pound per square inch (psi)	megapascal (MPa)	0.00689476

Mass conversion factors

To convert from	to	multiply by
pound (lb)	kilogram (kg)	0.4535924
ton (2,000 lb)	kilogram (kg)	907.1848
grain	kilogram (kg)	0.0000648

Temperature conversion factors

To convert from	to	use the equation
degree Fahrenheit (°F)	degree Celsius (°C)	tC = (tF – 32)/1.8
degree Fahrenheit (°F)	kelvin (K)	tK = (tF + 459.7)/1.8
kelvin (K)	degree Celsius (°C)	tC = tK – 273.15

Appendix C Walk-around sheets

The following sheets offer guidance on the issues you need to check when conducting a walk-around to identify sources of waste and areas for improved waste management. Blank lines are left to enable you to tailor the sheets to your organisation.

Raw materials

Issue	✓ X ?	If you answered...	Comments/Quantities/Costs
Are materials inspected on arrival?		✓ What happens to defective or damaged materials? How are they damaged? Could this be prevented?	
Are raw materials stored appropriately?		? Do they frequently get bruised/ crushed/go out of date before they have the opportunity to be used?	
What happens to part-containers of raw materials?		? If residue or hard-to-get-at ingredients are left in a container, what happens to them? Are they disposed of or washed into the effluent stream, where a bit of extra effort would save you ingredients and disposal costs?	
Do raw materials have a shelf-life?		✓ How is this managed? Are there any records of the amounts which are wasted owing to expired shelf-life?	
Are samples taken and, if so, how much and for what purpose?		? What is the purpose? Quality or temperature control? Is too much taken? How is it disposed of?	
Are good quality off cuts of raw food materials re-used, where possible, in other products for retail outlets?		✓ The demands of customers for a certain size of product can lead to otherwise good quality whole product or off cuts being wasted – at a substantial cost. Try discussing a change in specification with the customer and/or find additional customers with less stringent specifications.	

Materials management

Issue	✓ X ?	If you answered...	Comments/Quantities/Costs
Are materials weighed or measured?		✓ How? Is a record kept of these figures?	
Does spillage occur when materials are transferred?		✓ Is this a regular spill or a one-off occurrence? Can you measure how much is being spilled and roughly what this spill costs?	
Are there wastes from preparation (peel, trimmings, bones, etc)?		✓ Can these be re-used in any way, such as animal feed, and if not are they disposed off correctly in line with the Animal By-Product Regulations (ABPR)?	
Can you avoid breakages and damage by improving storage and handling techniques (especially after value has been added by processing)?		✓ You may be able to fix this problem easily with low-cost measures. It is best to calculate the cost of waste caused by damages and weigh this up against any new purchases.	
Are products frequently damaged during the production process?		✓ Is it possible to provide protection to the products to minimise damage in the production process?	
Can you plan production to minimise changeover losses?		? All losses cost you money in materials and waste disposal costs. If you can reduce wastes, do.	
Do you know what causes the most product damage?		X Establish the total material losses for the process. Compare these losses with utilisation rates to find the relative importance of process and materials handling losses.	
Is there any reprocessing of materials?		✓ Excellent; re-use is always better than recycling.	
Is there any area loss (e.g. of sheet materials)?		✓ Can you reduce this by reprogramming machines to cut closer or changing product shape?	
Are materials left over at the end of a batch?		✓ If so, what happens to them? Refer to the waste hierarchy for the best option.	
Is there wastage during the start-up of the process?		If so, what happens? How could this be avoided?	

Materials management (continued)

Issue	✓ X ?	If you answered...	Comments/Quantities/Costs
Do prepared materials have a shelf-life?		✓ How is this managed? Does wastage ever occur?	
Are materials wasted or damaged in transfers within the process?		✓ Could this be improved by a simple action such as reducing the speed? Fewer units produced per hour may be more acceptable at a higher quality rate.	
Are there any conveyor or transfer losses?		✓ Could this be improved by a simple action such as reducing the speed? Fewer units produced per hour may be more acceptable at a higher quality rate.	
Are materials wasted during cleaning of transfer containers/ pipework?		✓ What happens to materials left in containers or pipework after transfer? Could a method such as pigging reduce waste?	

Packaging

Packaging is paid for twice – once to buy it and again to dispose of it.

Issue	✓ X ?	If you answered...	Comments/Quantities/Costs
Are raw material containers designed to be returned to the supplier?		✓ Are they, in fact, returned?	
Are there designated disposal routes for transit packaging (e.g. pallets, slip-sheets, shrink-wrap)?		✓ Could this packaging be reduced, re-used or recycled?	
Are raw material containers re-used for transporting materials within the process?		X If not, could they be used in this way?	
Is raw material packaging recyclable?		✓ Is it, in fact, separated for recycling?	
Do empty raw material containers have ingredient residues in them?		✓ Could a change in practices prevent this from occurring? Would more staff training help?	
Can you find ways of minimising packaging with both suppliers and customers?		✓ This will require a bit of thought and discussion. Could you all benefit?	
Could you re-use any packaging for your products, where appropriate, or elsewhere in the workplace?		? Re-use is always more cost-effective and environmentally friendly than recycling or disposal.	
Is the packaging over-engineered for your requirements?		✓ Making changes to the way that final products are packaged can substantially reduce your costs.	
Is packaging rejected during the start-up phase of the packaging process?		✓ Can anything be done to reduce this? Watch the process.	
Don't just think of product packaging. Do you know what happens to the packaging of the product packaging?		? Can it be re-used, returned to the supplier, or recycled?	

Packaging (continued)

Issue	✓ X ?	If you answered...	Comments/Quantities/Costs
Are there rejects from checkweighers and metal detectors?		✓ If so, are any patterns emerging? Which product is rejected the most and why?	
Are rejected product and packaging separated?		✓ Could either one be reworked, re-used or recycled?	
Is product rejected for quality reasons?		✓ If so, what is reducing the quality? Is the cost of the rejects higher than the cost of improving the quality?	

Refrigeration

Issue	✓ X ?	If you answered...	Comments/Quantities/Costs
Are refrigeration units closed when they are not in use, and are they set to the correct temperature?		X Your fridges will be working harder than they should to maintain temperatures, using much more energy.	
Are refrigeration units sited as far as possible from any heat sources, such as radiators or air-conditioning equipment?		X Your fridges will be working harder than they should to maintain temperatures, using much more energy.	
Is there is enough space around the unit to let it draw in and expel air through its vents?		X Your fridges will be working harder than they should to maintain temperatures, using much more energy.	
Is the refrigeration equipment free from leaks, especially at the joints, valves and seals?		X Any leaks should be repaired as soon as possible. Units should be inspected as part of a regular maintenance schedule to ensure further leaks are detected and rectified.	
Do you have refrigerators containing non-perishable goods, such as soft drinks?		✓ Why not turn them off overnight and at weekends? This will save energy.	
Are you planning on purchasing new or additional equipment?		✓ When purchasing new refrigeration equipment, look for units that are on the Energy Technology List of approved energy efficient products. You may qualify for a tax break under the Enhanced Capital Allowance scheme (http://etl.decc.gov.uk/etl).	

Product movement

Issue	✓ X ?	If you answered...	Comments/Quantities/Costs
Are products moving efficiently around the factory or are bottlenecks being created at certain production points?		✓ The speed of a line should not exceed the speed of the slowest process. It is important that this particular process should be kept running as close to maximum capacity as possible.	
Could you study the performance of each individual process and determine which are the poorest performers?		? How many units are produced per hour?	
Have process speeds been altered from their optimum settings?		✓ Is this change increasing reject rates?	
Are products falling off conveyor systems, or are there any incidences of mechanical handling damaging product?		✓ Could incidences be reduced with a redesign to the line, to provide added protection to the product?	

Other measures

Issue	✓ X ?	If you answered...	Comments/Quantities/Costs
Are employees trained to understand the effects of their actions?		X Conduct resource awareness presentations to demonstrate to all members of staff the true costs of waste. If they make savings, you could measure the amount and then split this between staff as a bonus, donate it to charity, or use it to improve staff facilities.	
Do you run staff awareness campaigns?		X Put up posters to remind staff of what they can do to reduce resource use (e.g. switching lights off). Suitable posters are available free from the Carbon Trust (www.carbontrust.co.uk) and Recycle Now (www.recyclenow.com).	
Do you have a team of people responsible for environmental issues?		X Set up a resource efficiency team with members from all levels and departments. Involve the relevant people both inside and outside the company (e.g. purchasing manager, waste manager and suppliers).	

Water

Issue	✓ X ?	If you answered...	Comments/Quantities/Costs
Is ingredient water used and how is this measured?		✓ Does cooking/evaporation change moisture content, and how can this be estimated?	
Could you make everyone aware of water costs, especially the difference between purchase and effluent disposal costs?		? Water companies will often assume that the amount of water entering the premises leaves as effluent. Check the bills to make sure that you are paying only for what you are disposing of; consider metering discharges if there are large evaporative losses or water is being incorporated into the product. Where a large quantity of water is consumed in the production process, consider installing sub-metering to identify individual area efficiency.	
Is the water supply turned off to processes that are not operating?		X If you're not using them, why not turn it off and save water.	
Have you checked for leaks in the water system?		✓ Repair all leaks as soon as possible, even dripping taps, as this will save you water and money instantly. Check your water meter regularly to help identify whether you have any leaks. If the meter is running even when the plant is closed, you probably have a leak.	
Could you set hot water controls to stop heating one hour before the end of daily work?		✓ The water will retain its heat for that last hour and you'll save on energy.	
Do you know the quality of wastewater for processes?		? Discharging wastewater to effluent streams can be wasteful; in some cases this water may be of sufficiently high quality to be re-used.	
Can you reduce the strength and volume of your effluent, thus reducing effluent treatment and disposal charges?		? Could you treat effluent effectively on site?	
Have you fitted flush controls to urinal systems in all men's toilets?		X Remember you may qualify for Enhanced Capital Allowance assistance if the products and processes purchased appear on the Water Technology List (www.hmrc.gov.uk/capital-allowances/fya/water.htm).	

Water (continued)

Issue	✓ X ?	If you answered...	Comments/Quantities/Costs
Have you installed water saving devices into older toilet cisterns where possible (e.g. hippo bags saving 2 litres per flush)?		X Remember you may qualify for Enhanced Capital Allowance assistance if the products and processes purchased appear on the Water Technology List (www.hmrc.gov.uk/capital-allowances/fya/water.htm).	
Have you fitted trigger controls to hosepipes used in clean-down procedures?		X If hoses are just left running, you will be pouring water and money down the drain.	
Is the load on the effluent treatment plant (ETP) measured?		✓ If so, do you keep a record of monthly figures and are there any abnormalities?	
Are there screening wastes or other liquid wastes from the ETP?		? If so, what are they, and how are they disposed of?	
Are the effluent properties (suspended solids/ chemical oxygen demand) measured?		? Do you do anything with this information?	

Utilities

Issue	✓ X ?	If you answered...	Comments/Quantities/Costs
Could you implement no-cost and low-cost methods to improve energy efficiency and reduce costs?		? Put up posters to remind staff of what they can do to reduce resource use (e.g. switching off lights and unused equipment). Suitable posters are available free from the Carbon Trust (www.carbontrust.co.uk).	
Do you reset air-conditioning temperatures in the summer?		X Be responsive to the outdoor climate. Do you need it so hot or cold?	
Are you heating unnecessarily?		? Check the timers on your heating and make sure they are on only when you need them. (e.g. during working hours).	
Do you change light fittings to more efficient, energy saving bulbs when they reach the end of their life?		X It's inexpensive to replace as and when new lights are needed.	
Do you have targets that you publicise to staff?		X Monitor your progress. Look at energy statements for the last year and note the levels of use and the cost. Use these as a target to beat in the future.	

Waste

Issue	✓ X ?	If you answered...	Comments/Quantities/Costs
Did you shop around local waste contractors and find the best option?		X Is there a better deal out there for your business? Look for other waste contractors on http://recycleatwork.wrap.org.uk/	
Is it possible to rationalise the number of waste collections or waste bins that your business uses on a weekly or monthly basis?		X If not, why not?	
Do you recycle?		X Where possible, consider segregation for wastes that are recyclable and may offer lower collection and disposal costs.	
Are bins clearly labelled?		X When segregating wastes, ensure that the desired contents of each bin are clear to staff through posters or colour-coding of bins.	
Do you ensure that any inactive waste streams are segregated to ensure that the correct landfill tax tariff is applied?		X You could be paying more than you need to. By contaminating all your waste, you will have to pay the hazardous waste price to dispose of every single tonne.	
Are you careful to order only the ingredients needed for the production process?		X By smart ordering, you can avoid having to throw away unused products.	
Could you talk to your neighbours to see what waste management practices they have implemented and which local waste contractor they are using?		? The negotiating power of a collective of companies is greater than that of the individual.	
Is finished product written off (e.g. cancelled orders, out of shelf-life)?		✓ Can you reduce this by more tightly controlled management?	
Are materials collected separately for recycling?		✓ Are they actually recycled?	
Are there other sources of waste (e.g. canteen, offices, staff facilities)?		✓ What happens to each waste stream?	

We hope that you have found this guide helpful on your route to greater resource efficiency. Don't forget that WRAP is here to help you to improve resource efficiency. Visit the website at www.wrap.org.uk or contact the WRAP Resource Efficiency Helpline on 0808 100 2040.

Waste & Resources Action Programme

The Old Academy
21 Horse Fair
Banbury, Oxon
OX16 0AH

Tel: 01295 819 900
Fax: 01295 819 911
Email: info@wrap.org.uk

Resource Efficiency Helpline:
0808 100 2040

www.wrap.org.uk/brehub

March 2013