Waste Minimisation

An Environmental Good Practice Guide
For Industry

This guide will help industry and the Environment Agency move forward together to minimise waste and achieve national environmental goals.
WASTE MINIMISATION

An Environmental Good Practice Guide for Industry

“The cost of your waste is not so much the cost of getting rid of it as the value of what you are getting rid of!”

Published by the Environment Agency April 2001, to help business achieve sustainable practice through waste minimisation.

Minimise waste – maximise profit

The way we use our planet’s natural resources is now widely recognised as one of the root causes of many environmental problems. Waste and industrial emissions have a major impact on the environment both nationally and globally. Effects such as global warming, ozone depletion, acid rain, air and water pollution are all derived from local emissions, but the resources consumed may be mined and manufactured from anywhere in the world.

From extraction to consumption the global economy consumes vast quantities of raw materials, water and energy. In the UK some 600 million tonnes of raw materials, excluding water, are used each year. More than 90 per cent of the resources we consume are either thrown away as wastes or discharged to the environment as effluent or air emissions.

Since the Environment Agency first published this guide in 1998, waste minimisation has become an established business practice for many organisations and thousands of businesses have now implemented waste reduction programmes. But many organisations have yet to grasp the true cost that waste has on their business or how much it costs the environment through contaminated land, dirty rivers and air pollution. Reducing waste is a key to a cleaner world and more competitive industry.

The cost of waste is much higher than many businesses realise. The true cost involves the time, energy and materials used to produce the waste, and will be many times the cost of disposal or effluent treatment. In fact, waste represents the loss of valuable company assets and natural resources. Reducing waste through waste minimisation can contribute to increased profitability and competitiveness while at the same time benefiting the environment.

This revision to the Agency’s Waste Minimisation Guide shows how waste minimisation and related resource efficiency techniques can be adopted by any organisation to improve performance. The guide offers step-by-step assistance in waste reduction through the introduction of a range of practical and tested solutions. Whether used individually or as a training tool with a group of companies, I am convinced that this guide will help businesses to improve their performance and reduce environmental impact.

Barbara Young
Chief Executive Environment Agency
THE BENEFITS OF WASTE MINIMISATION
Understand the benefits of waste prevention and minimisation

WASTE MINIMISATION
How to initiate and implement a waste minimisation programme

REDUCING WATER USE
Simple measures to reduce water use

ENERGY EFFICIENCY
Simple measures to reduce energy use

WASTE MANAGEMENT
Identify compliance issues and benefit from waste management good practice

POLLUTION PREVENTION & CONTROL
An overview of the legal framework and good practice in pollution prevention and control

ENVIRONMENTAL ISSUES
Some information on issues of concern

ENVIRONMENTAL SOURCEBOOK
Where to go for further information and help
Reduce waste... share this document with colleagues!

www.environment-agency.gov.uk
THE BENEFITS OF WASTE MINIMISATION

What is waste minimisation?

Waste minimisation is about preventing and reducing waste at source through the efficient use of raw materials, energy and water. This is achieved by understanding and changing processes to reduce and prevent waste. This is also known as process or resource efficiency. Waste minimisation includes the substitution of less environmentally harmful materials in production processes and the design of products that have less environmental impact during their manufacture and use. Waste minimisation can provide competitive advantage to business in four ways:

• Cost savings
  
  Production costs can be reduced through improved resource efficiency.

• Compliance
  
  A proactive approach ensures that the company minimises the possibility of litigation.

• Risk reduction
  
  Control and reduction of risks and liabilities not only reduce the likelihood of fines and bad publicity but can also boost investor confidence.

• Market positioning
  
  Eco-friendly products can give supply chain confidence and improve customer relations.

Cost savings

Material resources leave a company either as product or waste. A representation of a resource throughput is shown below.
Improving resource efficiency by implementing a waste minimisation programme can improve productivity and quality to give a lower unit production cost.

Waste minimisation can result in increased output, reduced processing time and less waste, all of which benefit the bottom line of a business.

**Waste minimisation in action**

An engineering company with a turnover of £20 million regarded its annual waste disposal bill of £50,000 as an absorbable overhead.

During a waste minimisation audit, it was found that 33 per cent of purchased raw materials ended up as waste. With an annual raw material spend of £2 million, the waste material was valued as £670,000 and represented 3.6 per cent of turnover - a sum equal to half the profit!

The Managing Director authorised a full inquiry to monitor processing systems as a valuable indicator of performance. Opportunities were found to reduce waste generation and within six months product yield had increased from 67 per cent to 80 per cent. This represented a direct saving of £260,000 on materials alone as well as reducing disposal costs. The following year, after the introduction of staff awareness training and a staff suggestion scheme, the yield increased to 85-90 per cent.

In just over three years the waste minimisation programme has saved over £1 million pounds worth of materials, increasing output and adding significantly to the bottom line.

**Compliance**

The number of laws and regulations to protect the workforce, the public and the environment has increased dramatically over recent years. Failure to comply with these can lead to prosecution and large fines and/or imprisonment. In addition, the adverse publicity can have negative effects on business performance.

The Pollution Prevention and Control (England & Wales) Regulations 2000 are the first UK regulations that specifically require prescribed installations to adopt resource efficiency measures. It is expected that future legislation will focus even more on the way the products are produced.

By adopting a systematic approach to the identification of the environmental impacts of a business and checking these against legislation, peace of mind and reduced risk of prosecution can be obtained.
Compliance saves money

A small industrial finishing company, switched from using conventional paint sprayguns to using high volume low pressure (HVLP) guns as part of an upgrade programme to meet the requirements of Local Air Pollution Control.

Using HVLP guns results in less bounce back of the paint spray and consequently less paint is wasted as overspray.

Following the purchase of these guns, together with training for all sprayers, a dramatic 21 per cent reduction in paint use was achieved.

The payback period on the cost of the guns and training in their use was less than three months. With production levels having doubled over the last year, the saving is now worth over £40,000 a year, showing that compliance needn’t be costly.

Risk reduction

Certain activities within a business present a risk of an incident which could be illegal.

Pertinent questions include:

- Is there an undue risk from the use and storage of particular materials (for example oil, chemicals or foodstuffs)?
- Are there health and safety implications associated with the use of resources, operation of processes or generation and handling of waste?
- Can health and safety risks from handling raw materials be reduced?

Building Materials Manufacturer

An East Midlands Building Materials company manufactures pre-cast concrete products. Three of its manufacturing sites are based at one locality with a combined turnover of £7 million.

Two of the factories were involved in the Leicestershire Waste Minimisation Initiative. This gave them the impetus to examine the true cost of waste and their impact on the local environment. The process highlighted an issue in the manufacture of paving slabs during which a wet concrete mix is compressed into a mould. The waste water from this process was collected and discharged to river. Although this was a consented discharge, trace heavy metal levels in the discharge occasionally breached the consent limits.

The company decided to remove the risk of prosecution and also save money by recycling the waste water back into the concrete mixing stage. This action did not compromise the quality of the concrete paving slabs.

As well as savings on the cost of the consent to discharge, the changes removed the risk of breaching the permitted limits and the local environment has also improved as a result of this change in working practices.
Market positioning

Traditionally, the interests of shareholders were the prime driving force behind business activities. This is now recognised as a rather limited view, and it is recognised that the interests of a wider group of people, so-called stakeholders, can be equally important for business success. Stakeholders include employees, customers, neighbours, shareholders, banks, insurers, local authorities and regulators. Considerable market advantages can result from a proactive approach to environmental management.

Pertinent questions include:

- Are stakeholders pressing for improvements in the business such as cost savings, improved environmental image or reduced risk of pollution incidents?
- Would customers prefer a “greener” product? This needn’t mean higher prices.
- Can market share be increased or new markets targeted by “going green”?
- Can the reputation of the business be enhanced in the sector, getting “first mover advantage” over competitors, by “going green”?

Many businesses have enhanced their relationship with customers through environmental initiatives such as reusable transit packaging, end-of-life takeback schemes (giving access to the customer when they need a new product) and other projects. These benefit both business and the environment.

Turn waste into new product

Fosse is a company based in the East Midlands working to develop the use of by-products from industry in the manufacture of valuable products.

Fosse had developed a process to convert a by-product from the paper-making industry into a product called FStend. It was designed to enhance the performance of plastics and elastomers.

The project has resulted in a plant that each year can use up to 12,000 tonnes of wet paper sludge that would previously have been landfilled. This has saved approximately £150,000 for the producers of the waste. Fosse have a clear market position as a company working to reduce industry’s impact on the environment.
How to achieve the benefits

Waste minimisation involves action on three fronts:

- **People**
  
  Many reductions in waste can be achieved through better housekeeping. It is essential that employees are aware of the issues surrounding waste and are motivated and trained to prevent it.

- **Systems**
  
  A systematic approach to measurement and control highlights deficiencies and problems, enables targets to be set and maintains levels of efficiency.

- **Technology**
  
  Capital investment in new technology can improve productivity and reduce waste generation, giving very short paybacks

**People**

Within the workplace, waste generation often goes unnoticed and is just considered as a by-product of processing. Greater awareness by individual employees is to be encouraged so that they can reduce waste. Management need to be receptive to suggestions for change and perhaps develop a reward scheme for improvements.

**Kimberly-Clark**

Kimberly-Clark joined the Medway and Swale Waste Minimisation Club to boost existing waste minimisation activities at their Larkfield Mill site. The company also benefited from learning how other companies were taking action to reduce waste and costs.

Membership of the club stimulated the members of the Mill Support Group, an existing team of senior managers and technical staff, to become more active in the field of waste minimisation. The Mill Support Group developed an action plan of how and when the most helpful suggestions from these brainstorming sessions would be implemented. Responsibility for implementing specific measures was delegated to the shift champions. They ensured that specific tasks were carried out by the relevant people and arranged support from other departments, eg maintenance, as necessary.

About 450 good ideas have been generated by this strategy. Actions have already been taken that have saved £187 000/year. Further potential savings opportunities, worth £90 000/year, have been identified.

When the Mill Support Group reviewed employee suggestions, many of the ideas were found to involve reducing the site’s water consumption. These ideas ranged from changes to operating practices to minor engineering modifications.

Mr D Penfold, Environmental Co-ordinator said: “The enthusiasm of operators for the project was a pleasant surprise. Their commitment even extended to giving up their own time to take part”.
An understanding of the environmental issues surrounding waste creation and the recognition that less waste can mean significant reduction in costs can help to refocus productivity targets. New targets to accommodate improved practices must take into account the associated reduction in waste. An increase in the unit labour cost of production can often be offset against reduced material costs and still lead to higher margins.

The foundation for environmental improvement is the involvement of employees who need to understand their role in controlling environmental effects and preventing pollution. Input from every level is important: employee motivation can be enhanced by getting their involvement and giving them ownership of environmental issues, leading to reduced waste and increased productivity.

Waste minimisation is also compatible with other “people” initiatives such as Investors In People and Total Quality Management.

Information on training opportunities in waste minimisation is provided on page 15.

**Systems**

“if you don’t measure it you can’t manage it” is now a recognised management phrase.

Process measurement is essential in order to gain control. The more businesses measure processes the greater the control they will have. Objectives and targets for improvement can only realistically be set when influencing factors and actual figures are known.

A systematic approach to measurement and control highlights deficiencies and problems, enables targets to be set and maintains levels of activity. This can be linked and driven by existing management systems such as ISO 9000 or ISO 14001.

**KP Foods**

KP Foods, based at Ashby de la Zouch, is part of the United Biscuits Group. They employ 900 people on site to manufacture snack foods such as HulaHoops and Skips. KP took part in the Leicestershire Waste Minimisation Initiative in 1994.

KP Foods highlighted reject levels as a major waste issue on site. Further work in this area showed that variation in the feed rate and moisture content of raw materials interact to vary the moisture content of the snackfood dough. This could lead to an increase in the reject level of the pellets made from the dough.

After some initial work to reduce mechanical variation in the process, KP Foods set up a system to monitor dough moisture content using statistical process control (SPC) techniques. They used the information from their monitoring system to control the feed rate of flour and water to the process.

By controlling the moisture content of the dough within a narrow range they reduced their pellet reject levels by more than half. The engineering improvements in conjunction with the SPC monitoring system have reduced waste on the pellet plant by 57 per cent from 480 tonnes pa to 205 tonnes pa by the end of the project.
Technology

New technology can significantly improve manufacturing efficiency. The total cost of a capital investment programme should take into account the long-term financial and environmental benefits gained from reducing waste.

Cleaner technology brings cost savings

MacDermid Canning plc formulates chemicals for the surface finishing industry at its Albion Works in Birmingham. An environmental review in 1996 highlighted several areas that could be improved relating to excessive water use and effluent leaks. It also indicated the substantial business benefits that could be achieved through waste minimisation and the use of cleaner technology. A small team began work to improve the site’s environmental performance.

Subsequently, when the company was investigating the installation of additional equipment to meet increased production demands, the team presented a good case for using cleaner technology. The resulting, fully computerised mixing facility is energy efficient and has virtually no discharge, with wash waters being re-used in later batches. The plant also provides a better working environment.

The benefit of the new plant at current production levels include:

- Around 80% reduction in water use and 94% reduction in effluent volumes
- Annual savings of £168 000 from reduction in raw material wastage
- Reduction in energy costs of around £21 000/year
- Payback on additional investment (compared with conventional solution) of around two years

The Surface Finishing Division of MacDermid, based at the Albion Works in Birmingham, has a turnover of £25 million and employs around 100 people. Some 1800 products, including proprietary additives (eg detergents) and standard electroplating chemicals, are made at the site.

“As well as saving us money and significantly reducing our environmental impacts, the whole process has led to a culture change”. Geoff Hampshire, Group Environmental Manager.

Investment in technology need not involve large amounts of capital: major gains are often made from a number of small, low-risk, low-cost investments.
Environmental policy

Many companies have developed an environmental policy as part of their company mission statement. Their policy may declare that they will:

- comply with environmental legislation
- reduce consumption and waste of natural resources
- reduce polluting emissions
- work with customers and suppliers to address their environmental impacts

As such, waste minimisation and environmental management programmes become an essential part of company strategy.

Environmental policies should be written to communicate the environmental priorities of the business effectively to everyone with any interest in the matter. A good policy contains a framework for continual improvement in environmental performance through target setting.

Environmental management systems

An environmental management system provides a framework to identify, control and minimise the impacts that commercial operations have on the environment through:

(i) securing compliance with environmental regulations;
(ii) preventing pollution and minimising wastes;
(iii) continual improvement in environmental performance.

Standards for environmental management systems

The recognised international standard for environmental management systems is ISO 14001. This involves a structured approach to the identification and management of those aspects of a company’s activities which have a significant environmental impact.

Companies may seek certification to the ISO 14001 standard. This provides an independent assessment and verification of compliance with the standard carried out by an accredited certification body. The UK Accreditation Service (UKAS) accredits Certification Bodies.
THE ISO 14000 SERIES

ISO 14000 is a series of international environmental standards that include the following elements of environmental management:

- Environmental Management Systems (ISO 14001, 14004)
- Environmental Auditing & Related Investigations (ISO 14010,11,12)
- Environmental Labels & Declarations (ISO 14020,21,24,25)
- Environmental Performance Evaluation (ISO 14031,32)
- Life Cycle Assessment (ISO 14040,41,42,43)
- Terms & Definitions (ISO 14050)

Full details of the ISO 14000 series can be obtained from the British Standards Institution.

Eco-Management and Audit Scheme (EMAS)

EMAS is a voluntary scheme that is supported by the government and UK environmental regulators. The scheme is specified by an EC regulation. Key features of EMAS include:

- open to all types of organisation from all economic sectors;
- includes ISO 14001 as the EMS standard;
- defined internal and external auditing requirements;
- publication of an independently verified environmental statement;

Companies wishing to participate under EMAS must apply for registration to the scheme to the competent body IEMA who will consult the Environment Agency, and others, to ensure that regulatory requirements are being met prior to issuing the registration.

Further details on how to participate can be accessed from the EMAS web site www.emas.org.uk In the UK, EMAS is administered on behalf of the government by the Institute of Environmental Management & Assessment (IEMA) See sourcebook for details.

For further advice on environmental management systems in the context of regulated installations (for example, under the IPPC regime) and the voluntary promotion of ISO 14001 and EMAS contact the Environment Agency on 08459 333 111 or refer to the Agency’s web site www.environment-agency.gov.uk.
WASTE MINIMISATION

This section of the guide contains the necessary tools to minimise waste in any company or organisation, small or large.

A step-by-step guide to waste minimisation

How to develop and implement an Action Plan to eliminate waste

Step 1  Assess the Scope to Save
How to collect basic data and estimate the potential for savings

Step 2  Get commitment for ACTION
Shows how to get senior managers and staff involved

Step 3  Individual process mapping
Clearly lays out the process using flow charts

Step 4  Data collection and analysis
Details how much material is being used at each stage

Step 5  True cost of waste
Determines the true cost of waste

Step 6  Prioritising issues
Reviews factors other than cost that can influence the need for change

Step 7  Problem solving and generating options for improvement
Looks at how to generate ideas for improvement

Step 8  Opportunity assessment
Looks at how to assess the technical and financial viability of projects

Step 9  Project implementation and maintaining momentum
Suggests how to maintain interest in waste minimisation

ADVICE

The methodology outlined here is a generic approach. There are several other developed methodologies for waste minimisation including the 3E’s methodology (Emissions, Efficiencies, Economics) which is particularly suitable for process operations and methodologies from the US Environmental Protection Agency and the United Nations. For further information on waste minimisation methodologies refer to the Sourcebook.
Step 1  Assess the Scope to Save

Waste minimisation begins with looking at what goes into your production processes and business operations. Collection of basic cost data will identify the principal materials and energy resources used and indicate the areas where cost savings can be made.

Start by listing all input materials. Here are some reminders:

INPUTS

Raw materials - essential materials used directly in the product;
Ancillary materials - materials used indirectly for production, e.g. materials for cleaning, maintenance and effluent treatment;
Consumable materials - materials for offices (paper and toner cartridges), sales (brochures and samples), personal protective equipment;
Packaging materials - materials used to package and transport finished goods;
Energy - fuel and electricity. Where possible, separate fuel for space heating, process heating, vehicles and any other energy sources;
Water - water from the water company mains, bore-holes, rivers, reservoirs.

Now list the process outputs:

OUTPUTS

Products - is rework a major issue? What level of rejects does your process have? Are you overfilling or giving away materials to your customers?
Emissions to air - often a free-of-charge disposal route includes boiler chimneys and extraction vents for solvents, as well as noise, dust and heat. There can be significant costs associated with monitoring and abatement of emissions.
Waste water - discharges to trade and surface water runoff to watercourse or foul sewer. Effluent charges depend on the level of contamination which reflects the amount of material being lost.
Solid and liquid waste - the cost of removal of skip, drum and other wastes by waste management contractors.

Now identify the costs related to each input and output:

Quantify how much money is spent on each of the resources you have listed. For simplicity, try to find costs for the last financial or calendar year.

In most companies the best source of data is usually purchase records and invoices, where quantity and cost data can be found together. Internal stock transfer records can be misleading and inaccurate and should only be used if purchase records are
unavailable. Material suppliers may also be able to provide information about purchases if the data is not available in-house. Energy information (gas, electricity, and fuel oil) can be easily found from invoices. So can water and effluent costs. If necessary make estimates based on one month’s or quarter’s usage, but be aware of seasonal changes such as increases in energy consumption during winter. If your bills have estimated readings, start reading your meters regularly.

Waste disposal and skip hire information and costs should be held internally within your company or could perhaps be obtained from your waste management contractors.

\[
\text{The true cost of waste} = \text{disposal costs} + \text{purchase cost of materials} + \text{handling/processing costs} + \text{management time} + \text{lost revenue} + \text{any potential liabilities.} = \text{much more than you realise!}
\]

Remember: The cost of your waste is not so much the cost of getting rid of it as the value of what you are getting rid of!

Having gathered basic cost data, the next key question to ask is what is the potential for savings? Completing the scope to save exercise will help focus where reduction efforts will give the greatest savings, in other words it will help identify priority areas for waste minimisation.

The scope for savings can be estimated by comparing the amount of material purchased with the amount of that material in the final product. This will identify raw material losses: opportunities for improvement.

Ranking material costs in order with the largest first can also help you to focus on where reduction efforts will give the greatest savings. Often 80 per cent of costs come from 20 per cent of materials. A small saving on your largest expenditure can be very significant to the final cost per unit.

Otherwise, figures can be estimated using the typical savings given in the scope to save table. These are derived from waste minimisation projects undertaken in over 500 companies of all sizes using a diversity of manufacturing processes.

Use the scope to save table to list costs related to each resource and identify the range of savings which could be made as suggested in column 4. Then compare the potential saving to the turnover and profit of your business. Is it a significant saving? How much more product would you have to sell to put an equivalent sum on the bottom line?

**REMEMBER:**

Reductions in resource wastage are often easier to achieve than savings in other areas and directly influence production costs.

Waste disposal costs are those associated with disposal (including the landfill tax) and do not represent the true cost of waste.
### Waste minimisation scope to save table

<table>
<thead>
<tr>
<th>COLUMN 1</th>
<th>COLUMN 2</th>
<th>COLUMN 3</th>
<th>COLUMN 4</th>
<th>COLUMN 5</th>
<th>COLUMN 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resources and services</td>
<td>Quantity</td>
<td>Cost per year</td>
<td>Scope to save</td>
<td>Your estimate of scope to save (£)</td>
<td>Priority Ranking</td>
</tr>
<tr>
<td>Raw materials:</td>
<td></td>
<td></td>
<td></td>
<td>1 to 5 per cent</td>
<td>(1=highest)</td>
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<tr>
<td>• first most used</td>
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<td>1 to 5 per cent</td>
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<td>• second most used</td>
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<td>• third most used</td>
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<td>1 to 5 per cent</td>
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<td>• all other materials</td>
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<td>10 to 90 per cent</td>
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<td>packaging</td>
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<td>5 to 20 per cent</td>
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<td>ancillary materials</td>
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<td>10 to 30 per cent</td>
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<td>consumables</td>
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<td>5 to 20 per cent</td>
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<td>Energy:</td>
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<td>10 to 30 per cent</td>
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<td>• electricity</td>
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<td>20 to 80 per cent</td>
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<td>• heat for process and space heating, for example gas and fuel oil</td>
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<td></td>
<td></td>
<td>20 to 80 per cent</td>
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<td>water</td>
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<td>10 to 50 per cent</td>
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<td>trade effluent</td>
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<td>solid and liquid waste</td>
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<td><strong>Total</strong></td>
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The percentages quoted in the scope to save column have been achieved in many businesses around the country. Evidence is available from demonstration projects like the Aire & Calder Project, Project Catalyst, Leicestershire, West Midlands, Humberside, Merseyside and many others.

The true cost of waste is always much greater than the cost of disposal and in some cases has been 5 – 10 per cent of turnover. The Scope to Save is a tool to help companies identify potential priority areas for waste minimisation. Achievable savings will vary from company to company. Some resources will be well managed and there will be less scope for waste minimisation – analyse which resources are most likely to have high wastage. Only by undertaking a detailed analysis will you find out what the potential for saving is.
Step 2  Get commitment for ACTION

Having gathered basic cost data and identified the scope for cost savings and areas for improvement, the next step is to get senior management and staff commitment to implement a waste minimisation programme.

- Emphasise the benefits of waste minimisation to senior managers and use the quotes and case histories in this Guide to justify efforts to reduce waste.
- Discuss with senior management the scope to save and the potential level of cost savings which may be achievable through waste minimisation.
- Show the Agency’s waste minimisation video “Money for nothing and your waste tips for free”.
- Use the materials in the Envirowise guide GG125 to make a presentation to senior management on waste minimisation and what it involves.

Senior management

Experience on many waste minimisation projects has shown that senior management or board commitment to waste minimisation is critical to success. Waste minimisation must complement the business strategy and be integrated into the company culture to maximise the benefits. Full commitment requires time and authority to enable:

- Dedication of resources, essentially people, to assist with the investigation.
- Establishment and encouragement of a waste reduction policy.
- Understanding and fulfilment of legal obligations.
- Budgeting for small investments that are shown to be cost-effective.

Project champion and project team(s)

Ensure the project champion has the support of senior management and is credible, in order to put in place the necessary communications, resources, action programmes and training to make waste minimisation possible. Appoint a project champion who is enthusiastic and has the ability to motivate the project team and staff to maintain an interest in reducing waste. Time needs to be made available for the champion to make the project work - the scope for savings should justify this time.

This is an ideal personal development role for staff, as they will obtain an overview of the entire business and a grounding in a wide range of disciplines.

Establish a project team. For larger companies, this may involve a team of people from accounts, purchasing, production and environment functions. The project team will need to involve employees from all levels in the company (management to shop floor).

Staff involvement

The involvement of all staff is needed for identifying opportunities for waste reduction and for implementing any changes. However, not all staff will necessarily welcome the programme and may try to put barriers in the way. Time is often an issue and the
A project may be seen as another unwelcome initiative demanding more time. Another barrier is fear; if staff have been aware of areas of wastage for some time they may be reluctant to point them out in case they are asked why they did not do so earlier. Such barriers can be overcome by taking the time to raise staff awareness and allowing people to contribute fully to the waste minimisation programme.

A variety of information and tools can be used to raise awareness, for example:

- Posters
- Newsletters
- Suggestion schemes
- Information on payslips
- Team briefings
- Training sessions
- Quizzes

A staff awareness campaign must be properly planned. Posters can be effective but if used in isolation will not necessarily motivate people into taking a specific action. Get the message across using as many ways as possible.

Communication channels must run both ways. Ensure that people are given the chance to ask questions about environmental issues.

Congratulate all staff involved with the project on a regular basis. Produce a results bulletin making sure that if the savings are good some measure of reward is given to staff.

**RAISING STAFF AWARENESS**

The Agency has produced a pack to help raise awareness of waste minimisation opportunities. The pack includes posters, hints and reference to other key sources of information.

Refer to the sourcebook or the Agency’s website - www.environment-agency.gov.uk

**Training**

There are a number of courses available which focus specifically on waste minimisation. Courses range from 2-3 day introductions to modular first degree or post-graduate level programmes. Many waste minimisation clubs offer structured training in waste minimisation which is often tailored to the specific needs of industry managers.

Organisations to contact:

- Your local waste minimisation club - call the Environment and Energy Help-line on 0800 585794 or visit their web site for details; www.envirowise.gov.uk
- Local Business support organisations such as Business Link or Groundwork

**WASTE MINIMISATION ‘FAST-TRACK’ ADVICE FROM ENVIROWISE**

Small and Medium sized companies can now receive a FREE one day ‘Fast-Track’ visit from an experienced consultant. Call the Environment and Energy Help-line on 0800 585794
**Step 3  Individual process mapping**

Process mapping will show in pictorial form how materials flow through process operations. Mapping explains where ancillary materials, consumables and energy are used and where known wastes (gas/solid/liquid) are generated.

It may be worthwhile concentrating on mapping out the processes which consume the resources identified as priorities (for example, where water is consumed, water use and reduction of effluent may be a priority).

Start by drawing a flow diagram of the production process.

![Flow diagram of production process](image)

Look at the following example:

![Flow diagram of degreasing process](image)

Resource **inputs** can be any resource used or consumed in the process (materials, energy and water).

**Outputs** can be final or intermediate products.
**HINT**

Begin with a list of process operations. Mark these on a large sheet of paper (A3 or the back of an old roll of wallpaper) and use a list of the raw materials to complete the inputs and outputs from each stage. Remember that there may be occasional outputs, such as spent solvent, which can have significant costs.

It can be a good idea to get operators involved in generating the flow diagram and certainly they should be shown the finished diagram for the process so that they can validate it. There are several pieces of software which can also be used to produce flow diagrams. *WMIT* (available from the Environment & Energy Helpline) has a function for this.

See also *Waste Mapping: Your route to More Profit - ET219*, available from the Environment & Energy Helpline. Tel. 0800 585794

Several diagrams may be required for complex processes or where ancillary processes, such as steam generation, are complicated. Join operations together where the output from one unit operation is the input to another.
Flow diagrams should be prepared for all manufacturing and ancillary processes:

- Manufacturing processes may either directly add value to the product or be directly involved in the production process, such as materials handling, packaging, product storage and despatch.

- Ancillary processes include: energy generation (such as steam generation, compressed air, nitrogen generation, water treatment), and environmental controls (such as scrubbers, incinerators, effluent treatment) and other operations (such as borehole pumping).

**Remember:** Do not forget to include internal recycling routes, such as solvent recycling, production rework, reusable internal packaging and any water reuse.

Look at the following example that shows a flow diagram of an industrial paintshop process:

![Flow diagram of an industrial paintshop process](image)

**Remember:** Consumables used throughout the process, such as personal protective equipment (PPE) and energy such as heating and lighting, are not attributed to a particular part of the process, but should still be considered as they are part of the overall costs of production.
Step 4  Data collection and analysis

Having mapped all stages of the process in Step 3, the next step is to identify the amounts of materials, utilities and wastes at each processing stage. All materials, water and energy entering a process must come out of it as either useful product or waste (solid, liquid, gas or heat). This is called a mass/energy balance. Step 4 will show where resources are used and converted to waste rather than becoming useful product.

The basic data derived from the waste minimisation ‘Scope to Save’ table can be apportioned to each process and each part of the process. This can be done by performing an “historical” audit or a “live” audit.

Historical audit - collection and analysis of existing data

For an historical audit, information can be gathered from invoices, production logs, process specifications and bills. This should give a better understanding of how resources are consumed and gives the chance to carry out a simple reconciliation of material use which can help to identify inefficiencies.

Simple comparison of performance should identify which parts of the process are running efficiently. For example, the number of jars of jam filled should match the number of closures (lids) used. If there is a discrepancy then there is a problem: either too few are being supplied or too many are wasted. Similarly, there are published figures for the energy use of typical processes. Comparing these against actual usage, in a fashion similar to benchmarking, can identify the scope to improve.

HINT

Energy and environmental performance benchmarking guides for selected industries are available from the Environment and Energy Helpline
Tel. 0800 585794

The data from the historical audit can be useful in providing baseline data from which to monitor cost savings.

In most cases this search will not provide sufficient data for an accurate and detailed understanding of process variations. It will therefore be necessary to initiate a live audit.

The live audit - collection and analysis of new data

Mark all current measurement points on to the process flow diagrams produced under step 3. Include all existing (even if not read) utility meters. Remember to cross-check with all production logs to see what is regularly measured or monitored.

Now use the process flow diagrams to identify the key resource flows which need to be measured. Identify where additional measurements will be needed.
Having identified additional measurement requirements, choose how they are going to be measured.

Key questions when considering further data collection include:

a) can the data be derived from other measurements?

b) do operations need to be modified to be able to get this information? (for example a separate bin to hold redundant chemical bottles to identify residue losses).

c) can a meter be fitted and the cost justified?

Having identified how to measure resource flow, choose when to measure it and who will be doing the measuring. It’s especially important to fully brief all staff involved with additional data collection so that they are aware of the purpose of data collection and, most importantly, what to do if things go wrong. One route for collecting this additional data is to employ a low-cost resource such as a recent graduate or a student on a college placement to investigate and reduce waste. This has been used to great effect on many projects, although it is important to recognise that they need training and guidance for what is a difficult task. Local business-support organisations may be able to assist with this.

**DATA COLLECTION HINTS**

It is important to plan additional data gathering carefully. Here are some basic tips to avoid wasting time and effort:

- Measurement systems should be easy to use and provide the information to the accuracy that is needed, not the accuracy that is technically possible.

- Measurement equipment can inexpensive (for example, water flow rates can be estimated using a bucket and stopwatch).

- The quality of the data must be such that the correct conclusions are drawn (for example, adjusted for stock).

- Define how frequent data collection should be in order to account for process variations. Begin with weekly data collection but avoid one-off measurement exercises over abnormal workload periods (such as Christmas, shutdowns).

- Checksheets are a simple way of monitoring waste or reject generation, using the five bar gate notation (III) to count occurrences.

- Remember to measure production over the same period.
Data analysis

Once you have collected the data you will need to analyse it to turn it into useful information.

A mass balance will help show where waste is generated and identify the quantity or magnitude of waste in individual departments, processes or unit operations. In other words a mass balance is a method of comparing all the inputs to (raw materials, energy and water) and outputs (product, waste in skips, effluent etc) from a site, department or process and quantifying the losses. The inputs and outputs are identified from the historical and live audit. To help sort the data and identify gaps where further knowledge is required, the information can either be added to the process maps or shown in tabular form. This will aid in checking the mass/energy balance for each unit process and the process as a whole.

Mass balance data shown on a process map for carpet backing process

![Process Map]

Mass balance data shown in tabular form:

<table>
<thead>
<tr>
<th>Inputs to process</th>
<th>kg/hr</th>
<th>Outputs from process</th>
<th>kg/hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>carpet (1kg/m²)</td>
<td>2,400</td>
<td>backed carpet</td>
<td>2,610</td>
</tr>
<tr>
<td>latex solution</td>
<td>448</td>
<td>waste carpet (offcuts - fent and selvedge)</td>
<td>85</td>
</tr>
<tr>
<td>selvedge (by difference)</td>
<td>50</td>
<td>waste latex</td>
<td>40</td>
</tr>
<tr>
<td>water loss in flue gas</td>
<td></td>
<td></td>
<td>163</td>
</tr>
<tr>
<td>Total</td>
<td>2,898</td>
<td>Total</td>
<td>2,898</td>
</tr>
</tbody>
</table>

Remember to use common units. Also, be careful to include stock changes within a process. Stock changes can be positive (if material is accumulated over the audit period) or negative (if material stocks are reduced over the audit period):

Waste = inputs - outputs - stock changes

Note: stock change = closing stocks less opening stocks.

A mass balance can also be displayed on a Sankey diagram - see page 23.
HINT

It is worth remembering that all costs are made up from the consumption of a resource and the unit cost of that resource (that is £/tonne, p/kWh, p/m³).

There is often scope for cost reduction in energy and water resources by finding alternative supplies or suppliers. For example, gas is often cheaper than oil for steam raising, electrical heating is very expensive in comparison to gas or oil and borehole water is often cheaper than water purchased from a water company (although an abstraction licence is necessary).

In waste disposal, finding alternative waste disposal routes can provide cost savings (for example, shredding confidential paper waste is much cheaper than incineration). Some recycling routes can even cost nothing. If particular types of waste are segregated, they may be removed free of charge. At the very least ensure that skips are only emptied when they are full - don’t pay for fresh air to be removed from your site!

Trend analysis

Plotting the data gathered on to a trend graph may help to identify unusual variations in resource use.

For example:

This will help in spotting increases in consumption, but it is important to relate this to production. In the example above, week (a) has a higher than normal consumption, but this was due to overtime. In week (b), however, the oven was left on over the weekend. This is shown more easily by a scatter plot of consumption against production:
By doing this, specific consumption of resources can be identified, for example kWh per unit production, which will help you to set targets and identify poor performances.

In the example shown the line is the target or standard and week (b) is clearly seen to be using more than the target, especially when compared to week (c) which produced the same output for much less electricity.

This process is known as monitoring and targeting, or M&T. Measure to manage (MtM) or monitoring and targeting (M&T) uses the periodic comparison of material/utility consumption or waste/rework generation with some measure of activity such as production output. The method uses scatter graphs to analyse the data.

More information on data analysis can be found in the Good Practice Guide GG25, “Saving Money Through Waste Minimisation: Raw Material Use” and its sister publications - see the Sourcebook.

Example of actual water use against target

Water minimisation improvement implemented
Lapse (deviation from target) noticed and corrected
Statistical process control (SPC) is a well established control system laying a foundation for good quality management and process control. It is a powerful tool promoting conformance and consistency during production as well as preventing the production of waste from a manufacturing process. Further benefits are early warning of product quality moving away from an agreed quality standard and a reduced post production quality inspection frequency. At its most sophisticated level SPC can form an integral part of a total quality approach.

Further information on M&T and SPC can be obtained from the Energy Best Practice Programme and Envirowise, both accessible through the Environment and Energy Help-line on 0800 585794

Other methods for displaying data: Pictorial representations of data are useful in identifying the relative sizes of waste or resource consumption. Examples include pie charts, histograms, Pareto charts, Sankey diagrams etc.
Step 5  True cost of waste

Having identified the movements and consumption of resources throughout the process in Step 3 and with a clearer picture of the efficiency of each process from Step 4, the next stage will determine the true cost of wastage for each process.

The real cost of producing waste must include:

- raw materials costs
- processing costs including effluent treatment/air emissions abatement costs/rework costs
- the effect waste has on capacity by reducing productivity
- management time associated with dealing with waste
- costs for monitoring a particular discharge
- environmental liabilities in storing and disposing of waste

Costs associated with raw materials

In its simplest form, the true cost of waste can be calculated as the cost of the raw material in the waste added to the cost of disposal. Where more than one material is in the waste, this calculation must be made for each component. Other resources such as energy, water and ancillary material (such as electricity, gas, steam, cooling water, including the ancillary water treatment chemicals for steam and cooling water) can also be considered. Use figures for one year unless more detailed analysis is available.

<table>
<thead>
<tr>
<th>Description</th>
<th>£</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount of raw material purchased (A)</td>
<td></td>
</tr>
<tr>
<td>Amount of raw material in product (B)</td>
<td></td>
</tr>
<tr>
<td>Loss of raw material to waste (C = A - B)</td>
<td></td>
</tr>
<tr>
<td>Unit cost of raw material (D)</td>
<td></td>
</tr>
<tr>
<td>Cost of raw material waste (E = C x D)</td>
<td></td>
</tr>
<tr>
<td>Cost of disposal of raw material waste (F)</td>
<td></td>
</tr>
<tr>
<td>Raw material cost of waste (G = E + F)</td>
<td></td>
</tr>
</tbody>
</table>
Other costs may also be relevant to the true cost of waste:

- Stock losses (material lost before it gets to the process, or product lost before it is despatched to the customer, for example, materials that have exceeded their shelf-life);

- Quality losses (downgraded product, seconds);

- If rework is a significant concern, add the cost of re-handling and processing the rework to the true cost of waste. Rework should not always be considered as waste because the resources still end up in the products;

- The cost of handling waste, that is, storage, internal transport, managing waste-disposal contractors and dealing with the regulatory authorities;

- The costs of running effluent treatment or air emissions abatement plant;

- Environmental monitoring;

- The costs of protective equipment and workplace monitoring where hazardous substances are being used;

- Environmental liabilities - the costs of authorisations and the risks of incidents;

- Liability insurance.

Although businesses have many elements in common, it is impossible to cover here all aspects of cost associated with individual wastes. The true costs should be examined for each and every waste.

### Capital Investment example

Remember; the cost of your waste is not so much the cost of getting rid of it as the value of are getting rid of!

A waste stream may only cost £3,000 a year to dispose of, but if those materials represent £40,000 worth of resources, then an investment of £21,500 to reduce the amount of waste by half would pay for itself in one year and would also increase output: On the face of it, spending £21,500 to reduce disposal costs by £1,500 would seem like madness, but as this example shows the true cost of waste is more than it seems.

### An example from the South Wessex Waste Minimisation Group

Flight Refuelling Ltd. in Wimborne, Dorset is a major supplier of specialist products and services to the aerospace and defence industries. Since embarking on a structured waste minimisation programme the company has made total savings in excess of £120,000 with a large percentage of these savings derived from a solvent reduction initiative. Solvent usage within the company has been reduced by some 45,000 litres p/a saving the company some £90,000.

Other waste minimisation initiatives involve paper/cardboard recycling, scrap metal recovery, plastic recycling, adhesives and strip light recycling.
Step 6  Prioritising issues

Having looked at the true cost of waste in Step 5, this stage will examine how to prioritise areas for reducing waste and increasing resource efficiency.

The most obvious way of ranking issues is in terms of cost. Cost can be ranked either in terms of waste (remembering the true cost of waste - Step 5) or resource consumption (the bigger the cost, the more potential for waste and hence savings).

Capacity constraints may also have to be considered. Eliminating waste and improving yields can increase plant capacity. This might be an attractive way of releasing capacity of a plant, without moving to extra shifts or major capital investment.

Compliance, risk and environmental issues are equally important and should not be ignored when prioritising issues. The risks and costs from handling certain materials are likely to increase through tightening legislation and financial instruments such as the landfill tax. Certain materials are also being phased out and it might become a priority to anticipate whether any materials used are of concern and to look for alternative methods and materials to eliminate these.

Pertinent questions include:

Which wastes have the greatest costs - is there any scope to reduce these?

Is capacity constrained/can the business sell all that it makes?

Are there any bottlenecks which can be eliminated? Remember that the slowest step in the process dictates the overall rate of production.

Are any processes or materials subject to legal controls? If so, what are the requirements for improvement, for example reduced emissions?

Do any processes emit noise, vibrations, or odours which might constitute a statutory nuisance?

Is the waste stream associated with any additional processing and cost, for example an effluent requiring treatment before disposal?

Could capital expenditure be required to control a waste stream or emission under forthcoming legislation?

Is there an undue risk from the use and storage of particular materials? Are there safer alternatives?

Are stakeholders pressing for environmental improvements to the business?

Could environmental improvement increase market share?

Are customers pressing for change in the nature of the products?

Priority areas for improvement can be identified by asking these questions about business operations.
Step 7  Problem solving and generating options for improvement

Having identified where waste is being generated (process mapping) and the quantity that is being generated (historical and live audit), the next step is to identify why waste is being generated and identify opportunities for waste minimisation.

Finding areas to reduce waste:

“Cherry picking”

By working through Steps 1 to 6, some opportunities for waste minimisation should have already been highlighted and appropriate measures taken, for example, a leaking valve, lights that are not switched off, packaging that can be returned to a supplier (avoiding the waste disposal cost), and so on. These might be called low hanging cherries, as they are easy to pick off.

Be careful, though, not to let a short-term saving constrain future savings. Recycling a waste stream, for instance, may have cost benefits but its better to reduce or eliminate this waste at source so it is essential to find the root cause of waste generation and address this rather than just the symptoms.

Problem solving

Many problems appear to have an obvious solution and it is often tempting to rush into action with the result that the wrong problem is solved or other future problems are created. Using a structured procedure can help to avoid these pitfalls.

Define the problem

The first step towards solving a problem is identifying that there is a problem and defining it. Describe it as fully as possible - write it down. For example

- Batch yield is too low
- Reject rate is too high
- Energy use is too high

To describe the situation consider the following questions - what, when, where - write down a full description of the problem then write a description of what should happen using the same headings.

Determine the causes

Sometimes potential solutions to a problem are easy to identify. A technical and economic feasibility study may then help to show the optimum solution. However it is often found that no apparent solution comes readily to mind so a more structured approach may be needed.

Root cause analysis (cause and effect, fishbone or Ishikawa diagram)

This is a tool for identifying and clarifying the relationship between the effect and its main or obvious causes. The effect (waste) needs to be clearly stated and then general root causes identified. Generic headings can be used such as manpower,
machine, methods and materials. Team members then try to generate primary root causes (level 1) under those headings and any others they may identify (see section on brainstorming below). For example a primary root cause under manpower might be “manual control is difficult”. The relationship between level 1 causes and their causes (level 2) can then be identified.

When carrying out root cause analysis the most important question to keep asking is WHY

Root cause analysis uses a tool known as a cause-and-effect, fishbone or Ishikawa diagram.

![Cause-and-Effect Diagram]

**Example - car skidding**

In this example the effect, a car skidding, has had its causes split into tyre-related, driver-related, road-related and mechanical-related issues. These are then subcategorised by the problem-solving team.

![Car Skidding Cause-and-Effect Diagram]

**Generating Opportunities - brainstorming**

Having determined the root cause of the problem you then need to come up with some solutions for solving it. One technique used to generate solutions to a problem is brainstorming. In brainstorming a team tries to identify as many solutions to the problem as possible, however “way out” they might seem. Brainstorming is a creative process that makes use of the company’s most valuable asset - the ideas of its staff.
Brainstorming should involve a group of 3 to 10 people from every applicable area - production operatives, designers, engineers, specialists, supervisors, maintenance, management, quality, sales and marketing. A facilitator is present and responsible for the conduct of the meeting including ensuring the group remains focused on the problem.

**HINT**

Consider launching a staff suggestion scheme in order to get ideas from everybody. It is important to answer all suggestions, no matter how unfeasible they are, in order to encourage future suggestions. An incentive scheme could be operated in order to keep suggestions coming in, for example, a bonus as a fixed sum or a percentage of the saving. A good way of keeping interest in waste minimisation going is to open a charity bank account and put donations based on savings into the account.

**Brainstorming ‘rules’**

Make sure everyone is informed before the session what the problem is and then at the beginning of the session put the problem on a flipchart so that everyone can see it.

- Keep the problem short and simple - don’t try to cover too much in one session.
- Let others restate the problem in their own words to make sure they understand it.
- Do not be critical of any ideas - otherwise some people will not want to participate. Remember people don’t have stupid ideas, they have good ideas based on incorrect assumptions.
- Welcome creative thinking but don’t deviate onto other problems.
- Write all ideas on the flipchart so that everyone can see them and build on the ideas of others.
- Allow everyone to speak but don’t force them to speak.
- Set a time limit - a brainstorm needs to be short, sharp and focussed but it does need time to develop. It is after 10 minutes that the more creative ideas will start to emerge.
- No interruptions - ask everyone to switch off their phones.
- Make sure everyone understands the rules!

Once the ideas have been listed, they can then be clarified and discussed. Take questions about any of the ideas and make sure everyone understands each one. If necessary, reword ideas with the agreement of the originator to make them easier to understand.

Categorise and condense the ideas as much as possible, using group consensus, but don’t override the wishes of the originator.

Keep a record so that ideas can be assessed and then ranked for implementation.
Step 8  Opportunity assessment

Having generated a number of solutions to solve a waste minimisation problem, the purpose of this step is to assess their technical and economic feasibility and their environmental impact.

Technical assessment

Pertinent questions include:

- Can this be done? Some solutions are just too far-fetched.
- Is this solution appropriate to the problem (for example, installing automatic controls where a simple change to operating procedures would be just as good)?
- Does it solve the problem or fix the symptom? For example, a solution that identifies a recycle route for waste merely deals with the waste - it does not reduce or eliminate it.
- Who can implement this? Is external help needed or can it be done in-house?
- When can it be implemented? Some solutions may take longer than others to come to fruition.

If none of the solutions identified pass the technical assessment, try revisiting Step 7 (problem solving) or bring in external help to solve the problem.

Any solutions that are deemed to be technically feasible now require economic assessment.

Economic assessment

An economic assessment of a potential solution to a waste minimisation problem includes:

- one-off cost of implementation (such as capital investment or work required)
- on-going cost of operating or maintaining the solution (such as running costs, inspection/auditing costs)
- the financial benefits from improved environmental performance (see earlier section on the benefits of environmental management)

In many cases a simple payback calculation is sufficient to assess the economic feasibility of a solution or to identify an optimum solution - one with lowest total costs for the business. For example, when the costs of running and replacing low energy bulbs are taken into consideration, there is a clear benefit in their use, even though the initial capital cost is higher.
Calculating payback

The payback can be calculated by dividing the total one-off cost of the project by the net saving of the project (the difference between gross saving and running costs). This gives a payback figure in years.

For example a £42,000 piece of equipment with running costs of £8,000 per year will save £67,000 in effluent charges. So the payback is:

One-off cost (£42,000) divided by the net annual saving (£59,000) gives a payback of 0.71 years or 8 1/2 months.

More in-depth assessment methods may be required. These could include undiscounted and discounted financial analysis. Speak to the company accountant if there are any doubts about calculating cost benefits.

**HINT**

For contacts and more details of financial appraisal methods for technology investment see the Sourcebook. There is a guide available from Envirowise called “Investing to increase profits and reduce waste” (GG82) which contains detailed examples of financial appraisal.

Environmental Assessment

It is very important to assess the effect that any planned changes have on the environment:

- will the environment benefit? Consider the environmental effects of proposed changes. It is important to ensure that the overall environmental burdens are minimised;

- is the environmental problem being transferred elsewhere? For example, scrubbing an air emission into water does not necessarily fix the problem;

- are there any environmental reasons for not proceeding with the project - could legislation affect its desirability in the future?

- Some companies are carrying out life-cycle assessments of their products and processes to identify those with the lowest environmental burden or impact.

**Life Cycle Assessment**

For an introduction to Life Cycle Assessment refer to the Envirowise publication - Life-Cycle Assessment: An introduction for industry - ET257 - available from the Environment & Energy Helpline 0800 585794
Step 9  Project implementation and maintaining momentum

A successful project relies on communication up and down the management structure to maintain momentum and commitment.

Project implementation

Some solutions will be straightforward changes to operating procedures or simple technical changes to equipment. Other projects may involve changing peoples’ attitudes and behaviour. Individuals will need to be more responsible for the consequences of their action or inaction. Environmental, health and safety, and business or cost awareness training could be a good way of delivering this information.

Capital investment projects will need planning and integrating into the business plan, taking into consideration when the capital and manpower to manage and implement the project will be available.

Once implemented, the project must be monitored in order to confirm the return on investment and to learn from any mistakes. Above all, a successfully implemented project helps to maintain momentum - “nothing promotes success like success”.

Maintaining momentum

Management reports are essential for maintaining the commitment of senior management and directors. The savings from investing in time, manpower and technology will help to sustain the project. Regular reporting also acts as a good mechanism for alerting managers to any problems. Old problems may recur if implemented waste minimisation measures start to fail, and new problems may arise as the business changes.

Shopfloor reports are essential for maintaining the commitment of the workforce, on whom the success of all projects depends. Most people appreciate feedback from work they have undertaken. (refer to the Environment Agency’s Waste Minimisation Awareness Guide ‘Getting Staff Involved’ for useful hints on staff involvement - see the Sourcebook for details)

Use simple, meaningful and relevant key performance indicators, such as:

- grammes of solvent used to manufacture a pair of shoes (g/pair);
- kilogrammes of fruit used to manufacture a tonne of jam (kg/tonne);
- number of litres of water used per tonne of product (litres/tonne);
- amount of electricity used per item produced (kWh/item).

Ongoing measurement of waste

Systems to monitor and measure material/utility consumption and waste/rework generation will also sustain project momentum. Monitoring systems simply involve recording material/energy usages and waste/rework generation on production reports. Measuring systems use physical devices to quantify resource consumption and waste generation.

Whichever way data is obtained, it is essential that the information is reported and acted on.
REDUCING WATER USE

Background

Under Section 24 of the Water Resources Act, the Environment Agency is responsible for licensing direct abstraction from ground and surface water sources, where applicants must demonstrate reasonable need for new or additional supplies of raw water. Under the Environment Act 1995, water companies have a duty to promote the efficient use of water by their customers; some water companies meet this requirement at least in part, by providing free advice to their business and industrial customers on water efficiency.

In some parts of the country there are restrictions on the availability of both ground and surface waters. Over the next 7 years the Agency will be preparing Catchment Abstraction Management Strategies (CAMS) which will review how water resources, at the catchment level, can be managed in a sustainable way. Contact the Environment Agency for details.

Why reduce water use?

Efficient water use contributes to the sustainable management of water resources, enhancing the local water environment whilst contributing to local economic growth and development. There are also a number of immediate advantages for the individual company - reducing water consumption and wastage will result in lower water bills, as well as reducing the quantity of wastewater requiring treatment and disposal. The scope for saving water and the associated financial benefits are demonstrated in case studies collated by Envirowise, see for example GC22, GG67, GG111, EG105. Refer to the Sourcebook for details.

What are the water efficiency options?

There are a wide range of water efficiency measures that can be implemented to control not only the use of water within the industrial process, but also within the office and canteen areas of the site (see Envirowise Guide GG67). The starting point is always an initial water balance identifying and accounting for all water uses at all stages of the process and key locations. This is followed by routine measurement and reporting procedures which will identify leaks and wastage.

If your company is designing a new site or process or undertaking significant refurbishment, there are a number of opportunities to incorporate measures such as greywater recycling, rainwater harvesting, recycling and reuse of process water. In offices, kitchen and canteen areas, low water using appliances could be installed such as low flush toilets, waterless urinals and spray taps (see for example the Water efficiency fact cards produced by the Environment Agency). The design of site landscaping should also consider the use of drought tolerant plants and low rate irrigation systems, using harvested rainwater, to minimise the use of sprinklers.

There are three actions you can take to reduce water use:
Action 1: The water audit

Follow steps 3 and 4 in the previous section and undertake a simple water audit, based on the mass balance approach. When drawing up your process map, identify all sources of water on site, the purpose for which each water source is used, and the actual quantity used. Also include all sources of wastewater effluent and associated quantities. If you do not have access to data on actual water consumption, you can estimate your water use using a number of simple techniques:

- Refer to information provided by the equipment manufacturer.
- Use a bucket and stopwatch to measure the flow of water.
- Estimate water use using standard water use figures, for example toilet use can be estimated from the frequency of use and cistern volume.

HINT

Not all uses of water require high quality, expensive mains water. To identify the scope for substituting water from alternative sources, the water quality requirements associated with each use should be identified. The results of the process mapping exercise should provide you with a clear indication of the flows of water into, through and out of your site. Where appropriate, you should consider installing equipment to monitor actual consumption, this will help you identify unusual patterns of consumption which may indicate a water leak.

Comparing the level of water consumption on your site against other similar producers is a useful way of gauging the scope for improvement. Collate information on the level of production over the period you have collected water consumption data, then calculate the water use per unit of production. Compare this figure against national benchmark figures, see for example the Optimum use of water for industry and agriculture: Best practice manual, produced by the Environment Agency (see the source book for details).

National Water Demand Management Centre

The Environment Agency’s National Water Demand Management Centre provides a focus for information and expertise to ensure the acceptance of water conservation throughout society. Together with Water UK, the Centre co-manages the Water Efficiency Awards, which recognise excellence in water conservation and efficiency in industry, business and the public sector. The Water Efficiency Awards 2000 publication showcases the winning, commended and shortlisted entries. For a copy of this, or for information on future awards programmes, and details of water efficiency publications please contact: National Water Demand Management Centre, Tel. 01903 832073 or refer to the Agency’s web site www.environment-agency.gov.uk (see the source book for details of publications).
Action 2: The water action plan

On the basis of this simple water audit you should formulate and implement a water action plan, which should be revised annually. The action plan should include a clear monitoring procedure for pipelines, to reduce wastage through leakage. This should include:

- A plan identifying all pipelines, meters and stopcocks on site;
- A programme to ensure that all pipelines not in use can be drained and closed. This should include installation of stop taps and values at each tee in the system;
- A programme to ensure that all pipes are insulated to prevent frozen and burst pipes.

Significant quantities of water are used in cleaning and washing down processes. Where appropriate, you should include within the action plan a programme to eliminate or minimise these uses of water. This should consider the following measures:

- Automatic shut off valves to prevent flows exceeding the stated limits and/or duration;
- All hoses, hand lances and washing equipment should have trigger controls attached;
- Where ever possible, all solid waste should be vacuumed or manually cleaned, e.g. brushed, scraped or mopped in preference to hosing down;
- The scope for reusing wash water, in particular final rinse water, should be evaluated.

The action plan should establish and promote targets for reduced water consumption within the site. The constraints on reducing water use beyond a certain level should be identified within the plan, as these are often site specific.

To ensure these targets are achieved, a member of staff (or team) should be given responsibility for implementation of the water action plan.
Action 3: Implement practical cost effective measures

There are many simple, practical cost effective measures which companies can implement to reduce water use:

- Fit non-removable trigger sprays to water hoses
- Install cooling towers on a closed loop rather than once through cooling water
- Re-circulate water in liquid ring vacuum pumps reusing cooling tower and boiler blow down waters
- Collect and reuse rainwater for some cleaning operations
- Recycling of other process waters for wash waters triggering rinse water bath purges using conductivity probes
- Use counter current rinses for multi-stage cleaning putting sensors onto urinal flushes rather than timers
- Specify a policy of purchasing low-water using appliances

Case study - Phillips Research Laboratories

Phillips Research Laboratories conducts research into consumer electronics. At its premises in Redhill it managed to save 45,260 m³ of water a year by redesigning its machine water cooling system. Cooling water previously discharged to drain is now recycled and reused in the laboratories. The new drainage collection system was installed for an initial investment of £150,000, with ongoing maintenance and electrical running costs of £8,200 a year.

The management team instigated the project as part of their ISO 14001 initiative. The team working on the project was made up of a cross-section of administration, scientific, technical and engineering staff. An initial water balance survey showed that over 70% of water use was for machine cooling, and that this cooling water was only used once and then discharged to drain. Following an in-house feasibility study it was agreed to develop a new system.

A new drainage collection system was installed, which returned the cooling water back into the main storage tanks via a plate heat exchanger. Annual water consumption has been reduced by 68% with a financial saving of £38,000 in the first year.

ENERGY EFFICIENCY

Background

Improvements in energy efficiency not only lead to better environmental performance but also significant cost savings. Energy use is the main contributor to the release of greenhouse gases leading to the threat of global warming and climate change, so savings in energy use mean a reduction in this threat. Businesses consume about one-third of the UK’s annual energy use and for this reason, the UK government is looking increasingly at ways to encourage companies to become more efficient. Recent measures include the Climate Change Levy on energy consumption and the inclusion of energy efficiency requirements in the Pollution Prevention and Control (England and Wales) Regulations, 2000.

This section provides the basic information and first steps towards helping your business become more energy efficient. In addition, there is a wealth of information which can be obtained through the Energy Efficiency Best Practice Programme (EEBPP) run by the DETR. The EEBPP provides impartial, authoritative information and advice on energy efficiency techniques and technologies in industry, transport and buildings. The information is disseminated through publications, videos and software, together with seminars, workshops, the Environment and Energy Helpline (0800 585 794) and other events. A range of published literature is available free of charge and many of these documents can be downloaded from the EEBPP web-site: www.energy-efficiency.gov.uk

Where to Start?

It is important to recognise that energy efficiency is a management issue needing to be tackled using management techniques. Monitoring and Targeting are the basic ingredients of energy management. When you monitor energy use and compare the result with benchmarks for your type of industry you are then able to identify areas of potential savings and set targets which will identify the most cost effective improvements as a priority. The basic principles of energy management are very simple, but can be adapted in complexity to suit the needs of the industrial or commercial activities to which they are applied and consist of:

- finding out how much energy is used, where and when it is used throughout the site
- setting up regular energy monitoring procedures in order to see changes and improvements
- identifying areas where energy is being wasted
- identifying the best opportunities to make energy efficiency improvements
- setting targets for improvement, which are regularly reviewed, with senior management endorsement and clear staff responsibilities

Remember the importance of your workforce. Feedback to staff at all levels is an essential element of any management programme.
Energy Use

The first stage of energy management is to measure how much energy is being used and for what purpose. By mapping out energy consumption for different company activities, a clearer picture of the energy saving opportunities can be developed.

Start by listing the types of energy used on the site. These may include:

- electricity from the public supply
- natural gas
- electricity from a direct supplier
- steam or hot water from a direct supplier
- liquified gas (LPG, propane)
- fuel oils (gas oil, heavy fuel oil)
- transport fuels (petrol, diesel)
- coal and coal-derived products
- wood or biomass fuels
- wastes or by-products used as fuels

Then list the amount of each energy type used over a representative 12 month period. Information can be obtained from energy suppliers’ bills, noting the amount supplied, the units in which energy is supplied and the price. Electricity and gas are usually supplied in kilowatt-hours (kWh) and it is recommended that these same units are used for all energy types.

Information is available from the Energy Efficiency Best Practice Programme on how to compare the energy value of different types of fuel. As a simple guide, 1 kWh = 3,600kJ.

Next identify how much and what type of energy is used in different parts of the site. The actual breakdown you use will depend on the number of production units and facilities on your site. This is made much simpler if you have sub-metering within the site, but alternatively can be estimated based on the rating and operating hours of major equipment. This should also show the direct links between any energy generated and used within the site, such as steam-raising boilers.

Example breakdown: Energy use by department

<table>
<thead>
<tr>
<th>Business Activity</th>
<th>Energy Source</th>
<th>Amount (kWh/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>site boiler 1: supplying steam to process units</td>
<td>waste residues</td>
<td></td>
</tr>
<tr>
<td>site boiler 2: supplying space heating and hot water to office block</td>
<td>natural gas</td>
<td></td>
</tr>
<tr>
<td>process unit: roasting ovens</td>
<td>steam from boiler No 1</td>
<td></td>
</tr>
<tr>
<td>process unit: crushing plant</td>
<td>electricity</td>
<td></td>
</tr>
<tr>
<td>process unit: effluent treatment plant</td>
<td>electricity</td>
<td></td>
</tr>
<tr>
<td>chilled storage warehouse</td>
<td>electricity</td>
<td></td>
</tr>
<tr>
<td>office block</td>
<td>steam from boiler No 1</td>
<td></td>
</tr>
<tr>
<td>HGV transport</td>
<td>diesel</td>
<td></td>
</tr>
</tbody>
</table>

This type of breakdown allows you to see clearly which areas of your business use which type of energy and makes it easier to identify where the most effective improvements can be made within each production unit. In addition, it can highlight possible synergies between different activities such as use of waste heat or coolant streams.
Energy Monitoring

Energy consumption usually varies over time on a daily, monthly or seasonal basis depending on the production cycle being used. So in addition to measuring the annual consumption, an ongoing record of changes in energy consumption over time should be made by setting up a monitoring system. This helps you to spot any trends in energy use and relate these to changes in production and overall energy efficiency improvements.

Monitoring systems vary in sophistication. For simple production sites it may only be necessary to keep a manual log of metered supply or bulk energy deliveries. However, for larger, more complex manufacturing sites it is often worthwhile installing individual meters and monitoring energy use for separate production units. Ideally, energy consumption should be metered on a continuous basis. Energy sources such as electricity and natural gas are usually available to meet demand as it arises, so are metered continuously. However, continuous metering is not always possible, e.g. for solid fuels such as coal, or where energy sources are used intermittently.

HINT

Advice on the best approach to energy management to suit your production process can be obtained from the EEBPP, including for example:

- GPG112 Monitoring and Targeting in large companies,
- GPG231 Introducing information systems for energy management,
- Fuel Efficiency Booklet 13, waste avoidance measures

A useful technique to monitor improvements in energy efficiency is to calculate the Specific Energy Consumption (SEC). This is a benchmark for how much energy is consumed per unit of raw material processed or product output, which takes into account variations in production capacity.

SEC is usually expressed in terms of energy, by simply dividing energy consumption by an appropriate production unit to provide a direct measure of the efficiency of energy consumed. The time periods over which energy consumption and production levels are measured must be the same. There is no fixed rule on the unit of production that should be used as the basis for SEC, but it should be whatever unit most closely mirrors the primary purpose and level of production at the installation, for example tonnes of product or of a key raw material.

A good way to keep monthly records of the SEC is by using computer based spreadsheets. These will enable trend graphs to be produced and easy comparison from month to month and year to year. The technique can also be used to correct energy consumption figures for heating and cooling systems by the use of Degree Days. (refer to information available from BRECSU).
Energy Efficiency in Buildings

Energy consumption within buildings is often overlooked in the industrial sector, yet space heating, ventilation, air-conditioning, associated pumps and fans, lighting and office equipment can be a significant proportion of overall consumption. Simple, low cost measures can save up to half of the buildings-related energy use.

Lighting

- use the most inherently efficient lighting systems - some lamps and luminaires by design are more energy efficient than others
- install the luminaires in such a way as to provide appropriate lighting density (i.e. do not overlight and maximise the use of natural daylight)
- use effective controls so that lighting is only used when required (e.g. use of occupancy sensors and avoidance of “one-switch-per-floor”)

For more information see the EEBPP publication: GPG 160 Electric lighting controls - a guide for designers, installers and users.

**LIGHTSWITCH**

‘Lightswitch’ is a government supported initiative managed by the Energy Saving Trust and helps businesses to invest in the most energy efficient lighting options. Rebates are available for up to 50% of the capital cost up to a maximum of £3,000

Ring the Lightswitch Helpline on 0990 133538

Heating, cooling and ventilation

- use waste process heat for space heating, where available
- select high efficiency heating equipment by ensuring that energy efficiency is part of the specification
- install point-of-use water heaters to meet low demand for hot water in remote locations
- use thermostatic valves to control space heating temperatures
- use natural ventilation rather than air conditioning
- prevent heat losses by adequate draught-proofing of windows and using roll doorways
Site Boiler Systems

Many manufacturing sites require hot gases, steam or hot water for production processes. This is most often generated on site from the combustion of gas, oil or solid fuel in steam or hot water boilers. The energy efficiency of such systems is dependent on type of fuel, combustion equipment, type of boiler and distribution system. As an alternative to on-site boiler plant, the import of steam or “waste” heat from neighbouring installations can be a cheaper, more efficient option. For further information see EEBPP publications:

- GPG030 Energy Efficient Operation of Industrial Boilers
- GPG197 Energy Efficient Heat Distribution
- ECG066 Steam Generation Costs
- ECG067 Steam Distribution Costs
- GIR005 Review of Small Steam Turbines

Don’t forget the importance of lagging pipes, including flanges to save energy.

Where there is a large on-site demand for both electrical power and steam, it may be worthwhile considering the use of a combined heat and power (CHP) plant. CHP uses a combustion turbine or engine connected to a generator to produce electricity, while the exhaust heat is used to raise steam or hot water or provide absorption chilling. Making use of this ‘waste’ heat can save between 20 and 30% of a site’s primary energy and is therefore financially attractive. A feasibility study is usually undertaken to determine whether a scheme is suitable for an installation.

Compressed Air

The energy used in generating and supplying compressed air is significant. Some simple measures can be carried out to ensure that it is used in the most efficient manner:

Housekeeping measures

- Consider turning off compressors during non-productive hours.
- Review the level to which air is pressurised, you may be able to reduce it, which reduces consumption and leakage.
- If there are applications which require higher pressures or have longer operating hours than the rest of the system, investigate whether it might be worth installing a dedicated compressor.
- Check that the air inlet to the compressor is not taken from inside the building, compressors operate more efficiently using cool air.
- Control/sequence compressors to operate on a ‘demand-controlled’ basis; compressors use as much as 70% of on-load power when they are idling. Seek professional advice.
- Initiate an effective system for reporting leaks. Carry out an ‘out of hours’ survey, to listen for leaks, locate them and tag.

- Make sure all redundant piping is isolated - it is often a source of leaks.

- Check that the condensate collection system is working correctly, and that there is no constant bleed of air. Condensate traps may be jammed open or have been bypassed. Consider fitting electronically operated condensate traps, which are more reliable.

**Treatment**

- Investigate treating the bulk of the air to the minimum level possible, then improving the quality for specific appliances.

- Regularly inspect and maintain the air treatment system. Check the pressure drop across the pre- and after-filters. If it is above 0.4 bar the filter may need replacing. It is cheaper to replace the filters than to pay for the loss in air pressure when they become clogged.

- Measure the dryer inlet temperature. This should not exceed 35°C with the compressors on full load.

- Measure the temperature of the dryer room, it should be within 5°C of the outside ambient temperature. If the room is too hot there is a loss of performance.

**Use of compressed air**

- Over 90% of energy used by a compressor is turned into heat, so consider whether you can fit a heat recovery system to the compressor(s) and use this heat elsewhere in your buildings.

- Use of higher efficiency nozzles (which entrain free air) can maintain performance, yet reduce the distribution pressure and hence energy consumption.

- Make sure that air tools are not left running when not in use.

- Check that compressed air is not used for ventilation or cleaning purposes, such as blowing off swarf.

- Look at alternatives to compressed air tools, electrically powered tools are cheaper.

- When purchasing a new compressor take into account its energy efficiency since electricity will be the major running cost.
Steam Systems

Steam supplied from boilers is often distributed to different production units or buildings within a site. Some simple measures listed below can minimise inefficiencies associated with the distribution and return systems:

Maximise condensate return

- Hot condensate that is not returned to the boilerhouse has to be replaced by treated cold make-up water and wastes some 20% of the energy absorbed in the generation of the steam from which the condensate is derived. This may be the greatest single energy loss in steam utilisation. The additional make-up waste also adds to water treatment costs.

- If condensate is being discharged to drain because of the risk of contamination, it may be possible to return the condensate to a break tank via an analyser to detect the presence of any contaminant. Alternatively, recover useful heat from contaminated condensate before discharging it to drain.

- The energy in any steam used for direct injection to process may be considered to be fully utilised.

Avoid loss of flash steam from condensate return

- When condensate is discharged from steam traps and flows along the return piping, some flash steam is formed.

- Try to find a new use for the flash steam - it will typically contain some 40% of the energy in the original pressurised condensate. All too often flash steam is simply vented to atmosphere.

- If the condensate and associated steam cannot be accommodated in the boilerhouse hot well, flash the collected condensate down to a low or atmospheric pressure local to the point of use of the steam and pump the residual condensate back to the hot well. This practice is also preferred where there are long runs of condensate piping.

Isolate unused piping

- Check all pipework is used. There may be branches of the distribution system that are no longer used and can be removed from the system.

- Use valves or slip-plates to isolate piping that supplies steam to infrequently used items of plant. Such piping imposes a disproportionate standing loss on the system and is likely to receive less maintenance attention.

- If you remove part of a redundant section of piping and fit a blank flange, check that the remaining piping is adequately supported.
Improve Steam trapping

- Ensure that inspection of steam traps is a documented routine activity.
- Make sure that the replacement of defective traps is given high priority.

Repair Steam Leaks

- Ensure that a documented system for reporting and rectifying of leaks is in place.
- Make sure that the repair of steam leaks is given high priority. Costs can soon mount up with only a few leaking valve glands.

Refrigeration Plant

Many manufacturing processes use chillers, coolers and cooled storage as part of their operations. Energy use in refrigeration systems often offers significant opportunities for improvements in efficiency from simple measures as described below:

Around the refrigeration plant

- Keep the condensers clean. Blocked condensers increase the condensing temperature, and a 1°C increase in condensing temperature increases running costs by 2-4%. The cooling capacity also drops and the required temperature may not be achieved. Get the condensers cleaned regularly and budget to replace badly corroded ones.

- Make sure air entering the condensers is as cold as possible. The warmer the air onto the condenser the higher the condensing temperature. Shade the condensers if necessary and ensure warm air is not re-circulated - remove anything obstructing the airflow.

- Check the refrigerant sight glass for bubbles. Bubbles in the sight glass usually mean a system is leaking (NB it is illegal to knowingly vent certain refrigerants). Find the leaks and repair them before the system is re-charged with refrigerant.

- Check that the oil in the compressor sight glass(es) is at the right level. The compressor will be more likely to fail if the oil level is too low (or too high).

- Report and repair any pipework that is vibrating. Vibrating pipe work is more likely to fracture, causing a major refrigerant leak. Get the pipe work fixed more securely, but make sure it is not too rigid.

- Keep the plant room as cool as possible. Otherwise, the plant will be running hotter than necessary, reducing reliability and performance. Ventilate the plant room, preferably with an extract fan that is switched on when the temperature gets too high. Make sure air can get in as well as out of the plant room.
In cooled rooms

- Keep the door closed as much as possible. An open door costs £6 per hour for a freezer store, and £3 per hour for a chill store. Ice around the door indicates poor sealing, with a consequent increase in the heat load. Stop product being loaded in the doorway and improve the sealing on the door. If the door has to be used regularly, fit a strip curtain.

- Do not stack product directly under the evaporators. This impedes the airflow over the cold store.

- Check your evaporators defrost properly. Evaporators that operate below 0°C should be completely defrosted when the ice starts to cover the fins - this may be every few hours or every few days. If the frost does not clear, or if the drain pan/lines are blocked, then the frost build up on the evaporator will get worse.

- Report ice on the floor and walls of the store. This indicates that a lot of air is entering the room, bringing with it moisture, which is condensing on the evaporator and the structure. It could also indicate a defrost problem.

- Do not keep the store colder than necessary. Cold stores are often held at lower temperatures than necessary because of worries about failure. “If the temperature is lower than it has to be, it gives us a few hours grace to get a contractor in when we have a problem” runs the excuse. In fact having a cold store at a lower temperature than necessary makes it more likely to fail!

In other areas

- Refrigeration systems have to remove the heat from many places other than the product or space you are cooling. Most of these heat gains are unavoidable, but they should always be minimised. Common examples are:

- Pumps and fans that circulate cold air, chilled water, or an anti-freeze solution generate heat, contributing most of the power they consume to the cooling load - switch them off when not required.

- Lights in a cold store or cooled room also contribute most of the power they consume to the cooling load - switch them off when not required.

- Cold refrigerant pipes (particularly the larger gas pipes) will pick up heat from their surroundings - they should be insulated, and avoid hot areas.
Motors and Drives

Use of motors and drives in manufacturing processes is widespread. The implementation of simple, low cost measures as described below can lead to substantial savings.

Switching the motor off

- Time the switching according to a fixed programme or schedule.
- Monitor system conditions, e.g. high or low temperatures, and switch off the motor when it is not needed.
- Sense the motor load so that the motor is switched off when idling.
- Check that changing requirements have not eliminated the need for the equipment altogether.

Reducing the load on the motor

- There is no point in optimising the drive if what the motor is driving is fundamentally inefficient.
- Is the system doing a useful and necessary job?
- Is the transmission between motor and driven equipment efficient?
- Are maintenance programmes adequate?
- Have losses due to the pipework, ducting, insulation etc., been minimised?
- Is the control system effective?

Minimising Motor Losses

- Always specify higher efficiency motors where feasible.
- When a motor fails, ensure that proper care and attention is given in the repair process so as to minimise energy losses.
- Avoid using greatly oversized motors.
- Check that voltage imbalance, low or high supply voltages, harmonic distortion or a poor power factor is not causing excessive losses.

Slowing down the load

- In pump or fan applications where the cube law applies, even a small reduction in speed can produce substantial energy savings.
- For belt drives only, a low cost option is to change the pulley ratio.
WASTE MANAGEMENT

This section covers good practice in achieving compliance with the legal requirements relating to the handling and disposal of controlled waste. In this context, waste means solid and liquid materials which will be removed from the site by the producer or by a third party carrier for treatment, recovery or disposal.

Waste might consist of raw materials not included in the final product, or it might be a by-product from processing or substandard product which cannot be economically reworked. However, it is important to remember that waste is generated in all areas within a company, not just those involved in the manufacturing process. Waste material can consist of packaging, consumables, damaged or redundant plant and equipment, office waste, canteen waste and maintenance waste.

Pertinent questions include:

How does the business deal with these wastes?

What are the legal controls on this waste?

How much does waste cost?

Step-by-step guide to waste management

Step 1  Identify waste streams
Pinpoints where waste is generated

Step 2  Categorise waste according to legal definitions
Defines the way waste material is categorised

Step 3  Select the best waste management option
Get the most out of waste

Step 4  Managing waste on site
Practical guidance on how to deal with waste on site

Step 5  Managing waste off site
Practical guidance on the handling and disposal of waste off site
Step 1 Identify waste streams

The starting point for waste management is to understand precisely what wastes are generated and where they come from. The best way to do this is by drawing process flow diagrams showing the movement of materials and the creation of waste throughout each process. See Step 3 in the waste minimisation section for details of how to map the process.

As well as identifying waste streams, it is important to characterise them in terms of physical properties - solid, sludge or liquid - and chemical properties - flammability, corrosivity and toxicity, etc. This will help in the categorising of wastes under legal definitions.

The legal definition of waste


It is important to note that materials destined for recycling are still classified as wastes.

It is the responsibility of the holder to decide whether a substance or object in his possession is waste, and to take the necessary action in relation to it.

If you have any doubts or questions about whether a substance or an object is a waste contact your local Environment Agency Office, telephone 0845 933 3111.

Your waste

Make a list of all wastes and add the following information:

- How much of each type is produced (by weight if possible);
- Where it is produced;
- Note carefully the waste composition;
- Where it goes.

Guidance on the definition of waste is given in the DOE Circular 11/94. See the Sourcebook for details.
Step 2  Categorise waste according to legal definitions

Having decided whether the substances or objects which are being stored, handled and disposed of from the site are waste, the next step is to ensure that waste is correctly classified.

Controlled waste and the Duty of Care

Part II of the Environmental Protection Act 1990 defines any waste arising from industrial, commercial or domestic sources as controlled waste. Controlled waste currently (Spring 2001) excludes mining, quarrying or agricultural wastes, radioactive wastes, waste explosives and (in most cases) sewage.

The Environmental Protection Act established a Duty of Care on anyone (apart from a householder in relation to their own waste) who has control of, or responsibility for, controlled waste at any stage from its production to its disposal. This duty requires each producer or holder of waste to take all reasonable measures:

- to prevent any other person treating, keeping or disposing of waste other than in accordance with waste management licensing legislation or in a manner likely to cause pollution of the environment or harm to human health;
- to prevent the escape of waste - both on site and during onward transfer;
- to ensure that waste is only transferred to an authorised person or to a person for authorised transport purposes;
- to complete a transfer note which must be signed and kept for a minimum of two years by the parties involved (along with or including a written description of the waste) when the waste is transferred.

Duty of Care Code of Practice

A Code of Practice, published in March 1996, provides guidance on how waste holders should discharge their Duty of Care. The information in this Good Practice Guide neither replaces nor supersedes the Code of Practice. Waste holders are strongly recommended to refer to the Code of Practice. Details in the Sourcebook.

Special waste

Certain wastes are considered to pose a potential risk and require special handling and treatment. The Special Waste Regulations 1996 (as amended) define what constitutes a special waste. A waste is classified as special if it has a hazardous property such as flammability, toxicity or corrosivity. Special waste has a more stringent system of control to ensure that it is handled correctly. Examples of commonly occurring special wastes include: asbestos-containing building wastes, used engine oils and car batteries.
Special wastes should be segregated and stored safely and securely, minimising the risk of pollution. The storage of special wastes might require licensing under Schedule 3 of the Waste Management Licensing Regulations, if the limits for storage are exceeded. You should talk to the Environment Agency if you think your wastes may be subject to licensing.

All movements of special waste must be accompanied by a special waste consignment note as defined by the regulations. For advice on the consignment note procedure please contact your local office of the Environment Agency or refer to the Environment Agency’s guide on special waste. The paperwork requirements of the Duty of Care are covered by the consignment note system with the exception that special waste producers must keep consignment notes for at least three years.

The Agency has produced internal guidance to assist officers to interpret and enforce the 1996 Special Waste Regulations (as amended). These are known as Special Waste Explanatory Notes (SWENs) and are intended for specific internal Environment Agency use. The explanatory note is based on information contained in the regulations and on current understanding. SWENs may be subject to change in the light of regulatory changes, future Government guidance or experience of regulating special wastes. However, in the interests of transparency, the notes are available to industry and can be downloaded from the Agency’s web site. Explanatory notes have no status other than as internal Agency guidance to its staff and it remains the responsibility of the waste producer or holder to establish the waste’s status as “special”.

A duty is imposed on the Agency by Regulation 19 and Schedule 3 of the Special Waste Regulations 1996 to conduct periodic inspections of special waste producers.

Understand your waste

The special waste regulations place a responsibility on waste producers to categorise their wastes.

● If you are in any doubt as to whether your wastes may be special waste you should refer to the Agency’s guidance or contact your local office of the Agency 0845 9333 111 or refer to www.environment-agency.gov.uk

● Failure to comply with the special waste regulations is an offence

Packaging and packaging waste

Around 9 million tonnes of packaging waste is produced in the UK every year, at least 50% of which ends up in landfill sites. The Producer Responsibility Obligations (Packaging Waste) Regulations 1997 (as amended) introduced a new system of control on packaging materials and packaging wastes.

Producers in the packaging supply chain are required to take certain steps in order to ensure the achievement of UK packaging waste recovery targets. These targets have risen from 38% in 1998 to 56% by the year 2001, and may be subject to future change. Information regarding the obligations on producers of packaging are contained in the 1997 regulations and in detailed guidance published by the Agency.
and DETR. Industry groups and approved compliance schemes have also produced guidance on the regulations and the implications for business. The Agency also maintains a series of Explanatory Notes on specific aspects of interpretation which are available from local offices of the Agency. See the Sourcebook for relevant publications.

In summary, producers who handle more than 50 tonnes of packaging materials in a year and who have an annual turnover of £2 million or more are required to:

- Register annually with the Agency (or SEPA) or an approved compliance scheme;
- Submit packaging flow data to the Agency or scheme, based on packaging handled during the previous calendar year;
- Provide evidence that recovery and materials recycling targets have been achieved.

The Packaging (Essential Requirements) Regulations 1998

These regulations implement the single market provisions of the ‘Packaging’ Directive. The main requirements are that no person responsible for packing or filling products into packaging or importing packed or filled packaging into the UK may place packed or filled packaging on the market unless the packaging fulfils the Essential Requirements and Heavy Metal limits.

The Essential Requirements are that packaging must be minimal; noxious or hazardous substances must be minimised: packaging must be recoverable through recycling, incineration with energy recovery or composting/biodegradable; packaging may be reusable. The Heavy Metal limits apply to cadmium, mercury, lead and hexavalent chromium.

Enquiries should be addressed in the first instance to your local authority Trading Standards department who are responsible for the enforcement of these regulations.

Minimising packaging waste

It is possible to significantly reduce packaging costs and cut waste levels by implementing relatively simple measures, many with low or no associated costs. Weight reduction of packaging will help towards reducing recovery and recycling obligations.

Simpler packaging design can also help to save waste and money, by the eradication of composites which are difficult and more costly to recycle. Use packaging which is easier to recycle and avoid difficult-to-recycle packaging such as mixed plastics and save money.

Packaging Waste Minimisation Guides from Envirowise

<table>
<thead>
<tr>
<th>GG140</th>
<th>Cutting Costs and Waste by Reducing Packaging Use</th>
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<tbody>
<tr>
<td>GG141</td>
<td>Choosing and Managing Reusable Transit Packaging</td>
</tr>
<tr>
<td>ET250</td>
<td>Unpack those Hidden Savings: 120 Tips on reducing packaging use and costs</td>
</tr>
</tbody>
</table>
First steps

The first thing to do is to appraise the current situation and assess how much packaging is currently being used. It is also worth looking at the demands of customers and asking if they are valid or if they would prefer something else. Having assessed the packaging flow through the company, examine the different options currently available, looking at cost, recyclability and durability (for re-use).

Good practice

Reuse of packaging is nearly always a better option than disposal. An increasing number of reusable systems are being developed, often based around transport packaging and using plastic and wood. The systems take account of the potential for losses and failure to return, often by introducing economic incentives to retain and return the packaging. As the benefits both to suppliers and customers are realised there is an increasing acceptance of reusable packaging. This further fuels innovation in reusable packaging to enable such systems to meet a wider variety of applications.

TIPS ON GOOD PRACTICE

- Reduce packaging weight to a minimum
- Select easily recyclable materials
- Try not to use composite materials
- Label packaging to indicate materials used.
- Reduce cross-contamination of materials
  for example paper labels on plastic sleeves

The best option by far is to reduce to a minimum all packaging which is not readily recyclable and then look at reusing as much as possible. Packaging which is reused does not pick up an obligation under the regulations and thus reduces the regulatory burden.

Recycle as much of your waste as possible, and request recyclable material in packaging in order to support the recycling market and reduce the cost for having waste recycled where possible. Use easily separable packaging and reduce contamination to a minimum (for example, inkjet direct on to packaging instead of using labels). Mark your packaging to indicate the type of material it is; this will make it easier to sort and increase its value. Don’t mix different types of recyclables and keep process waste separate as this can’t be used to meet obligations or to obtain Packaging Waste Recovery Notes (PRNs). Cut down on process waste because, as well as all the benefits previously outlined in this guide, this competes for recycling capacity.

How to profit

If a business is involved with recycling or recovering packaging waste, or if it could adapt a process to use such waste as a raw material, consideration could be given to seeking accreditation from the Agency to become an reprocessor. Examples of processes include use of plastic packaging waste to manufacture such things as crates, stillages and street furniture, or incineration of packaging waste with energy recovery. This would allow the business to issue Packaging Recovery Notes (PRN’s) which can be used to offset obligations or sold on to other obligated companies.
Step 3  Select the best waste management option

Waste management good practice

Good waste management ensures that any potential value in the waste is realised while taking care of our environment. Good waste practice should follow the waste hierarchy. The hierarchy has four basic levels, providing a framework for decision making and reflecting the environmental and cost issues surrounding waste:

1. Reduction (Minimisation)

   It is better not to produce waste in the first place. Can the amount of waste be reduced by implementing waste minimisation as described in the waste minimisation section of this guide? Waste minimisation also covers the use of less environmentally harmful materials by substitution.

2. Reuse

   The reuse of materials can result in major cost savings. Can the waste stream be made reusable, for example, using returnable bottles or reusable transit packaging.

3. Recovery

   Many wastes can be reprocessed or recycled for reuse into new products, or the energy can be recovered from them by using them as fuel. Organic wastes can be composted.

4. Disposal

   Disposal is generally the least desirable option and involves either containment (landfill, deep injection) or destruction (incineration, chemical or biological treatment) of the waste.

Your waste

Using your list of wastes, consider for each waste:

- Can it be minimised?
- Can it be reused (even as a lower value by-product)?
- Can it be recovered, as with recycling, on site or off site?
- Are there any more environmentally acceptable disposal routes?

Reuse and recycling

Segregation of waste at the point of production prevents recoverable materials from being contaminated. It also prevents double handling of materials, saving time and effort, and can easily be achieved by raising staff awareness. Costs can be reduced and risks minimised if wastes are segregated appropriately. Each waste stream needs
to be considered in turn. Mapping waste production points on to a site plan will help you identify convenient points to locate shop-floor bins or skips for collection of segregated materials.

An empty drum is an attractive target for all nature of liquid wastes, but if incompatible chemicals are mixed the results could be catastrophic. Remember also that contaminated wastes such as oil-containing solvents may make recovery difficult and will lead to increased disposal costs.

Your waste

Using your list of wastes:

- Mark on a site plan where waste is produced, collected, stored and treated.
- Are there any opportunities for segregation?

Waste Exchange

There are several types of organisations that may be able to take a wide spectrum of your commercial and/or industrial waste streams:

Commercial Recycling/Recovery Companies

There are long established markets for many wastes e.g. scrap metals and paper though increasingly new companies are establishing markets for specialist wastes e.g. electronics and plastics, not traditionally recovered.

Waste Exchanges

Increasingly and often through partnerships, local and national waste exchanges are forming. These provide a forum in which companies can advertise and view specific waste streams with a view to finding a mutually beneficial exchange partner.

The “Non-Profit” Sector

In many areas of the country “non-profit” or charitable organisations will take wastes for a variety of end uses from clothing and fabrics to furniture and plastics. Local Authorities increasingly operate Scrap Stores, which provide learning materials for schools from local companies wastes.

Contact details for waste materials with a traditional market are easily found in local business directories e.g. Yellow Pages. In recognition of the difficulty in identifying a supplier for newer commercial waste streams both government and non-government organisations are compiling ‘Recycling Directories’. Your Local Authority recycling officer or Environment Agency Office should be able to provide some guidance for the waste streams listed below:

- Oils/Fats
- Batteries
- Office Supplies
- Solvents
- Electronics
- Fluorescent Tubes
- Plastics
- Paints
- Green/wood Wastes
Step 4  Managing waste on site

This section contains practical guidance on managing wastes on site. It is important to ensure that environmental legislation is not being, or likely to be, breached by poor waste management. For example, a leak of liquid waste into a watercourse would be a breach of both the Duty of Care and the Water Resources Act 1991. Groundwater regulations came into force on 1st January 1999 and aim to prevent pollution of groundwater by controlling discharges or disposals of certain dangerous substances.

Your waste

Make a list of all your waste storage and treatment facilities:

- Do they require authorisation or a licence?

Some waste processing activities may require an authorisation from the Environment Agency or your Local Authority, depending on the type and scale of the activity. The storage of some types of wastes also requires a licence. Check with the Environment Agency or your Local Authority if you have any doubts.

Responsibility

Whether a company has 5 or 500 employees, a nominated individual should have overall responsibility for waste management. All employees should be aware of the responsibilities of this individual, and employers should ensure that the nominated waste manager is given suitable training and support.

Marking of wastes

Once the nature of wastes has been identified and the suitability of segregation and recycling established, containers and areas may need to be set aside for specific waste streams. Labelling is especially important to identify which containers are used for particular wastes. Signs should also specify what wastes should not be put into containers. Where permanent notices cannot be attached to receptacles or to an adjacent wall, removable hanging signs should be used.

Skip audit highlights the costs of waste

One company which was paying £6,500 per year to dispose of its waste carried out a skip audit to identify the value of materials being disposed of. An assessment of all waste arising for a typical week demonstrated that the true cost of waste was in the region of £100,000 per year - a sum equivalent to half the profit of the business!

Control of skip contents

It is important to prevent wastes being put into the wrong place. Lockable skips should be used to prevent the unauthorised deposit of waste, particularly where skips are located in a publicly accessible area. The key holder could act as skip monitor to vet materials before disposal.
Burning of waste

The burning of waste on site is illegal unless it is carried out in accordance with waste management licensing requirements and Local Authority air pollution controls.

Safe storage of wastes

Steps must be taken to prevent waste escaping. This means preventing waste and litter from blowing off site and waste escaping into the ground. Litter is not only unsightly but polluting. It is recommended that skips are netted and waste storage areas enclosed to prevent litter being blown out. Additionally, measures are needed to protect waste from scavenging by vandals, children or animals.

To minimise leakage, wastes must not be kept in corroded, worn or damaged containers. The type of container used should be appropriate for the waste it is to contain. Metal drums are not always suitable for acid wastes and open-top clip drums are not suitable for liquid wastes. Don’t overfill containers - space needs to be left in the top of drums to allow expansion of the contents during transport and storage. Wherever possible, chemicals should be in their original containers to avoid the danger of incompatible chemicals mixing.

Detailed guidance on drum storage is available from the Environment Agency in the form of Pollution Prevention Guidelines - (PPG 26) Tel. 08459 333111

All wastes and waste containers must be situated so that they do not constitute a risk of pollution from leaks and spillages to surface water or foul drains. Small bunded areas are a good idea, with ramped kerbs to enable vehicular access where necessary.

Risk reduction of storage locations should entail:

for liquid wastes (eg oils, solvents):

- Siting tanks in bund walls on an impervious base. The bund wall needs to be impervious to the substance contained in the tank (note: breeze blocks are not impervious to oil unless suitably coated);
- Making sure that valves and pipes are contained within the bunded area;
- Making sure that the bund has no drain which would allow liquids to escape;
- Not overfilling tanks, and checking the amount in the tank before adding more;
- Clearly marking containers and pipework with details of the contents.
- After rainfall, check that water has accumulated in the bund - if it hasn’t the bund isn’t working properly!

for swarf skips and refuse compactors:

- Siting within a raised kerb area and preferably covered, as they often leak causing pollution of surface and groundwaters. Leakage should be cleaned up using sand or absorbent material.
Physical treatments

Waste volumes can be reduced by the use of compactors. Compacting waste into an enclosed skip reduces the number of movements, lowering haulage costs. Compaction is not, however, waste minimisation. Care must be taken to prevent the leakage of liquids during the compaction process. Some forms of waste treatment and compaction may be subject to waste management licensing requirements; check with the Environment Agency.

Your Waste

For each point of waste storage and treatment:

- Check areas and containers are suitably marked.
- Fit locks where appropriate.
- Nominate a skip monitor to hold keys and be responsible for waste.
- Assess the risk of spillage and leakage from waste storage areas (for example windblown papers, dust, liquid, odour)
- Can waste escape during transportation?
- Where will it be taken?
- What controls (technical/procedural) are required?

Staff training

Introduction of good waste management practice and procedures is the first step, but to be effective employees must be trained.

Training may be needed to increase awareness and modify existing practices so that waste is handled correctly.

See page 15 and the sourcebook for information on how to involve staff and contacts on training opportunities.

HINT

The Environment Agency has produced a FREE Pollution Prevention Pays pack containing a video, leaflet and poster with simple guidelines to help industry prevent pollution. To obtain a copy please telephone 08457 337700.
Step 5 Managing waste off site

Among other duties previously discussed, the Duty of Care requires each person to take all reasonable measures to ensure that waste is only transferred to an authorised person, or to a person for authorised transport purposes, with an accompanying description which enables subsequent holders of the waste to fulfil their Duty of Care with regard to that waste.

Who is an authorised person?

Section 34(3) of the Environmental Protection Act lists authorised persons who, generally speaking, will be one of the following:

- a waste collection authority;
- someone who is the holder of, or who has an exemption for, a waste management licence;
- someone who is registered as a carrier of controlled waste;
- someone who has an exemption for registration as a carrier of controlled waste (for example, producers who carry their own waste do not need to be registered - unless the waste is construction and demolition waste).

What are authorised transport purposes?

Authorised transport purposes include:

- transport within the same premises
- imports and exports.

For details of the regulations governing the trans-frontier shipment of waste, contact the Environment Agency.

Carriers of waste

It is the responsibility of waste producers to ensure that their waste is handled by an authorised person. When passing waste to a carrier it is advisable to check the registration details. Copies of registration certificates can be obtained from the Environment Agency. If a carrier claims exemption from registration, it is especially important to establish that they are actually exempt.

It is equally important to know where the waste is going to, and to be satisfied that the waste will not escape en route to its destination. This can involve covering skips and containers, adequately securing drums and taking any other necessary measures to prevent spillage.
Containers

All waste “empty” containers sent off site for disposal or reconditioning should actually be empty, otherwise their contents must be fully described on the transfer note or waste description. If containers contain hazardous materials then they may need to be classified as special waste. If in doubt seek advice.

Selecting a waste contractor

Local and national directories (such as The Environmental Services Association Directory) provide information on waste management and recycling contractors. See the Sourcebook for details. Take care to ensure that selected contractors comply with legal requirements.

Transfer notes and written descriptions

Waste producers are required to make records of all wastes consigned and to keep those records available for inspection. The controlled waste transfer note must be filled in and signed by both the transferer and transferee. An example transfer note is provided on page 64.

TRANSFER NOTES & WRITTEN DESCRIPTIONS

Among other things, the transfer note must state:

(a) the quantity of waste transferred (preferably the weight);
(b) how it is packed - whether loose or in a container;
(c) if in a container, the kind of container.

There must also be a written description of the waste. The written description must provide enough information to enable subsequent holders to avoid mismanaging the waste. This may be provided separately or combined with the transfer note.

Copies of documents must be retained for at least two years. Details of waste movements should be included as part of a Management Information System to allow annual costs to be measured and to set budgets.

Checking up at the disposal site

It is good practice to periodically check sites receiving waste to ensure that waste is being dealt with satisfactorily and that the site holds a relevant waste management licence or exemption.
Good practice

It is good practice to maintain a waste management file to store all relevant information such as transfer notes. Filling in a table similar to the one opposite will permit information to be accurately and clearly recorded.

Your waste

- Review your Duty of Care practices against the Code of Practice.
- Check the registration of your waste carriers.
- Check the licences of your waste management contractors.
- Ensure that you keep your waste transfer notes for a minimum of two years. (Note: consignment notes for special wastes must be kept for a minimum of three years).
- Keep a waste management folder, to make your job easier.
- For obligated businesses under the Packaging Regulations, packaging flow data and evidence of compliance including PRN’s (Packaging Waste Recovery Notes) should be kept for four years.
<table>
<thead>
<tr>
<th>Type of waste</th>
<th>Source/manager</th>
<th>Container and location</th>
<th>Carrier registration (Reference no. and date of expiry)</th>
<th>Destination (licence seen)</th>
<th>Site audit</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food Waste</td>
<td>Canteen</td>
<td>6m³ skip W4</td>
<td>LDK 742 / Oct '02</td>
<td>Joe's Landfill</td>
<td>Jan '01</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Goods Inwards</td>
<td>26m³ skip W4</td>
<td>Recycle-it</td>
<td></td>
<td>Jun '99</td>
<td></td>
</tr>
<tr>
<td>Cardboard</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Duty of Care: Controlled Waste Transfer Note

## Section A - Description of Waste

1. Please describe the waste being transferred:

   - [ ] Loose
   - [ ] Sacks
   - [ ] Skip
   - [ ] Drum
   - [ ] Other

2. How is the waste contained?

   - [ ] Loose
   - [ ] Sacks
   - [ ] Skip
   - [ ] Drum
   - [ ] Other

3. What is the quantity of waste (number of sacks, weight etc):

## Section B - Current Holder of Waste (Transferor)

1. Full Name (BLOCK CAPITALS)

2. Name and address of Company

2. Which of the following are you? (Please one or more boxes)

   - producer of the waste
   - importer of the waste
   - waste collection authority
   - waste disposal authority (Scotland only)

   - [ ] holder of waste disposal or waste management licence
   - [ ] exempt from requirement to have a waste disposal or waste management licence
   - [ ] registered waste carrier
   - [ ] exempt from requirement to register

   - Licence number:
   - Issued by:
   - Give reason:

   - Registration number:
   - Issued by:
   - Give reason:

## Section C - Person collecting the waste (Transferee)

1. Full Name (BLOCK CAPITALS)

2. Name and address of Company

3. Which of the following are you? (Please one or more boxes)

   - waste collection authority
   - waste disposal authority (Scotland only)

   - [ ] authorised for transport purposes
   - [ ] holder of waste disposal or waste management licence
   - [ ] exempt from requirement to have a waste disposal or waste management licence
   - [ ] registered waste carrier
   - [ ] exempt from requirement to register

   - Licence number:
   - Issued by:
   - Give reason:

   - Registration number:
   - Issued by:
   - Give reason:

## Section D

1. Address of place of transfer/collection point:

2. Date of transfer:

3. Time(s) of transfer (for multiple consignments, give “between” dates):

4. Name and address of broker who arranged this waste transfer (if applicable):

5. Signed:

   - [ ] Transferor
   - [ ] Transferee

   - Full Name:
   - (BLOCK CAPITALS)
   - Representing:

   - Signed:
   - (BLOCK CAPITALS)
   - Representing:

Source: The Duty of Care - a code of Practice 1996
POLLUTION PREVENTION & CONTROL

Preventing water pollution

All industrial sites pose a potential threat to our natural water environment.

Spillages occur throughout the country every day - sometimes devastating wildlife habitats, killing fish and destroying the invertebrate life on which fish and many other animals feed.

**POLLUTION FACTS**

- Just one litre of solvent is enough to contaminate 100 million litres of drinking water (that’s equivalent to approximately 50 Olympic sized swimming pools).
- Oil is a particularly harmful pollutant. One gallon of oil can cover an area of water the size of two football pitches.
- In 1999 there were over 14,000 substantiated water pollution incidents in England and Wales.

Most water pollution incidents are avoidable. Careful planning of procedures and facilities can reduce the risk of spillage, and simple precautions can prevent a spillage becoming a pollution incident. Most of the measures needed to prevent pollution cost very little, especially if they are included at the design stage. In contrast, the costs of cleaning up a pollution incident can be very high. Moreover, pollution prevention measures may offer substantial economic benefits. These include saving expensive raw materials and products, fewer site accidents, and a reduced risk of prosecution for water pollution offences and liability for clean-up costs. Introduction of pollution prevention measures is the first step, but to be effective employees must be trained in their implementation.

**Site Drainage**

On most sites there are 2 types of drain which must be kept separate:

*The foul water drain* is designed to carry contaminated waste water safely to a sewage works for treatment. Prior agreement from your water company is required before connection to the foul water system.

*The surface or clean water drain* is designed to carry only uncontaminated rainwater as it will lead directly to a local river, stream or soak-away. This includes most road drains.

Problems arise when wrong connections allow pollution to enter the surface water drain.
- Drains should be clearly identified by colour coding all manhole covers and drainage grids. Foul water drains should be painted red and surface water blue and all staff should be made aware of the colour-coding.

- A comprehensive drainage plan of your site which identifies all drains should be available. Key staff should be familiar with the plan and have easy access to it.

- It is important to ensure that there are no wrong connections above or below ground. For example, sinks in a manufacturing or processing area will often be used as a convenient means of waste disposal. It is therefore essential to ensure that sinks are correctly connected to the foul water system.

**Deliveries**

Special care should be taken during deliveries, particularly when hazardous substances and materials are being handled. Deliveries should be supervised at all times.

Establishing safe procedures and making someone responsible for supervising deliveries can help avoid spillages - preventing damage to the environment and saving valuable raw materials.

- Prior to delivery double check storage tank levels to prevent overfilling.
- Label all storage containers with the nature and volume of their contents.
- Ensure that all storage tanks are well designed and constructed. Tanks sited above ground should have bund walls to contain any spillage.
- Put contingency plans in place in case of accidents and make sure that all staff are aware of what to do in the event of a spillage or other accident.
- Ensure all loading and unloading areas are clearly marked and isolated from the surface water drain.
- Install catch pits or sumps with isolating values at delivery points.
- Fit automatic cut-off valves on delivery pipes to prevent spillages due to over filling.
- Wherever possible, site pipelines above the ground where they are accessible. If a pipeline has to be installed underground, it should be placed in a protective sleeve or duct and regularly inspected and tested for damage, corrosion and leaks.
- Always ensure that a stock of absorbent materials are available to mop up small spillages.
Storage

Bulk storage of oil and chemicals is becoming increasingly common and represents a major threat to the water environment. Whilst the potential for accidental spillage is at its greatest during deliveries, storage facilities also pose a risk, so be prepared at all times and ensure they are appropriately bunded.

Oil separators (also known as interceptors) should be installed on any surface water drains which could be at risk.

- Regularly check the bund walls are secure. The wall and floor must be impermeable to the material stored in it and there should be no drains or valves.
- Ensure that overflow pipes on all tanks discharge within the bunded area.
- Always store drums within a bunded area - preferably roofed.
- Regularly pump out any rainwater which may have collected within the bunded area. This water may be contaminated and should be disposed of with care.
- To prevent pollution, oil separators (or interceptors) should be installed on any surface water drain which could be at risk - particularly in fuelling and lorry parking areas.
- Make sure that water containing detergents is prevented from draining into oil separators.
- Consider security measures to guard against vandalism and theft. Lockable valves should be fitted on all storage tanks, fences should be secure and doors and gates kept locked. Where possible, materials should be stored under cover.

Cleaning

All cleaning agents are potentially polluting. Do not allow yard or parking areas to be cleaned by hosing to the surface water drain.

- Washing operations should be carried out in designated, kerbed areas which drain to the foul sewer.
- No detergents are suitable for discharge to surface drains, even those described as ‘biodegradable’.
- A detailed guidance note for the use of pressure and steam cleaners (Ref: PPG13) is available from the Agency.
Groundwater pollution

Pollutants like oil, solvents and chemicals can seep through the earth and contaminate groundwater - a vital source of drinking water. In particular, chlorinated solvents are the most widespread and severe cause of groundwater pollution. It is essential that this type of pollution is avoided, as once groundwater has become contaminated, it is very difficult and expensive to clean up.

Under the Groundwater Regulations which came into force in January 1999, ‘List 1’ substances (e.g. solvents, hydrocarbons, mercury) must be prevented from entering groundwater. Entry into groundwater of ‘List 2’ substances must be restricted so that no pollution is caused.

For further details about the Groundwater Regulations contact the Environment Agency.

Training

Training plays a crucial role in protecting the environment. Trained and knowledgeable staff can help prevent a pollution incident - saving money and crucial time.

- Develop a site pollution incident response plan to prevent and mitigate damage to the environment caused by fires or spillages.

- Display the Environment Agency’s emergency hotline number prominently (0800 80 70 60) so that time is not wasted before expert help is on the scene of a spillage, accident or other pollution incident.

- If possible, give staff personal responsibility for regular checking of pollution prevention devices and procedures.

- Ensure that all staff are aware of the importance of protecting the water environment and the efforts your company makes on site to prevent pollution.

FREE TRAINING MATERIALS & GUIDANCE

To obtain a FREE copy of the Agency’s “Pollution Prevention Pays” awareness training video and other pollution prevention materials ring 08457 337700.

To report any environmental incident call Freephone 0800 80 70 60, 24 hours a day
Air Quality Management

Air pollution is the most widespread form of pollution and impacts at local, national and global levels to affect human health and well-being, vegetation, crops, wildlife, buildings and other materials, and the world’s climate.

As the environmental impacts of air pollution are becoming better understood, so legislation is changing to control, reduce and prevent it.

Examples of changes which have already impacted on everyday life include the switch to unleaded petrol and the change to CFC-free aerosols. The many rigorous controls on industry which apply to emissions to air range from general controls which apply to all businesses to very specific controls which apply to individual processes.

Urban air quality has been identified as a key issue for government environmental policy. Standards and targets have been set for nine individual pollutants based on expert opinion. Local authorities and central government have powers to establish plans for delivering air-quality objectives wherever air quality is at risk.

Standards have been set for the following pollutants, which can affect human health and well-being:

- lead (hence the reduced cost of unleaded petrol);
- benzene, polycyclic aromatic hydrocarbons (PAH) and 1,3 butadiene (especially from petrol vapour emissions);
- sulphur dioxide, carbon monoxide and nitrogen dioxide, especially from all combustion processes (industrial, domestic and transport related); particulates from diesel combustion and powder handling, among others;
- ozone (which at ground level is damaging to health), produced by the reaction of nitrogen dioxide (and other oxides of nitrogen) with volatile organic compounds (VOCs, a group which includes many common industrial solvents) in the presence of sunlight.

Improvements to air quality are being sought by a combination of controls on different sources. There are also historical controls on smoke and nuisance emissions from industry. These controls can be summarised as general controls which apply to all companies and activity-specific controls which relate to specific manufacturing activities.
General controls on business

a) Nuisance

Part three of the Environmental Protection Act 1990 controls potential nuisance from industrial sites. Nuisance is a complicated area of law, but covers dust emissions, odour, noise and smoke. The legislation applies to all businesses.

b) Dark smoke

Under the Clean Air Act of 1993, the emission of dark smoke is specifically prohibited from the chimney of any building or any other chimney which serves the furnace of any boiler or industrial plant.

Activity specific controls

Local air pollution control (LAPC)

This covers emissions to air only and captures a wide range of process including vehicle respraying, pet-food manufacturers, coating, waste-oil burners and a wide variety of other industrial processes. Each process requires an authorisation from the Local Authority in which it is situated. A range of process guidance notes set out the pollution prevention techniques which should apply on a process-by-process basis. Companies should use the “best available techniques not entailing excessive cost” (BATNEEC) to meet emission limits.

Integrated Pollution Control (IPC)

IPC applies to more major polluting industries and covers emissions to air, water and land from these. The term integrated is used to highlight the fact that the “best practicable environmental option” (BPEO) should be used - for example the knock on environmental effect of scrubbing air pollution out of exhaust gases to produce an aqueous contaminated effluent should be considered.

IPC authorisations are issued by the Environment Agency which will specify the conditions which will apply to the process.

IPC will be phased out over the next 6 years as the Integrated Pollution Prevention and Control (IPPC) regime is implemented (see section on IPPC below).

Solvent management

One area of particular concern for industry is the emission of Volatile Organic Compounds (VOCs) from industrial processes. VOCs are a group of compounds which are used as solvents, cleaning agents and chemical reactants in many processes. As well as contributing to photochemical smogs, some of these are ozone-depleting chemicals and can also be greenhouse gases.
There are many methods available for reducing VOC emissions, depending on the type of process. These include:

- the use of low solvent and water-based paints and cleaning agents;
- the use of more efficient paint transfer techniques, reducing overspray and bounceback;
- the use of fully enclosed degreasing machines.

**HINT**

Envirowise has produced several guides and case studies giving assistance with implementing cost effective solvent reduction measures.

*Call the Environment & Energy Helpline on 0800 585 794*

**Transport**

Emissions from transport pose the most widespread threat to air quality. As well as technological changes to limit pollution through cleaner fuels and catalytic convertors, there are many actions which can be taken to reduce emissions through more efficient transport operations, including:

- driver training - this will reduce fuel consumption, wear and tear and accidents;
- regular maintenance of vehicles;
- efficient planning and scheduling of deliveries and journeys.

**Integrated Pollution Prevention and Control (IPPC)**

The Pollution Prevention and Control (England and Wales) Regulations came into force on 1st August 2000.

The IPPC Directive is designed to prevent, reduce and eliminate pollution at source through the prudent use of natural resources. It is intended to help industrial operators move towards greater environmental sustainability.

Many of our larger industries are already familiar with the UK system of Integrated Pollution Control (IPC) legislation. Although the Directive builds on this legislation, it would be wrong to view it as IPC with an added “P”. Like IPC, it covers emissions to air, land and water as well as heat. But IPPC goes further and covers a wider range of processes. The aim of IPPC is to protect the environment as a whole.
Which activities are covered?

The Directive covers installations where one or more of the following categories of activities (subject to certain capacity thresholds) are carried out:

- Energy industries - eg power stations, oil and gas refineries
- Production and processing of metals - ferrous and non-ferrous
- Mineral industry - eg cement works, glass works
- Chemical industry - organic, inorganic, pharmaceuticals
- Waste management - eg landfill sites, incinerators
- Other activities - paper/board, tanneries, slaughter houses, food/milk processing, animal carcass disposal, intensive pig/poultry units, organic solvents users.

Operators will need to show that they will run their installations in a way that prevents emissions to the air, land or water or, where that is not practicable, reduces them to a minimum. In doing this, operations must apply on the following general principles:

- use Best Available Techniques to prevent pollution;
- minimise waste and recycle it where they can;
- use energy efficiently;
- prevent accidents and limit their environmental consequences;
- return the site to a satisfactory state after operations cease;
- have effective management systems in place.

“Best Available Techniques” are those that prevent or minimise pollution, can be implemented effectively and are economically and technically viable while meeting the overall aims of the Directive.

Full details about IPPC can be obtained from the Environment Agency’s web site: www.environment-agency.gov.uk
ENVIRONMENTAL ISSUES

This section gives an overview of environmental issues. Many issues revolve around society’s use of resources and the creation of waste. Consumption of goods is increasing more rapidly than the population, and every product has some impact on the environment during its life cycle. We need to address these pressures on the environment through better use of resources in economic activities, investment in cleaner technologies, more resource-efficient lifestyles and demand management.

The burden exerted by our society, our ‘footprint’, reaches beyond England and Wales as we depend on the rest of the world to meet some of our needs for food and other consumables. We need to consider the impact of our demands on the global environment.

Climate change

Climate change occurs naturally but its rate is influenced by greenhouse gas emissions from human activities. There is increasing evidence, recognised by the Intergovernmental Panel on Climate Change, of global warming over the past century. Rising sea levels and changes in temperature and rainfall patterns, including a greater frequency of extreme weather, are likely to increase the risk of flooding, put pressure on water resources, seriously harm wildlife and change conditions for agriculture. The UK should be able to adapt to such changes, at some cost, but many poorer nations could be devastated.

Greenhouse gas emissions are dominated by carbon dioxide from fossil fuel combustion. Energy uses in transport, industry, services and homes all contribute. Improved energy efficiency has reduced the emissions from industry, but energy use in the other sectors has increased. The move from coal to gas-fired electricity generation helped to reduce UK emissions slightly during the 1990s but energy savings are needed to keep emissions down. Other greenhouse gases include methane, of which about a quarter comes from landfilled biodegradable waste (e.g. paper and card, food, garden waste).

There are UK targets to reduce the amount of biodegradable waste sent to landfill. The UK has an international commitment and a Climate Change Programme to reduce its greenhouse gas emissions by 12.5 per cent between 1990 and 2010, with a domestic goal of cutting carbon dioxide by 20 per cent over the same period. In the longer term much greater action is needed globally to stabilise greenhouse gas concentrations.

Stratospheric ozone depletion

The ‘hole’ in the stratospheric ozone layer, first discovered in Antarctica, now occurs annually over the northern hemisphere, with ozone thinning as far south as the UK. The resulting increase in harmful ultraviolet radiation reaching the Earth’s surface increases the risk of skin
cancers in humans and may affect wildlife. The Montreal Protocol and its amendments are phasing out the production and use of CFCs, HCFCs and other chemicals which promote ozone destruction. This may allow the ozone layer to recover within around 50 years. The speed of progress depends on how efficiently ozone depleting substances are recovered from industrial processes and equipment such as refrigeration and fire-fighting apparatus.

**Acid rain and nitrogen enrichment**

Sulphur dioxide and nitrogen oxide emissions from fossil fuel combustion in power stations, transport and elsewhere, form acidic deposition (“acid rain”) which also has a high nitrogen content. This has caused extensive acidification of soils and fresh waters in the uplands of northern and western Britain, around 40 per cent of the land area. Populations of salmon, trout and other aquatic life have been particularly affected by the increased acidity. The excess nitrogen inputs cause nutrient enrichment which has adversely affected mosses, lichens and heather in Cumbria, the Pennines and the Brecklands of East Anglia. Power station and road vehicle emissions are being reduced and the area of the UK receiving pollutant deposition at damaging rates should fall to about 10 per cent for acidity and one per cent for nitrogen by 2010. The actual recovery of ecosystems will be much slower.

**Air quality**

Poor air quality may bring forward between 12,000 and 24,000 deaths annually in the UK. The Government’s Air Quality Strategy sets air quality objectives for human health to be met over the next few years. In 1999 air quality in urban centres failed these objectives on one day in 12 on average, mainly due to fine particles and ground-level ozone (nitrogen dioxide also failed the annual standard in many sites). In rural areas the objectives were not met on one day in eight on average, mainly as a result of high ozone levels (ozone is a secondary pollutant formed mainly from emissions of nitrogen oxides and volatile organic compounds (VOCs)).

Road transport is the biggest source of air pollution in urban areas with contributions from industry. Emissions are being reduced but the objectives for particles and ozone will be difficult to meet over the next ten years because of the diversity of sources, the cost of reducing VOC emissions, and the contribution of sources in mainland Europe. As well as the eight pollutants addressed by the Air Quality Strategy, there are numerous others whose effects are not well understood, for example heavy metals and organic chemicals.

**Soil and land quality**

In the UK, human activity has changed the landscape from woodland to one dominated by agriculture. The land is intensively used for growing food, building houses and industries, and for transport. Urban areas cover ten per cent of the land - four per cent more than in 1945. At this rate, a fifth of England and Wales could be urban by the end of the 21st century. An area of land larger than Greater London is thought to be contaminated. To reduce pressures on greenfield sites, areas of derelict and contaminated land need to be brought back into use. The Government has set a target for 60 per cent of new houses to reuse previously developed land by 2008. Planning guidance issued in 1993 should curb the growth in out-of-town developments.

We know very little about the quality of our soils, although there is some indication that they are deteriorating. Acidity has increased under many grassland soils and both arable and grassland soils show a substantial decline in organic carbon (essential for water retention, nutrient cycling and resistance to erosion). Soil loss by erosion has increased with changing farming practices. Some practices, for example landspreading of manures and slurries, are beneficial, but regulations seek to ensure that landspreading of waste is only done where it
benefits the environment. Future protection for soils will depend on farming practices and the value that society attaches to the soil. Both of these are very uncertain and there is an urgent need for a national soil protection strategy.

**Water quality**

River quality has improved over the past decade as a result of investment to clean up sewage and industrial effluents, but about eight per cent of rivers in England and Wales remain of bad or poor quality and others are affected to a lesser extent. Groundwaters, which are an important source of drinking water, can be contaminated by a range of industrial and agricultural chemicals, making them expensive to treat. Contaminants are also carried by rivers or discharged directly into estuaries and coastal waters putting marine life at risk.

Water is polluted by direct discharges from industry and sewage treatment works, by diffuse run-off from urban areas and farmland, by percolation into groundwaters, and by accidental spills. There were nearly 14,500 incidents in England and Wales in 1999. One-third of incidents are caused by industry, and include oil, fuel and chemicals from leaks, spills, contaminated site run-off and discarded materials. The UK is committed to reducing releases of harmful substances so that concentrations in the marine environment are near natural levels or close to zero for synthetic substances by 2020. A continuous improvement in the management of hazardous chemicals is necessary, including reduction and elimination where possible.

**Wildlife**

Many habitats have been lost or damaged and the plants and animals associated with them have become rare, threatened, and in some cases extinct. This has been caused by a range of factors including the intensification of farming over the past 150 years, building homes, roads and other developments, and pollution. For example, only one-sixth of the heathland present in 1800 in England now remains. Some woodland and farmland birds and small mammals have shown serious declines in numbers due to habitat changes, lack of food (linked to loss of insects and seeds through agricultural intensification) and competition from non-native species. Other species, such as some sea birds, otters and certain butterflies have increased in number or expanded their range.

Some 391 species and 45 habitat types have been identified as priorities for the UK Biodiversity Action Plan. The remaining area of these habitats will be protected from further loss and action taken to improve their condition; in many cases a target has been set to create a small additional area of the habitat. Similarly, listed species will be protected and steps taken to increase their numbers. Protection of other habitats and species of local value depends on the planning system, good practice by industry and farmers, and conservation initiatives supported by local businesses, agri-environment grants, voluntary groups and others.

**Use of natural resources**

More people and greater consumption of products and services are making increasing demands on the Earth’s natural resources. We are using more resources and creating more waste than ever before. Some natural resources, such as wood, and water are renewable, but the availability of other resources, such as oil, gas, peat and aggregates is finite. Society today must use natural resources more wisely to ensure that future generations are able to meet their needs.

About 400 million tonnes of waste is produced in England and Wales each year. Of this, industry, commerce and households produce 106 million tonnes. The rest is made up of construction and demolition wastes, agricultural wastes, mining wastes, sewage sludge and
dredged spoils. Municipal waste amounted to 28 million tonnes in 1998/99, up from 25 million tonnes in 1995/96, an increase of three per cent per year. Most waste is landfilled creating a range of environmental impacts, and we are running out of landfill capacity. The Waste Strategy for England and Wales is aiming to reduce waste and to improve waste management according to the ‘Best Practicable Environmental Option’ for each waste stream. This requires a substantial shift towards less waste, recycling and recovery of materials, and away from landfill (except where it is the best option).

Industry, businesses and households must share responsibility for the more efficient use of resources and waste minimisation. For example, water companies have targets to reduce leakage. The Government has set a target for five per cent of electricity to come from renewable sources by 2003, primarily to help reduce greenhouse gas emissions. There are targets to increase the use of secondary and recycled aggregates to reduce the need for quarrying and its associated environmental impacts. Using composted organic waste provides a peat-free alternative for gardens, reduces the landfilling of biodegradable material (which releases methane, a greenhouse gas), and protects the remaining peatland habitats which have been reduced by 94 per cent over the past 200 years.

Flood risk

Flooding can damage property and farmland and put lives at risk. Nearly five per cent of people and 1.3 million properties are at risk from flooding in England and Wales. By building on land in the natural floodplain and covering more land with hard surfaces, society has increased the likelihood and impacts of flooding. On average there have been 54 major flooding incidents each year in England and Wales between 1989 and 1997, although this varies greatly from year to year. Climate change is likely to worsen the risks of flooding from both rivers and rising sea levels.

Without flood defences, seven per cent of the land in England and Wales is at risk from river floods once every hundred years. Nearly 5,000 square kilometres of land (1.5 per cent) are below sea-level and protected from sea flooding by natural or artificial defences, including over half of our best quality agricultural land. Although more sustainable designs of defence are being introduced many hard defences have damaged natural habitats.

Quality of life

Quality of life is related to all the issues outlined above but includes factors which affect how we feel about the environment such as noise, litter and landscape quality. It also includes social and economic issues such as health, unemployment, crime and access to facilities. More homes and out-of-town development have benefited some but have increased urban sprawl and levels of traffic with consequences for the quality of both rural and urban life. Most people live in urban areas but many inner-cities are areas of social exclusion and offer only a poor quality of life. About three-quarters of pollution arises in urban environments, roughly 45 per cent from buildings and 30 per cent from transport. There has been a significant loss of tranquillity across much of England and south Wales.

The projected number of new homes for England and Wales is four million in the next twenty years. More people want to live in rural areas, taking up greenfield land, creating more traffic and altering the character of the countryside. Towns and cities need to become places where people want to live. Investment is needed to regenerate urban areas, for example by improving public transport and cleaning up the environment. Local businesses and industries need to be good neighbours by minimising noise, dirt and dust, intrusive lighting, pollution and litter. The social, economic and environmental benefits are interrelated and encapsulated in the idea of sustainable development.
ENVIRONMENTAL SOURCEBOOK

Contacts

British Standards Institution (BSI)  
389 Chiswick High Road, London W4 4AL  
Specifications and guidance on ISO14001 and other standards  
020 8996 7000  
e-mail: info@bsi.org.uk  
www.bsi.org.uk

Building Information Warehouse  
Free impartial advice on energy and environmental issues,  
buildings database of online information  
www.biw.co.uk

Building Research Establishment Enquiries Bureau (BRECSU)  
Information on building design and energy efficiency  
01923 664258

Business in the Environment (BiE)  
Aims to inspire business to achieve corporate social responsibility  
by making continuous progress towards environmentally sustainable  
development an essential part of business excellence  
020 7224 1600  
fax: 020 7486 1700

Business Link  
Network of business advice centres providing general business  
support, advice and information on environmental management  
0800 500 200  
www.businesslink.co.uk

Chartered Institute of Purchasing and Supply  
Provides information on building environmental considerations  
into purchasing decisions  
01780 756777  
fax: 01780 751610  
www.cips.org

Confederation of British Industry (CBI)  
Centre Point, 103, New Oxford Street, London, WC1A 1DU  
Provides a range of publications on environmental issues.  
Best business practice programme available  
020 7379 7400  
fax: 020 7240 1578  
www.cbi.org.uk

Department of the Environment, Transport and the Regions (DETR)  
020 7944 3000  
www.detr.gov.uk

Department of Trade and Industry (DTI)  
020 7215 5000  
www.dti.gov.uk

Energy Efficiency Best Practice Programme  
The Energy Efficiency Best Practice Programme, is a UK  
Government Programme designed to help organisations cut energy  
bills by 10-20%. Over 450 free publications, videos and software available  
0800 585794  
www.energy-efficiency.gov.uk/

Energy Design Advice Scheme  
University of Sheffield, Floor 13, The Atra Tower, Sheffield,  
S. Yorks, S10 2TN  
Provides access to advice on energy-conscious design and minimisation  
of environmental impact  
0114 272 1140  
www.energyweb.net

Energy from Waste  
26, Spring Street, London, W2 1JA  
Promotion of energy from waste, best practice, and endorsement  
of the principles of integrated waste management  
020 7976 0036  
fax: 020 7402 7115  
e-mail: info@efw.org.uk  
www.efw.org.uk

Environment Agency - general enquiries  
Environment Agency Head Office, Bristol  
Email: enquiries@environment-agency.gov.uk  
08459 333111  
01454 624400  
www.environment-agency.gov.uk
Contacts

Environmental Services Association (ESA) 020 7824 8882
154, Buckingham Palace Road, London, SW1W 9TR
Trade association representing waste management companies
fax: 020 7824 8753
e-mail: info@esauk.org
www.esauk.org

Envirowise (formerly Environmental Technology Best Practice Programme) 0800 585794
ETSU, Harwell, Oxfordshire, OX11 ORA
Government programme to help businesses cut costs. Provision of advice and good practice guides on an extensive range of environmental issues
www.envirowise.gov.uk

ENTRUST (Environmental Trust Scheme Regulatory Body Ltd) 0161 972 0044
Acre House, 2, Town Square, Sale, Cheshire, M33 7WZ
Sole regulator of the landfill tax credits scheme. Undertake audits of qualifying organisations to ensure compliance with the Landfill Tax Regulations 1996
fax: 0161 972 0055

Federation of Small Businesses 020 7592 8100
Offers members a range of benefits and services including free legal advice
fax: 020 7233 7899
www.fsb.org.uk

Freight Transport Foundation 01892 526171
Provides information and case studies on reducing the environmental impact of freight transport
fax: 01892 534989
www.fta.co.uk

Groundwork UK 0121 236 8565
A not-for-profit environmental organisation with many local branches offering subsidised services to small businesses including environmental “health checks” and reviews
fax: 0121 236 7356
www.groundwork.org.uk

HM Customs and Excise Landfill Tax Helpdesk 0845 9128 484
Advice and Enquiries Centre, Northern England Customer Services Division, Dobson House, Regent Centre, Newcastle-upon-Tyne, NE3 3PF
fax: 0845 9129 595
www.hmce.gov.uk

Institute of Environmental Management and assessment (IEMA) 01522 540069
Welton House, Limekiln Way, Lincoln, LN2 4US
Environmental management organisation promoting sustainable development by improving competence of individuals and organisations
fax: 01522 540090
e-mail: lincoln@iema.net
www.iema.net

National Society for Clean Air and Environmental Protection (NSCA) 01273 326313
136 North Street, Brighton BN1 1RG
Promotion of clean air through reduction of pollution. Publish a range of materials
fax: 01723 735802
www.nsca.org.uk

The Stationery Office (formerly HMSO) 020 7873 9090 (Orders)
51, Nine Elms Lane, London, SW8 5DR
UK legislation website
www.the-stationery-office.com
www.legislation.hmso.gov.uk

Waste Management Information Bureau (WMIB) 01235 463162
AEA Technology National Environment, F6 Culham, Abingdon, Oxfordshire OX 3DB
National referral centre for information and advice on waste management
e-mail: wmib.org.uk
www.wmib.org.uk

Waste Minimisation Clubs 0845 933 3111
Groups of businesses undertaking waste minimisation programmes
0800 585794

Waste recovery & recycling information
Contact the Environment Agency 0845 933 3111
For details of waste recovery facilities and waste exchange contacts

Waste & Resources Action Programme (WRAP) www.wrap.org.uk
New Government programme set up to promote sustainable waste management
Publications

Her Majesty’s Stationery Office (HMSO) is now known as the Stationery Office. Tel. 020 7873 0011

Energy efficiency

The Energy Efficiency Best Practice Programme produces a wide range of materials including good practice guides, case studies and videos for a wide range of energy saving techniques and technologies. Available from ETSU, telephone 01235 436747. For help on building energy efficiency contact BRECSU on 01923 664258.

Environmental awareness

The Department of the Environment, Transport and the Regions DETR Free Literature
Tel: 0870 1226 236

Engineering Employers Federation guide on the environment for employees (ISBN 0 901700 41 X) from 0207 222 7777. Customer Services Dept, EEF, Broadway House, Tothill Street, London SW1 H 9NQ.

Conservers at Work is a scheme developed by the Environment Council which promotes the benefits of environmental good practice in the workplace through easy-to-use guidance on a range of issues. For further details contact the Environment Council on 020 7824 8411 or write to Conservers at Work, The Environment Council, 21 Elizabeth Street, London SW1 9RP.

Environmental management


*The Office Toolkit* - the guide for facilities and office managers for reducing waste and environmental impact. BRE and PA consulting. BRE Telephone 01923 664462.

*Benefiting Business & The Environment* - case studies of cost savings and new opportunities from environmental initiatives. Institute of Business Ethics.

BS EN ISO 14000 series publications available from BSI: 389 Chiswick High Road, London W4 4AL Tel. 020 8996 7000


A variety of Sector Application Guides giving more detailed guidance is available from trade associations:

British Paper and Board Industry Federation, 01793 886086, Papermakers’ House, Rivenhall Rd, Westlea, Swindon SN5 7BE

British Food Manufacturing Industries Research Association, 01372 376761, Randalls Rd, Leatherhead, Surrey KT22 7RY

Textile Finishers Association, 0161 832 927931, King Street West, Manchester M3 2PF
Financial appraisal of projects

Methods are discussed in detail in the Energy Efficiency Best Practice Programme Good Practice Guide 69, “Investment Appraisal for Industrial Energy Efficiency”. Although the guide refers to energy efficiency projects, the same principles apply to waste minimisation projects.

Another useful guide, which also contains details of how to raise capital, is “Money and Machines - A Guide to Successful Capital Investment in Manufacturing”, published by the DTI.

“Investing to increase profits and reduce wastes” (GG82), is available from the ENVIROWISE and contains case studies from a range of industries.

Government policy

Water resources and Supply: An Agenda for Action (1996)

Integrated Pollution Prevention & Control (IPPC)


IPPC: A Practical Guide. DETR Publications Sales Centre, Unit 21, Goldthorpe Industrial Estate, Goldthorpe, Rotherham, S63 9BL Tel 0870 122 6236


Journals

The ENDS Report 0207 814 5300
Industrial Environmental Management Magazine 0208 651 7100
Environment Business Magazine 0207 393 7597
Packaging waste


Environment Agency National Waste Registration Unit (NWRU). Telephone 020 8305 4036 Fax (for registration packs) 020 8305 4027

The Producer Responsibility Obligations (Packaging Waste) Regulations 1997 and two sets of amendments (1999) are available from the Stationary Office

The Packaging (Essential Requirements) Regulations 1998 S.I 1165 are available from the Stationary Office, price £1.95

Government Guidance Notes for the Essential Requirements are available from; DTI Publications Orderline: Admail 528, London, SW1W 8YT. Tel: 0870 1502 500. Fax: 0870 1502 333

Local Authorities Co-ordinating Body on Food and Trading Standards (LACOTS) P O Box 6, Robert Street, Croydon, CR9 1LG. Tel: 0208 688 1996 Fax: 0181 680 1509 Email: mail@lacots.org.uk Web: http:/www.lacots.org.uk/

Pollution prevention

A number of pollution prevention guidelines are available from the Environment Agency, including a video called “Pollution Prevention Pays”. Tel 08457 337700

Special waste

The Special Waste Regulations 1996 (as amended) SI 1996 No 972 SI 2019, the Stationery Office, £5.60


A *guide to special waste*, Environment Agency 2001 from the Agency’s web site

Sustainable development

*An Environmental Strategy for the Millennium and Beyond* - The Environment Agency

Waste exchange and recycling

The Environment Agency can provide local information on facilities for the recovery and recycling of controlled waste. Contact your local Agency office on 0845 933 3111


Some Local Authorities have a waste exchange scheme and should be able to offer advice on recycling and scrap stores.

Waste Watch www.wastewatch.org.uk The national organisation that educates, informs and raises awareness on waste reduction, reuse and recycling. Operates Wasteline a telephone and postal information service giving people advice on where and what they can recycle and providing ideas for reducing / reusing waste. Wasteline: Tel: 0870 2430136

Waste management guidance


Waste management legislation


The Waste Management Licensing Regulations 1994 SI 1994 No. 1056
(ISBN 0-11-044056-0) available from The Stationery Office, Price £7.35

Waste minimisation guidance

Envirowise (formerly the ETBPP) has published a number of publications that give more detail on waste minimisation programmes, including:

GG25: “Saving Money through Waste Minimisation: Raw Material Use”
GG26: “Saving Money through Waste Minimisation: Reducing Water Use”
GG27: “Saving Money through Waste Minimisation: Teams and Champions”

Full details of Envirowise publications can be obtained from the Environment & Energy Helpline, 0800 585794

Waste Minimisation Guide by Barry Critenden and Stanley Kolaczkowski, published by the Institute of Chemical Engineers (IChemE) (ISBN 0 85295 3429), price £32.50.


WMIT - Waste Minimisation Interactive Tools. A software package to assist with the process of waste minimisation is available from Envirowise, Tel 0800 585794
Waste Minimisation - Getting Staff Involved. A guide to assist organisations to plan and implement a staff awareness programme. Contains examples and information for use in awareness campaigns eg posters. Available from the Environment Agency. Tel. 08457 337700

The Environment Agency has produced a video called “Money for nothing and waste tips for free”. Available free, by ringing 08457 337700.

Water resources and conservation


Environment Agency (1998) Progress in water supply planning: The Environment Agency’ s review of water company water resources plans, Environment Agency (Tel 01454 624 400)

Water use reduction


Saving water on the right track 1, NWDMC Environment Agency (1998) Tel. 01903 832275

Saving water on the right track 2, NWDMC Environment Agency (1998) Tel. 01903 832275

Water Wise 4: Are you pouring your money down the drain? Environment Agency Tel. 01903 832275

Water efficiency publications available from Envirowise (Call the Environment & Energy Helpline - 0800 585794)

Simple measures restrict water costs, GC22
Effluent costs eliminated by water treatment, GC24
Saving money through waste minimisation: Reducing water use, GG26
Water Use in the manufacture of speciality chemicals, EG105
Water use in UK paper and board manufacture, EG69
Reducing the cost of cleaning in the food and drink industry, GG154
Reducing waste for profit in the dairy industry, GG242


Cutting Water and Effluent Costs - John S. Hills

Water Use and Reuse - edited by David Newton and George Solt
Both available from IChemE.

For information on water conservation contact your local water company, the Environment Agency or The Office of Water Services, OFWAT, Central City Tower, 7 Hill Street, Birmingham. Tel. 0121 625 1300.
CONTACTS:
THE ENVIRONMENT AGENCY HEAD OFFICE
Rio House, Waterside Drive, Aztec West, Almondsbury, Bristol BS32 4UD.
Tel: 01454 624 400  Fax: 01454 624 409
www.environment-agency.gov.uk
www.environment-agency.wales.gov.uk

ENVIRONMENT AGENCY REGIONAL OFFICES

ANGLIAN
Kingfisher House
Goldhay Way
Orton Goldhay
Peterborough PE2 5ZR
Tel: 01733 371 811
Fax: 01733 231 840

MIDLANDS
Sapphire East
550 Streetsbrook Road
Solihull B91 1QT
Tel: 0121 711 2324
Fax: 0121 711 5824

NORTH EAST
Rivers House
21 Park Square South
Leeds LS1 2QG
Tel: 0113 244 0191
Fax: 0113 246 1889

NORTH WEST
Richard Fairclough House
Knutsford Road
Warrington WA4 1HG
Tel: 01925 653 999
Fax: 01925 415 961

SOUTHERN
Guildbourne House
Chatsworth Road
Worthing
West Sussex BN11 1LD
Tel: 01903 832 000
Fax: 01903 821 832

SOUTH WEST
Manley House
Kestrel Way
Exeter EX2 7LQ
Tel: 01392 444 000
Fax: 01392 444 238

THAMES
Kings Meadow House
Kings Meadow Road
Reading RG1 8DQ
Tel: 0118 953 5000
Fax: 0118 950 0388

WALES
Rivers House/Plas-yr-Afon
St Mellons Business Park
St Mellons
Cardiff CF3 0YE
Tel: 029 2077 0088
Fax: 029 2079 8555

ENVIRONMENT AGENCY
GENERAL ENQUIRY LINE
0845 933 3111
ENVIRONMENT AGENCY
FLOODLINE
0845 988 1188
ENVIRONMENT AGENCY
EMERGENCY HOTLINE
0800 80 70 60

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