CUTTING COSTS BY CUTTING WASTE: WASTE MINIMISATION FOR ENGINEERING COMPANIES

Engineering Workbook

ET185

The Environmental Technology Best Practice Programme is a joint Department of Trade and Industry and Department of the Environment, Transport and the Regions programme managed by AEA Technology plc through ETSU and the National Environmental Technology Centre.

The Programme offers free advice and information for UK businesses and promotes environmental practices that:

- increase profits for UK industry and commerce;
- reduce waste and pollution at source.

For more information, please contact the Environment and Energy Helpline on 0800 585794 (e-mail: etbppenvhelp@aeat.co.uk; world wide web: http://www.etsu.com/etbpp/).

Prepared with assistance from Symonds Group Ltd.

SUMMARY

All sizes and types of engineering companies can benefit from learning more about where waste occurs in their processes and then taking a step-by-step approach to reducing waste. Using less raw materials, chemicals, oils, water and energy to manufacture goods can:

- save money;
- reduce pollution;
- reduce waste disposal and effluent discharge;
- improve product quality.

Efficient and effective use of raw materials and improved process operations are vital if engineering companies are to remain competitive.

This Workbook is intended to provide busy people in all sectors of the engineering industry with the tools and information they need to implement a systematic programme to reduce waste. The Workbook, which was originally produced to support a workshop, can also be used as the basis for a presentation on waste minimisation.

The financial and environmental benefits of a systematic approach to reducing waste are easily achievable. To be successful, waste minimisation programmes must begin with commitment and active support from senior management. Many companies have found it helpful to appoint a Champion to co-ordinate and facilitate the programme. Involving everyone in the company is another key element for success.

Having obtained commitment, the next stage is to review the existing situation. The assessment phase involves:

- identifying and measuring waste;
- calculating the true cost of waste to your company;
- identifying priority areas for action.

The Workbook contains practical tools to help you get started in your company, including tips, a waste opportunity checklist, example process maps, blank inventories and a data assessment table for ranking options. Industry Examples are used to illustrate the savings that can be achieved through a systematic approach to reducing waste.

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1 INTRODUCTION

This Workbook is intended to help engineering companies of all sizes and types save money by reducing waste. The Workbook, which contains presentation material and exercises prepared originally for a workshop, explains the fundamental principles of waste minimisation. Industry Examples are used to illustrate the benefits that can be achieved by implementing a systematic approach to waste minimisation.

Reducing waste can help engineering companies to achieve cost savings, improve their performance, prevent non-compliance with environmental legislation and reduce adverse impacts on the environment.

The Workbook's concise layout is intended to help people with limited time who wish to:

- gain an understanding of the benefits of waste minimisation;
- take action to reduce waste and thus improve their company's overall performance.

Space is provided for you to make your own notes as you read the Workbook.

The Workbook can also be used to provide source material for a presentation or workshop on waste minimisation in your company. Please use the transparency templates given in the Workbook to prepare your own overheads.

The main objectives of the Workbook are to:

- explain the basics of a waste minimisation programme;
- show how a systematic approach can be used;
- provide you with useful tools and techniques;
- demonstrate how a programme to minimise waste can save money, improve efficiency and safeguard the environment.

Further help and advice

The Environment and Energy Helpline (0800 585794) can:

- Send you copies of relevant publications from the Environmental Technology Best Practice Programme (see Section 9).
- Tell you about environmental and other regulations that could affect your operations.
- Provide free advice and up-to-date information on environmental and energy issues, equipment suppliers and technologies.
- Arrange for a specialist to contact your company if you employ fewer than 250 people, at the discretion of the Helpline manager.

2 WASTE MINIMISATION: WHAT DO YOU NEED TO KNOW?

2.1 KEY ISSUES AND BENEFITS

PRESENTATION TRANSPARENCIES

PLEASE USE THIS SPACE FOR YOUR OWN NOTES

KEY ISSUES AND BENEFITS

- What is waste and waste minimisation?
- Waste management hierarchy
- Systematic approach to waste minimisation
- Financial and wider benefits

Obvious wastes, such as skips and effluent, are easily identified. However, waste is not just discarded materials - it includes wasted time, energy and raw materials. Adopting a systematic approach to waste minimisation brings financial and wider benefits.

WASTE COSTS MONEY

- Waste costs UK industry £15 billion/year
- Waste costs are equivalent to 4.5% of turnover

Waste costs money. At a conservative estimate, the cost to UK industry of solid wastes, liquid effluents, emissions to air and wasted time is over £15 billion/year.

Waste minimisation will save you money - typically up to 1% of business turnover. A £ saved equals a £ of extra profit.

MOST WASTE COSTS ARE HIDDEN

- Raw material/ingredient costs
- Energy use
- Water use
- Effluent generation
- Packaging
- Factory/office consumables
- Wasted time and effort

Your company may not realise the full cost of waste - often only the expense of disposal is appreciated, eg solid waste that appears in a skip. The true cost of waste is often hidden.

WHAT IS WASTE MINIMISATION?

The systematic reduction of waste at source:

- Raw material consumption
- Water and energy use
- Emissions to air, land and water
- Direct use of materials and services

Waste minimisation is more than just the material that ends up in a skip. It covers all aspects of the company. The materials, energy, labour and cost of treatment is often 5 - 20 times the cost of disposal.

By implementing no-cost and low-cost measures, you could reduce your water and effluent costs by 20% or more and your energy bill by 10%.

THE WASTE MANAGEMENT HIERARCHY

- Prevention — *Starting point and best option*
- Reduction
- Re-use
- Recycle
- Treat
- Dispose — *Finishing point and least preferred option*

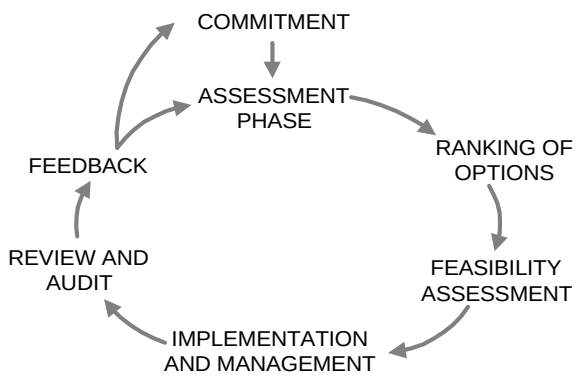
Prevention is better than cure. The nearer waste reduction is to the source, the more cost-effective it becomes. Recycling and treatment cost more and can lead to pollution, while landfilling or discharge usually costs most.

HOW IS WASTE MINIMISATION ACHIEVED?

- Prevention at source
- New process technology
- Re-use and recycling
- Examining supplier and customer links
- NOT end-of-pipe, NOT added costs

For the best long-term benefits look for solutions in the order above.

STEPS IN WASTE MINIMISATION



A systematic approach to waste minimisation begins with top level commitment and the formation of a project team. The next step is to quantify and cost your wastes. The best options for reducing waste can then be ranked, costed and implemented. Reporting on success provides feedback and maintains momentum, as well as helping to set future targets.

REMEMBER

- Waste can always be reduced
- What comes in must go out
- Every waste has its source
- Every effect has a cause
- Understanding waste leads to control, efficiency and quality

Waste minimisation will give you more control over disposal costs, make it cheaper and easier for you to comply with environmental regulations, and will improve your reputation with customers.

Finding Hidden Profit: 200 Tips for Reducing Waste (ET30) describes practical ideas for reducing waste. How many of these ideas could apply to your company? To obtain a free copy, contact the Environment and Energy Helpline on 0800 585794.

BENEFITS OF WASTE MINIMISATION

- ✓ Financial
- ✓ Process performance
- ✓ Competitive edge
- ✓ Compliance
- ✓ Environmental
- ✓ Public and company image

Reducing the amount of waste not only saves the cost of managing the waste, but makes greater savings in the cost of the production process. Minimising waste is essential to maintaining business competitiveness and sustainability.

FINANCIAL BENEFITS

"...the initiatives have produced significant cost savings with minimal capital and operating costs."

A chemicals manufacturer saved £30 500/year through waste minimisation, re-use and waste segregation.

A chemicals manufacturer saved £30 500/year by reducing waste volumes, re-using consumable materials and segregating wastes. The amount of waste sent to landfill fell by 78%. Most of the ideas for savings came from employee suggestions. The company's senior management is convinced that minimisation, re-use and recycling can produce very beneficial results in both financial and environmental terms. See Good Practice Case Study (GC16) *Sites Set on Cost Savings.*

For more details of any of the Industry Examples described in this Workbook, contact the Environment and Energy Helpline on 0800 585794.

PROCESS IMPROVEMENT BENEFITS

"We are saving money on every aspect of our water treatment and waste disposal."

An electroplating shop saved £102 000/year through improvements in water treatment.

An electroplating shop saved £102 000/year by installing a new ion exchange water treatment system in its electroplating plant. This reduced water treatment and waste disposal costs and improved operational efficiency. See Good Practice Case Study (GC24) *Effluent Costs Eliminated by Water Treatment.*

COMPETITIVE BENEFITS

"The new system has enabled us to improve our market competitiveness significantly by reducing costs and minimising workplace emissions."

A foundry saved £210 000/year through the introduction of a new sand binder system.

An iron foundry significantly reduced the amount of solid waste sand by increasing the amount of sand re-used from 70% to over 90%. Waste disposal costs fell by £210 000/year. The reduction in operating costs has allowed the foundry to improve its competitiveness in the market place. See Good Practice Case Study (GC35) *New Sand Binder System Reduces Foundry's Costs and Emissions.*

Reducing packaging and other waste saves over £100 000/year

A truck manufacturer saved £102 000/year by implementing more than 50 easily identified opportunities to reduce waste. These included the design of lighter packaging, packaging re-use and more efficient use of lighting, heating, water and compressed air.

For more details see Case History (CH75) *Packaging Redesign Increases Profits and Efficiency*.

COMPLIANCE BENEFITS

"...we have peace of mind from knowing that we can demonstrate compliance with all relevant environmental regulations."

A manufacturer of pigments and inks saved £96 000/year through an environmental mangement system.

Conducting a review of wastes and other environmental effects as part of an environmental management system requires companies to document relevant environmental legislation and understand how their business impacts on the environment. A manufacturer of metallic pigments and inks not only demonstrated compliance, but achieved significant cost savings. See Good Practice Case Study (GC49) *Environmental Management System Improves Performance.*

ENVIRONMENTAL BENEFITS

"The unexpected side benefit... has been that what is good environmentally is also good for the bottom line."

A textile manufacturer saved £15 000/year by a simple recycling system for latex.

A textile manufacturer developed a system for recycling the latex mix used to foam-back carpets. This low-cost initiative, which resulted from an employee suggestion, saved over £13 000 in the first year by reducing the amount of latex used by 5% and reducing the amount of aqueous waste disposed of to landfill by 45%. See also Good Practice Case Study (GC63) *Latex Recycling Achieves Substantial Savings for Little Cost*.

Waste minimisation team generates ideas

At the first team meeting, an engineering company identified 32 ideas to reduce waste and energy consumption. Savings totalled over £24 000/year. Most of the ideas cost nothing to implement and all had a payback period of less than 18 months.

SUMMARY

- Minimising waste is essential to maintaining business competitiveness and sustainability.
- Waste is not just discarded materials. It includes wasted time, energy and raw materials.
- Financial and environmental benefits are easily achieved from a systematic approach to waste minimisation.
- Prevention is better than cure. The nearer waste reduction is to the source, the more cost-effective it becomes.
- Successful waste minimisation programmes always begin with senior management commitment.
- The next step is to quantify and cost your wastes. This involves planning and organising your colleagues to assist in data collection. The best options can then be costed and implemented.
- Use free publications (see Section 9) from the Environmental Technology Best Practice Programme to get ideas and tips for your company.
- Make a fast start by implementing obvious measures with an immediate payback.

Key Actions:

Find out how much waste costs your company. Identify the key benefits from developing a systematic waste minimisation programme.

Contact the Environment and Energy Helpline on 0800 585794 for details of free advice and publications on waste minimisation.

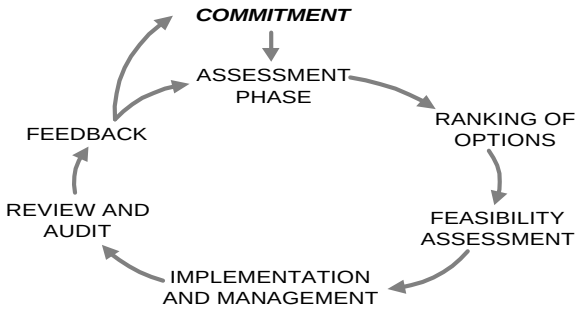
3 OVERCOMING BARRIERS AND GETTING STARTED

3.1 GETTING SENIOR MANAGEMENT COMMITMENT

PRESENTATION TRANSPARENCIES

PLEASE USE THIS SPACE FOR YOUR OWN NOTES

STEPS IN WASTE MINIMISATION



To obtain their active support, you need to convince senior managers of the benefits of waste minimisation and overcome any barriers they may see.

WHAT ARE THE BARRIERS?

- Senior management commitment
- Money
- Resources
- Time
- Change

To overcome these barriers, you may need to provide evidence that worthwhile savings can be made.

In the metal finishing industry, specific water consumption varies greatly with the least economical sites using several hundred times more water than the best. The difference in water costs between worst and best performance is over £100 000/year. For more details see Environmental Performance Guide (EG45) *Water Use in the Metal Finishing Industry*.

WINNING SUPPORT

- Find out how much waste is costing the company
- Show that waste is avoidable
- Provide evidence that savings can be made
- Choose a few areas with immediate savings

Find out how much waste is costing and target a few areas where immediate savings could be made, eg raw materials use, solid waste generation, water and energy consumption. Present these findings to senior management.

MAKING THE CASE

- Use Case Studies describing other companies' successes
- Look for ideas in *Finding Hidden Profit - 200 Tips for Reducing Waste* (ET30)
- Use the presentations in Good Practice Guide (GG125) *Waste Minimisation Pays: Five business reasons for reducing waste*
- For SMEs, get ideas from a Programme counselling visit to your company
- Target obvious areas identified using the tools described in this Workbook

Present the benefits of waste minimisation in a positive manner. Simple measures to eliminate taps left running, compressed air leaks, unnecessary lighting, etc can produce surprising cost savings - from a few hundred to several thousand pounds - and usually cost nothing to implement.

For more details of any of the Industry Examples described in this Workbook, contact the Environment and Energy Helpline on 0800 585794.

REDUCE PACKAGING

"Discuss with your chemical suppliers the minimum amount of packaging that can be used to deliver their product and return drums for re-use wherever possible."

An automotive manufacturer saved £1 200/year in landfill tax by returning waste chemical drums to the supplier for re-use.

Discuss with your suppliers the potential for returning or minimising packaging. Talk to your customers about re-using your packaging.

REDUCE LEAKS

"Large amounts of air (and energy) are simply lost from compressed air distribution systems through leaks. Simple checks can reduce leaks by up to 20%."

An Eastleigh printer made immediate savings of £700/year by reducing compressed air leaks.

Simple checks can reduce leaks from compressed air systems by up to 20%.

Simple water saving devices save multi-site company over £100 000/year

A wholesale food distributor demonstrated that significant savings can be made by implementing numerous small and inexpensive measures across a large number of similar sites. Installation of push taps, cistern volume controls and flush controls helped to control water use at 109 sites without adversely affecting the day-to-day running of the business. Net cost savings in the first year were over £33 000, giving a payback period of less than nine months. Savings in subsequent years amounted to over £106 000/year.

For more details see Good Practice Case Study (GC61) *Low-cost Measures Save Water at Multi-site Company*.

3.2 DRAW UP A STATEMENT OF COMMITMENT

PRESENTATION TRANSPARENCIES

PLEASE USE THIS SPACE FOR YOUR OWN NOTES

DEMONSTRATE COMMITMENT

- Draw up a Statement of Commitment
- Display in a prominent location
- Encourage others to get involved
- Publicise achievements

Demonstrating commitment will help to maintain momentum for the waste minimisation programme. The most effective method is to prepare a written Statement of Commitment and make this available for everyone to read.

STATEMENT OF COMMITMENT

- Keep it short and simple
- Realistic and achievable
- Easy to read and understand
- Dated and endorsed by a senior manager
- Remember YOU set the timetable

Stick to these few basic rules when writing your company's Statement of Commitment. The Statement is meant for everyone to see, so make sure the key points are easy to read and understand. Working towards waste reduction is a continuous programme, but the company set the timetable.

See Section 6 for more advice on writing a Statement of Commitment for your company.

PLEASE USE THIS SPACE FOR YOUR OWN NOTES

PUBLICITY

- Team briefings
- Notice-board
- Posters
- Company newsletter
- Ask for ideas and feedback

It is important to publicise the Statement of Commitment. If it is not publicised, no-one will know it exists or become involved in the waste minimisation programme.

Employee suggestions and ideas have contributed positively to developing waste reduction initiatives and achieving cost savings. It is important for staff at all levels to become involved.

Publicise the success and progress of your waste minimisation programme plans on notice-boards or in the company newsletter.

SUMMARY

- Successful waste minimisation programmes depend on senior management commitment.
- Active support from management will overcome company barriers.
- To win support, find out how much waste is costing your company and emphasise the potential for cost savings.
- To maintain momentum for waste minimisation, draw up a Statement of Commitment and get it endorsed by senior management.
- Make sure the Statement is easy to read and understand.
- Publicise the Statement and encourage others to get involved.

Key Action:

Convince senior management of the potential savings from implementing a systematic approach to waste minimisation. Get a Statement of Commitment publicised in your company.

3.3 WINNING SUPPORT WITH TEAMS AND CHAMPIONS

PRESENTATION TRANSPARENCIES

PLEASE USE THIS SPACE FOR YOUR OWN NOTES

WHY HAVE TEAMS AND CHAMPIONS?

- Appoint a company Champion to co-ordinate and facilitate
- Recruit a project team to achieve results
- Increase staff awareness and motivation to take action
- Maintain momentum for success

Most companies find it helpful to appoint a team leader or Champion to co-ordinate and facilitate the waste minimisation programme. Involving teams and Champions in the waste minimisation initiative helps to increase staff awareness at all levels and motivate individuals to take action and participate.

THE CHAMPION'S ROLE

- Co-ordinate and facilitate
- Communicate the programme
- Build the team
- Manage resources, actions and training
- Lead in the early stages
- Raise awareness and motivation

Champions are not required to complete all the tasks by themselves.

Ask the Environment and Energy Helpline on 0800 585794 for a free copy of Good Practice Guide (GG27) *Saving Money Through Waste Minimisation: Teams and Champions*.

CHAMPION PROFILE

- Enthusiasm
- Credibility at all levels
- Organisational skills
- Ability to motivate others
- Ability to communicate

Depending on the size of your company, the Champion could be the managing director, production manager, quality manager or environmental manager.

VALUE OF TEAMS

- Integration of waste minimisation into company culture
- Ownership and ideas
- Cross-functional benefits (different skills and ideas)
- Involvement removes barriers for change
- Improved awareness and understanding leads to cost savings
- Provides self-training

To integrate waste minimisation into your company's culture, you need to involve employees from all areas. Remember involvement creates ownership.

Use problem-solving teams to develop solutions to waste problems. Well-run team sessions can help identify improvements, create involvement and improve understanding.

STAFF AWARENESS BARRIER

- Poor awareness prevents progress
- Raising awareness stimulates participation
- Give staff the facts about waste
- How does the programme apply to you as an individual?

Poor staff awareness is a common barrier to successful waste minimisation. It prevents progress and needs to be overcome by teams and Champions. To raise awareness, staff need to be given the facts about wastes, told how the programme applies to them as individuals and be aware of the benefits.

STAFF MOTIVATION BARRIER

- People need to know the reasons for changing the way they work
- Well-motivated staff generate ideas
- Savings are made through people
- Incentives can drive motivation

Well-motivated staff are keen to generate ideas for reducing waste. Savings are often made as a result of employee suggestion schemes and well-motivated staff sustain interest and momentum in waste minimisation programmes.

In plating and anodising operations, rinse water can often be recycled for pre-wash. Alternatively, sometimes it can be concentrated by evaporation at room temperature for re-use in the plating tank.

INCENTIVE SCHEMES

- Use to encourage and motivate staff
- Donation to employee-nominated charity
- Annual or monthly prize
- Recognition

Incentive schemes can be extremely effective to improve and drive motivation of staff at all levels. The type of incentive depends on the company size and culture and is generally a financial payment, small prize or personal recognition.

Swarf machined from stock containing additives is often saleable at a higher value if segregated from the remainder. Avoid contamination of alloy swarf with other metals as this contamination reduces its scrap value.

SUMMARY

- Appoint a company Champion to co-ordinate and facilitate your waste minimisation programme.
- Set up a project team to help gather information and implement the programme.
- Raise awareness about the programme and motivate staff at all levels to get involved.
- Set up a suggestion scheme to generate ideas.
- Publicise achievements and savings.
- Provide incentives to sustain momentum.

Key Action:

Appoint a Champion and recruit a team to help. Decide how to raise staff awareness in your company and motivate others to get involved.

4 TOOLS FOR THE JOB

4.1 IDENTIFYING AND QUANTIFYING WASTES

PRESENTATION TRANSPARENCIES

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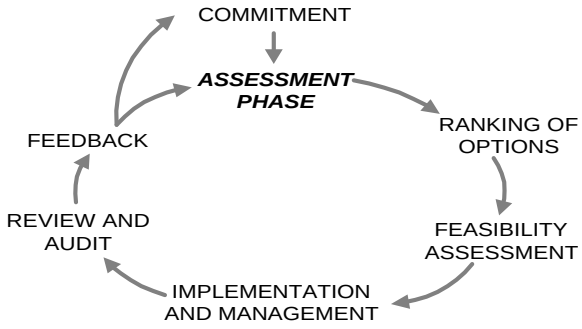
STEPS IN WASTE MINIMISATION



During the assessment phase, data on the quantities and costs are collected and organised. Collecting baseline information is important because it provides a benchmark against which to measure future improvements and cost savings. It is also crucial for the identification of priority areas to tackle and for the setting of achievable waste reduction targets.

WASTE MINIMISATION REVIEW

- Use a systematic approach
- Use appropriate tools for the job
- Conduct a waste survey

Use the document checklist provided to identify where to look for information and how to record it in the data assessment phase. Begin a comprehensive paper or electronic database of all information collected. For help, see Good Practice Guide (GG38C) *Cutting Costs by Reducing Waste: A Self-help Guide for Growing Businesses*, and (IT96) *Waste Management Interactive Tools* (WMIT).

Purchasing managers, site managers and accountants can be invaluable sources of information. They should be encouraged to participate in the programme during the assessment phase.

GATHERING AND ORGANISING INFORMATION

- Find the sources of information in your company
- Identify inputs and outputs for materials, energy, labour and wastes
- Collect information on quantities
- Collect information on costs
- Identify the true cost of waste

You need to establish how much waste your company generates and how much this costs each year.

You will need to examine your company's process inputs and outputs. For the inputs, start with the main raw materials, labour and utilities and for the outputs, identify the main wastes. Each step in a process adds value and incurs cost from the labour, materials and utilities (gas, water, electricity, etc) used in that process.

You should also collect information which will help to calculate the true cost of waste, eg staff costs, overheads, insurance and maintenance costs.

Regular monitoring produces significant energy savings

An energy efficiency campaign at a textiles manufacturer reduced energy consumption by 27%. Half of the savings were achieved with little or no capital expenditure. The key elements were good housekeeping, staff involvement and regular monitoring.

For more details, see the Energy Efficiency Best Practice Programme Good Practice Case Study 254 *Implementing an Energy Management Programme in a Textile Finishing Company*. GPCS254 is available free of charge through the Environment and Energy Helpline on 0800 585794.

WHERE DO YOU FIND INFORMATION?

- Company records and reports
- Site and process maps
- Flow diagrams of unit operations
- Meter readings and energy bills
- Water company and waste disposal contractor invoices

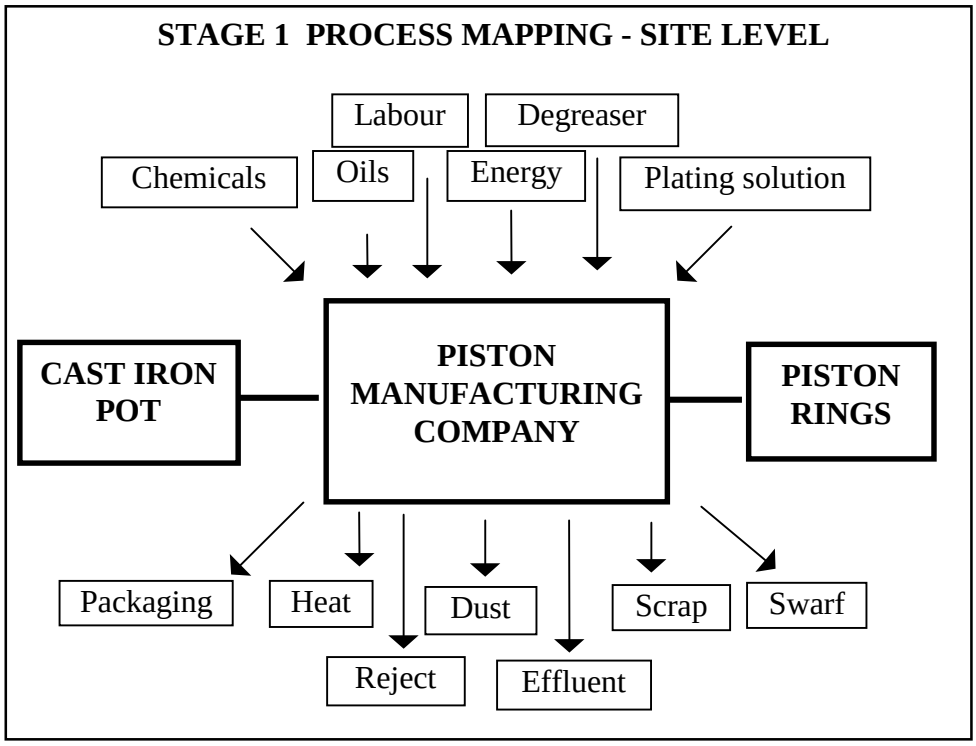
Start looking for information in your company records. Check bills, invoices and purchase ledgers for information on the use and cost of utilities, raw materials and waste disposal.

OTHER SOURCES OF INFORMATION

- Effluent discharge consents
- Water abstraction licences
- Process authorisations
- Duty of Care documentation
- Packaging waste regulations data

For many companies, the cost of purchasing water and disposing of aqueous effluent can form a major proportion of their operating costs. Other useful sources of information are waste transfer notes and consignment notes (necessary for compliance with the Duty of Care) and any records kept to demonstrate compliance with the packaging waste regulations.

Focus on a few major areas where the largest financial savings can be made.



Use a process flowsheet to map your company's inputs and outputs. Start by looking at your company or site as a whole and identify the main raw materials, utilities and wastes. Do you know the cost of each input and output?

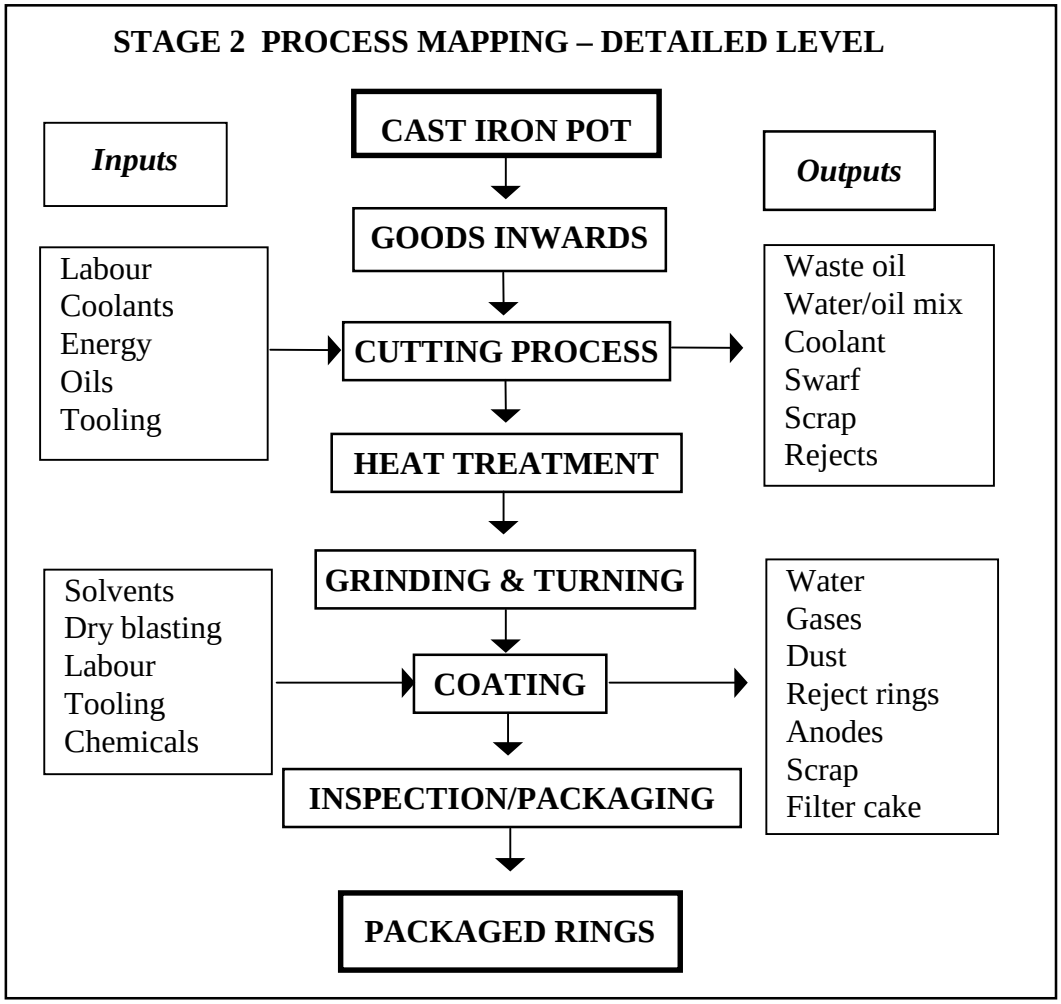
Determine the quantities of materials used and the costs associated with different forms of waste. This will help you to identify the areas of the business producing most waste and which therefore require priority attention.

Use information that is readily available or make best estimates initially.

Waste survey finds true cost of waste is three times more than expected

Do you appreciate the true cost of your waste? A Leicestershire-based dyer estimated effluent disposal costs to be around £50 000/year. In fact, the true cost was found to be over £150 000/year. Implementing a systematic waste minimisation programme subsequently reduced water and effluent costs by 19%, ie £28 500/year.

PRESENTATION TRANSPARENCIES



Use the same technique to map individual processes and gain more detailed information. This example shows the inputs and outputs for two of the six separate processes which form the company's manufacturing operation. Each step of the process adds value to a product and incurs a cost from the labour, materials and utilities (gas, water, electricity, compressed air, etc) used in that process.

Waste review highlights major source of scrap metal

A manufacturer of sports equipment examined the amount of scrap metal waste produced during the four processes used to manufacture golf club shafts. The review showed that more than 70% of total scrap metal waste was generated from only one of the processes, known as 'cold drawing'. Efforts focused on increasing yield and reducing avoidable scrap during the cold drawing process, resulting in a reduction of scrap metal waste of 64 tonnes/year and a saving of £50 000/year.

For more details see Case History (CH115) *Engineering Process Optimised to Reduce Scrap Metal*.

PRESENTATION TRANSPARENCIES

STAGE 3 CALCULATING VALUE ADDED

Item/process		Value added to product for each process
Raw material: CAST IRON POT		
Process 1:	Goods in	£0.20/ring
Process 2:	Cutting	(+0.05) £0.25/ring
Process 3:	Heat treatment	(+0.05) £0.30/ring
Process 4:	Grinding and turning	(+0.10) £0.40/ring
Process 5:	Coating	(+0.40) £0.80/ring
Process 6:	Inspection/packaging	(+0.15) £0.95/ring
End product: PISTON RINGS		**= £0.95/ring**

The company producing the piston rings was able to calculate the value added to the product for each process from information collected on the costs of labour, raw materials, water use, energy consumption and company overheads. These costs had been broken down for each process.

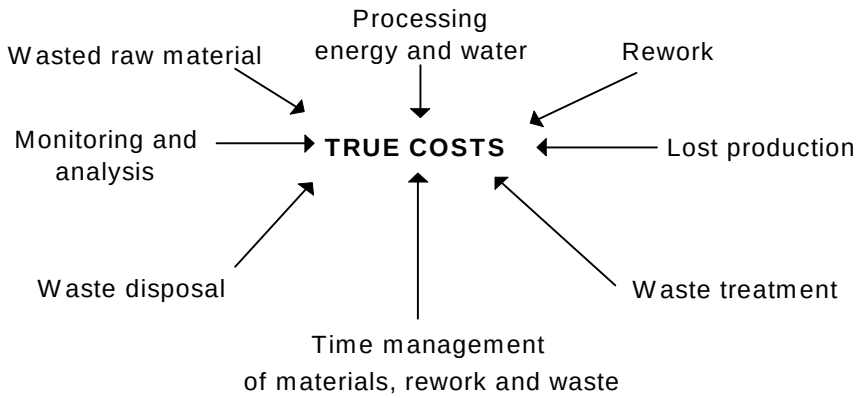
The main raw material, cast iron pots, cost £6.00 each, equivalent to 20 pence/ring. By the end of cutting, the ring had cost the company 25 pence to produce. The value added to the product from the process through the purchase of water, energy and labour costs was therefore 5 pence. The company was able to complete these calculations for all six processes, calculating the value of the finished product to be 95 pence/ring. The total value added to the product was therefore 75 pence.

The relative value added to each process can help to pinpoint the areas of the process with the maximum potential savings from waste reduction. In this example, raw material waste produced in later processes - particularly coating - is of significantly higher value. Coating was therefore targeted as a priority for waste reduction and cost savings.

Can you calculate the value added costs of your wastes?

Make operators aware of the value of the materials that they are handling and emphasise the economic and environmental implications of production losses caused by waste.

IDENTIFYING THE TRUE COST OF WASTE



Waste is not just discarded materials. It includes wasted raw materials, rework, lost production time, waste treatment costs, wasted labour, loss of materials to atmosphere and to drain, and excessive energy and water use.

WASTE SURVEY TOOLS

- Producing a mass balance
- Tracking materials through the site or process
- Lost yields
- Identification of unmeasured wastes and emissions

A waste survey helps to identify areas which may have been missed during process mapping. Waste survey teams are most effective if they include representatives from engineering/site services, production and management.

Chart production and wastes regularly. For example, use wipe-clean boards close to the relevant process.

PLEASE USE THIS SPACE FOR YOUR OWN NOTES

INVENTORIES

- Electronic or paper records
- Process or site level
- Inputs, products, wastes and emissions
- Provide a benchmark for future monitoring

Use inventories of inputs, products, wastes and emissions to record information systematically. This will help you analyse your information to identify and prioritise waste minimisation opportunities. Inventories also provide a benchmark against which to measure future improvements.

RECORDING INFORMATION

- Raw materials, eg tonnes/year
- Water and effluent, eg m^3/year
- Gas and electricity, eg kWh/year
- Fuel, eg litres/year
- Solid waste, eg tonnes/year
- Solvent use and emissions, eg tonnes/year
- Rejects, eg number/year or percentage

Record annual quantities of all raw materials, energy and wastes. Using the same units for solid materials, energy consumption and water/effluent makes comparison easier.

Use graphs, charts and simple diagrams to present your findings.

SUMMARY

- Collect information about the quantities and costs of your company's raw materials, utilities, wastes and costs.
- Use sources of information held by your company to begin the process.
- Conduct a waste review to help organise your data and identify gaps in information.
- Use process mapping to calculate the value added for each process and estimate the true cost of waste.
- Collect information about the hidden costs of waste, including overheads, rework and rejects.
- Set up a waste survey team to produce a mass balance of your site processes.
- Record information systematically to allow information to be compared in a meaningful way.

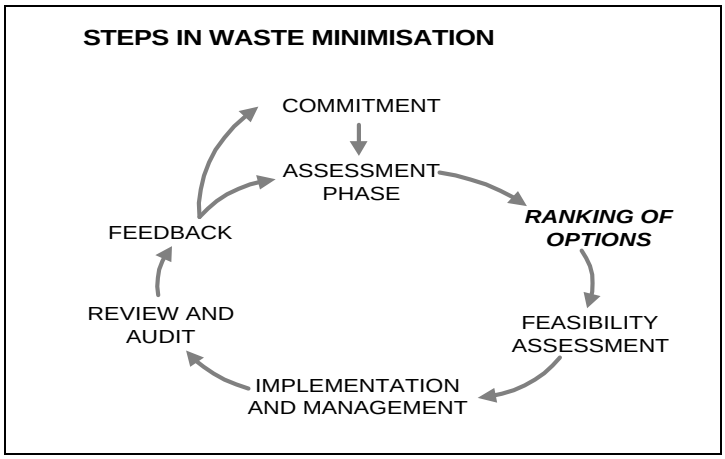
Key Action:

Establish how much waste is produced, how much energy is used and how much this is costing your company each year.

4.2 FOCUSING ON PRIORITY AREAS FOR ACTION

PRESENTATION TRANSPARENCIES

PLEASE USE THIS SPACE FOR YOUR OWN NOTES



The next stage in the waste minimisation process is to identify priority areas for waste reduction. The data assessment table can be used to:

- summarise data collected about your company's inputs and outputs;
- identify priority actions and rank options that will provide the greatest cost savings through improved efficiency and waste reduction.

Continuous improvement team drives down degreasing costs

An engineering company built on existing solvent reduction measures by implementing a five-year continuous environmental improvement programme. To maintain momentum, a small continuous improvement team was set up to implement, measure and report on waste minimisation initiatives. The installation of new, double-door closed degreasers and other measures to reduce operating costs have produced total net savings of over £60 000/year.

For more information see Industry Example 7 from Good Practice Guide (GG124) *Solvent Management in Practice: Industry Examples*.

DATA ASSESSMENT TABLE

The Piston Manufacturing Company (figures are examples only)

Material	**Quantity**	**Units**	**Rank**	**Cost (£/year)**	**Rank**
Cast iron pots	750	tonnes	1	525 000	1
Oils	6	tonnes	2	30 000	2
Degreasers	0.5	tonnes	5	2 500	3
Chemicals	2	tonnes	3	500	5
Plating solution	1.5	tonnes	4	750	4
Utilities	**Quantity**	**Units**	**Rank**	**Cost (£/year)**	**Rank**
Water	6 000	m^3	3	3 500	3
Electricity	3 000	MWh	1	90 000	1
Gas	2 500	MWh	2	30 000	2
Wastes	**Quantity**	**Units**	**Rank**	**Cost (£/year)**	**Rank**
Scrap	150	tonnes	2	15 000	1
Chemicals	1	tonnes	6	500	6
Oils	0.5	tonnes	7	250	7
Water/oil	7	tonnes	5	1 000	5
Swarf	20	tonnes	3	7 000	2
Effluent	2 000	m^3	1	3 000	3
Packaging	10	tonnes	4	1 500	4

Example data assessment table

The data assessment table is a practical tool that can be used to summarise information collected on the quantities and costs of raw materials, energy, gas, oil, water, wastes and emissions.

The table can be completed either on a site basis or for individual processes, depending on the level of detail of the collected information. Use a ranking system to identify priority areas to tackle in terms of cost savings and to highlight obvious areas for waste reduction.

Use the blank data assessment table given in Section 7 to rank options for waste reduction in your company and identify priority areas for action.

Separate all wastes at source. Label or colour-code waste containers and provide clear instructions on their use.

SCREENING WASTE MINIMISATION OPTIONS

- Waste management hierarchy (see Section 2)
- Potential cost savings
- Implementation potential
- Type of option
- Cost of option

Having identified the priority areas for action, it is necessary to evaluate possible options and select the best one(s) to implement.

Screening involves awarding points on a scale of 1 - 5 as follows:

Option.....		
Attribute	**Score 5**	**Score 1**
Place in waste hierarchy	Reduction at source	Disposal
Potential cost savings	High	Low
Implementation potential	Immediate	Not feasible
Type	Good housekeeping	New technology
Cost	No-cost	Outside budget

Scoring system for waste minimisation options

Energy teams help to achieve cost saving targets

An ongoing policy of minimising energy and utility costs at an organic chemicals manufacturer had resulted in numerous cost-saving modifications and practices. The company then decided to set targets for all management levels as part of a company-wide initiative. Energy teams established for each unit successfully harnessed previously untapped interest in energy efficiency. Additional ideas for reducing energy use saved the company £212 000/year - an overall saving of 9%.

For more details, see the Energy Efficiency Best Practice Programme Good Practice Case Study 331 *Energy Management Within a Strategic Framework.* GPCS331 is available free of charge through the Environment and Energy Helpline on 0800 585794.

COMPLETE DATA ASSESSMENT

- Provide data estimates for missing or incomplete information
- Identify monitoring requirements
- Put measuring systems in place

Completing the data assessment table may highlight gaps in your information. Make best estimates where possible, but also consider if you need to begin a monitoring programme to collect new, additional or more meaningful data.

MEASURING TO MANAGE

- If you don't measure it - you can't manage it.

This applies to raw material use, water use, energy use, wastes and effluents.

MEASURING AND MONITORING

- Use simple measuring systems
- Check bills
- Meter the site
- Meter individual processes and machines

Measuring systems should be simple, cost-effective and appropriate for your process or site, eg number of skips used/month, amount of effluent discharged (m^3/month) and utility bills. Consider installing meters for energy and water on individual processes/machines.

You can tackle waste only if you can accurately identify and account for changes in use.

RULES OF THUMB

- Make your best estimates
- Monitor number of skip lifts, composition and weights
- Relate utility use and waste generation to production levels
- Meter and monitor water and energy use
- Compare your performance with industry best practice

The main rule is to keep measuring and monitoring systems as simple as possible. For example, the amount of solid waste can be estimated from the number of skips, their average composition and uplift weights. Relate quantities and costs of inputs and outputs to production. Savings can then be attributed directly to waste minimisation initiatives rather than being dismissed as changes in production.

WIDER BENEFITS OF ONGOING MEASURING

- Demonstrates that savings have been made
- Targets for future waste reduction
- Ongoing monitoring of achievements

Record measurements and retain them for future reference. This will enable you to provide feedback and demonstrate achievements against targets.

When setting targets, be SMART (Specific, Measurable, Achievable, Realistic and Time-bound).

MONITORING SAVES MONEY

"Using auditing and monitoring to establish exactly where our emissions problems lay has allowed us to target our actions to reduce emissions and make cost savings quickly."

An adhesives manufacturer saved £6 000/year through using its solvent more effectively.

Measuring and monitoring need not be expensive - most systems more than pay for themselves. An adhesive manufacturer initiated a solvent management programme to make more efficient use of its solvents and reduce volatile organic compound (VOC) emissions. The company conducted a site survey and produced an inventory of solvent use. Using a simple mass balance approach, the company was able to quantify solvent losses and identify the processes most in need of improvement.

BENCHMARKING STIMULATES SAVINGS

A survey found that specific water consumption in the metal finishing industry varied from <1 m^3/tonne of product to >20 m^3/tonne of product. The difference between best and worst performance was worth more than £100 000/year.

Free Environmental Performance Guides from the Environmental Technology Best Practice Programme allow you to compare your performance with others in the industry. Phone the Environment and Energy Helpline on 0800 585794 for details of publications in your sector. The information above is taken from Environmental Performance Guide (EG45) *Water Use in the Metal Finishing Industry*.

Make sure that operators are aware of the value of the materials they are handling and the consequences of waste. Aim for maximum impact. 'We will save £5 000/year' has much more impact than 'We would reduce waste by 1%'.

METERING REDUCES WASTE

In a recent survey of UK industry, it was found that the more water meters installed at a site, the lower its specific water consumption.

In a survey of the amount of water used in the UK textile dyeing and finishing industry, it was found that the more water meters installed at a site, the lower its specific water consumption. For more information see Environmental Performance Guide (EG98) *Water Use in Textile Dyeing and Finishing*.

Could you benefit from installing more water meters?

Despite the cost, large amounts of compressed air are lost from compressed air distribution systems through leaks. Simple checks can reduce energy use by air compressors by up to 20%.

SUMMARY

- Summarise collected information in the data assessment table to help you identify priorities for cost savings.
- Rank options for waste reduction in order of priority and evaluate options to reduce waste.
- Set SMART targets for obvious areas of waste reduction.
- Identify monitoring requirements.
- Ensure systems are in place for measuring and monitoring against targets.

Key Action:

Use the data assessment table to rank options for reducing waste. Remember, you set the timetable for the waste minimisation programme - don't try to tackle everything at once.

5 WHERE DO YOU GO FROM HERE?

PRESENTATION TRANSPARENCIES

PLEASE USE THIS SPACE FOR YOUR OWN NOTES

SUMMARY - THE TEN POINT PLAN

1. Obtain senior management commitment
2. Appoint a Champion and project team
3. Publicise the project
4. Establish quantities and costs of wastes
5. Set up an auditing system and identify monitoring requirements

Prepare an Action Plan to implement your step-by-step approach to waste minimisation.

SUMMARY - THE TEN POINT PLAN

6. Collate raw material, product, energy use and waste data sheets
7. Identify opportunities to reduce waste
8. Prepare a plan for improvements
9. Set waste and energy reduction targets
10. Review progress against targets and publicise results

The Action Plan should include realistic and achievable targets that have been agreed by senior management. When implementing the Action Plan, involve everyone and provide regular feedback. Review progress against targets at least annually.

Consider all wastes from your production processes as a potential source of income. Try not to regard all your waste as general waste just because no alternative comes to mind.

FAST START

- Identify priority areas for action
- Make a fast start on obvious opportunities to reduce waste
- Identify quick and cheap cost-saving measures

You should now be in a position to take positive action in your company to reduce waste and improve performance. Seek ideas for making fast starts from free Environmental Technology Best Practice Programme publications (see Section 9).

INDIVIDUAL ACTIONS

- Turn it off
- Reflect on it
- Watt's up
- Don't be a drip
- Copy right
- Just the fax
- A package deal

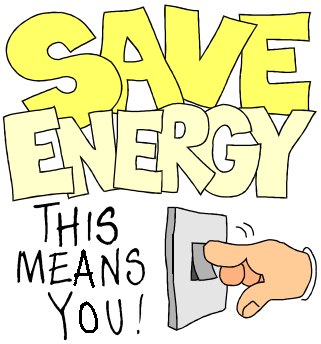
There are many ways in which individuals can contribute to improving the global environment through local actions, however small they appear. What's important is to think globally and act locally! Overleaf are a few facts which will certainly make you think.

Ensure that machine start-up procedures and settings are properly documented and that staff are trained to use these procedures.

PRESENTATION TRANSPARENCIES

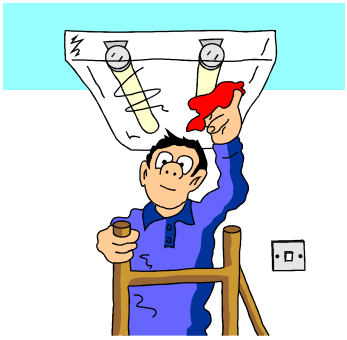
Turn it off

Inefficient use of office machines costs UK businesses up to £400 million/year in electricity charges. Turning off just ten monitors when they are not being used could save you £200/year in energy costs.



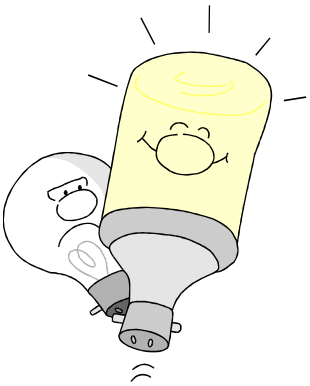
Reflect on it

A typical company has more fluorescent tubes than employees. If all fluorescent lighting fixtures in UK businesses used reflectors, up to 10 billion kWh of electricity could be saved.



Watt's up

Lighting accounts for over one-third of the energy used in commercial spaces. Many lighting improvements have a short payback period Energy efficient lighting can also reduce air conditioning costs by 8 - 10%. If all UK businesses used high efficiency lighting techniques, about 5% of all the electricity used in the UK could be saved.



Don't be a drip

UK office workers use enough water every day to fill 150 Olympic-sized swimming pools. If just 1 000 businesses with 100 employees installed tap regulators, the UK could save 15 million gallons of water every year.

Find out whether your waste could be re-used or recycled by another site or part of your group.

Copy right

In the UK, we make nearly 500 billion photocopies a year - that's around 930 000 copies every minute of every day. According to one expert, an average company with 100 employees uses about 250 000 sheets of copier paper a year. That amount would make a stack of paper stretching nearly five floors high.

If each copier in the UK made five fewer copies every business day, up to 2.5 million sheets of paper could be saved. This would save the equivalent of 200 000 trees and keep more than 3.7 million cubic feet of paper out of landfills.

Just the fax

There are now over one million fax machines in use in the UK. If everyone switched from full-page to half-page cover sheets, about 120 000 miles of fax paper would be saved without reducing the number of faxes sent. Alternatively, don't use a fax cover sheet at all. Buy fax transmission stickers and just stick one on the first page before you send it.

A package deal

The UK produces about 7.6 million tonnes/year of packaging waste - that's enough to fill nearly 19 000 jumbo jets. Each year we use the equivalent of 140 corrugated cardboard boxes for each person in the UK - enough to make a pile as big as a football pitch and one and a half times as high as Nelson's Column. UK businesses use an estimated six million cubic feet of polystyrene beads a year - enough to fill the Canary Wharf tower nearly three times.

These Clipart images are examples from the Environment and Energy Collection, available on disk free from the Environment and Energy Helpline on 0800 585794.

SUMMARY

- Prepare a ten point Action Plan to implement your systematic approach to waste minimisation.
- Get quick results to demonstrate the effectiveness of the waste minimisation programme.
- Think globally - act locally.
- Every individual can contribute to the improvement of the environment through local actions.

Key Action:

Make a start in your company by working through the exercises described in Sections 6 - 8.

6 EXERCISE: WRITING A STATEMENT OF COMMITMENT

The aim of the first exercise is to help you write a Statement of Commitment for your company. The Statement can be presented to senior managers in draft for their approval. Common barriers to writing a Statement include not knowing how to write one, what to include and how far to go.

Use the advice below to write a Statement of Commitment for your company. Remember that the Statement of Commitment is unique to each company and should reflect its culture and needs.

- Keep the Statement short, simple and easy to read. Make sure that it is realistic and achievable for your company.
- Select ideas and issues that are appropriate for your company.
- Include the answers to the following questions:
  - Who is making the commitment?
  - What is to be achieved and how?
  - What are the drivers, eg costs, legislation, supply chain pressure and image?
  - Who to contact for further information?
- Give the name of the person or group (MD or Board) making the commitment (with an appropriate signature).
- Give a commitment to review progress (give a date/timetable).
- The Statement of Commitment could include the following ideas or references to:
  - waste minimisation is environmentally friendly, saves money and leads to the reduction of environmental impact;
  - company-specific reasons for implementing a waste minimisation programme;
  - a commitment to participation in a local waste minimisation club (if appropriate);
  - support from external organisations, eg the Environment and Energy Helpline, regulators and business organisations;
  - waste minimisation can be integrated with existing quality and environmental management systems.

Some example Statements are given in Good Practice Guide (GG174) *Profiting from Practical Waste Minimisation: Running a workshop to maintain the momentum*, available free of charge through the Environment and Energy Helpline on 0800 585794.

7 EXERCISE: MAKING A START IN YOUR COMPANY

The aim of the second exercise is to help you construct a process map for your site or company. This will help you identify your company's inputs and outputs in a systematic manner and pinpoint obvious areas for waste reduction. An example process map is shown on page 25.

- Use the waste opportunity checklist (see pages 45 - 46), example inventories (see pages 47 - 50) and data assessment table (see page 51) to identify your wastes and areas for priority action. Please photocopy these pages, as necessary, for use in your company. Good Practice Guide (GG38C) *Cutting Costs by Reducing Waste: A Self-help Guide for Growing Businesses*, will also help.

- Concentrate on major sources of waste material, eg packaging, disposal of spent chemicals, heat, water and rework.

- Remember, each step of a process adds value to a product and incurs cost from the labour, materials and utilities (gas, water, electricity, compressed air, etc) used in that process. Use the example shown on page 26 to help you calculate the value added cost of your wastes.

- If possible, calculate the true cost of waste for your site or company.

- Don't be put off if you don't have all the information. Make your best estimate and make a note to make simple measurements later.

- Use the tools provided in this Workbook to help you get started. Ask for assistance if you need it by contacting the Environment and Energy Helpline on 0800 585794.

- Seek ideas from *Finding Hidden Profit - 200 Tips for Reducing Waste* (ET30) and WMIT (**W**aste **M**inimisation **I**nteractive **T**ools), a PC-based software tool designed to help companies reduce waste and thus save money. Both ET30 and WMIT are available free of charge through the Environment and Energy Helpline on 0800 585794.

Optimising packaging use

Use returnable packaging rather than cardboard and shrink-wrap. Ask your suppliers to do the same.

Discuss with your customers the minimum level of packaging acceptable to them and minimise the amount of packaging used to protect your product.

For practical advice on how to optimise the amount and type of packaging you use, see Good Practice Guide (GG140) *Cutting Costs and Waste by Reducing Packaging Use* and Good Practice Guide (GG141) *Choosing and Managing Re-usable Transit Packaging*.

WASTE OPPORTUNITY CHECKLIST

Department/section	Area	Possible waste	
Incoming materials	Loading docks, pipelines, receiving areas	Packaging/containers	☐
		Off-spec deliveries	☐
		Damaged containers	☐
		Spill residue	☐
		Cleaning rags, etc	☐
		Pallets (non-returnable)	☐
		Gloves, overalls, etc	☐
Storage (raw materials, parts, final products)	Tanks, silos, warehouse, drum storage, yards, storerooms	Tank bottoms	☐
		Off-spec materials	☐
		Excess materials	☐
		Damaged containers	☐
		Empty containers	☐
		Leaks from pumps/valves/pipes	☐
		Out-of-date materials	☐
		No-longer-used materials	☐
		Damaged products	☐
Production	Melting, curing washing, coating, forming, machining	Washwater	☐
		Solvents evaporating	☐
		Still bottoms in tanks	☐
		Off-spec product rejects	☐
		Catalysts	☐
		Empty containers	☐
		Sweepings	☐
		Ductwork clearout	☐
		Additives	☐
		Oil	☐
		Process solution dumps	☐
		Rinse water	☐
		Excess materials	☐
		Filters	☐
		Leaks from tanks/pipes/valves	☐
		Spill residue	☐
		Swarf, off-cuts	☐
		Sludge	☐
		Drag-out from baths	☐
		Packaging of dispatched goods	☐

WASTE OPPORTUNITY CHECKLIST (CONTINUED)

Department/ section	Area	Possible waste	
Energy	Buildings, processes, boiler plant and plant distribution system	High temperatures	☐
		Lights left on	☐
		Taps left running	☐
		Doors left open	☐
		Air leaks from compressor lines	☐
		Heat loss via roof/doors/windows	☐
		Money wasted through buying electricity, gas and water at high tariffs	☐
		Lamps beyond economic life	☐
		Poorly controlled or inefficient heating/hot water systems	☐
		Electric motors over five years old	☐
		Process heat not re-used	☐
	Other (additional)		☐
			☐
			☐
Water	Processes, toilets, kitchens	Urinals flushing continually	☐
		Underground leaks	☐
		Taps left running	☐
		Wasteful wash-downs.	☐
Support services	Laboratories, maintenance shops, garages, offices	Chemicals	☐
		Samples and containers	☐
		Solvents	☐
		Cleaning agents	☐
		Lubricating oils and greases	☐
		Scrap metal, wood	☐
		Caustics	☐
		Filters	☐
		Acids	☐
		Batteries	☐
		Office paper, etc	☐
Other	Consumables	Detergents	☐
		Overalls	☐
		Gloves	☐
			☐
			☐
			☐

INVENTORY OF PROCESSES	
Organisation	**Page of**

Process number	Process name

INVENTORY OF INPUTS		
Organisation	**Process**	**Page of**

Input number	Input name	Input use

INVENTORY OF PRODUCTS		
Organisation	**Process**	**Page of**

Product number	Product name	Product use

INVENTORY OF WASTES AND EMISSIONS		
Organisation	**Process**	**Page of**

Waste/emission number	**Waste/emission type**	**Waste/emission use (if any)**

DATA ASSESSMENT TABLE

To make ranking easier, if possible use the same unit of measurement for the different categories of inputs and wastes, eg tonnes/year for materials and wastes, kWh/year for energy and m^3/year for water.

Organisation			**Input/output**		
Prepared by			**Process/site**		
Inputs and wastes	**Annual quantity**	**Units**	**Rank (by quantity)**	**Cost (£/year)**	**Rank (by cost)**
Raw materials					
Water					
Energy					
Wastes/emissions					

8 EXERCISE: MAKING AN ACTION PLAN FOR YOUR COMPANY

The aim of the third exercise is to help you write an Action Plan for your company. This will help you to convince your colleagues of the savings possible and make a fast start with your systematic approach to waste reduction.

The Action Plan should ideally contain no more than ten points. Share your ideas with other people. They may be able to help you.

Key actions could include the following ideas or references to:

- convincing senior managers about the possible benefits and savings;
- appointing a Champion and identifying members of the project team;
- identifying obvious areas of waste and fast start savings;
- reviewing water, electricity, gas and waste disposal bills for the previous year and relating costs to production figures;
- talking to waste management contractors.

Use the action checklist overleaf to prompt you.

Do any barriers need to be overcome to get started?

Do senior managers need to be convinced of the benefits and savings possible?

Who would be the most appropriate Champion? Is it you?

Walk around the site looking for wastes and their source. Take photographs and distribute them around the company, eg in a newsletter (using a digital camera makes it very easy to distribute photographs via e-mail).

ACTION CHECKLIST

This checklist summarises the actions needed to establish a successful waste minimisation programme. Not all of these actions will be appropriate for your company - use the checklist as a prompt to choose the ones that are.

Action	**Person responsible**	**Completion date**
Look at waste costs.		
Identify quick savings.		
Get a Statement of Commitment from senior management.		
Publicise the project.		
Appoint a Champion and set up the project team.		
Overcome barriers to progress.		
Educate and train staff.		
Map your processes.		
Compile an inventory of processes.		
Compile an inventory of inputs, including water and energy.		
Compile an inventory of products.		
Compile an inventory of wastes and emissions.		
Complete the data assessment table.		
Rank priorities for reducing waste and energy use.		
Identify monitoring requirements.		
Identify opportunities for reducing waste and energy use.		
Set targets.		
Develop an Action Plan to achieve continual improvement.		
Publicise quick results.		
Talk to suppliers, customers, contractors, etc.		
Contact the Environment and Energy Helpline on 0800 585794.		
Your ideas:		

9 USEFUL PUBLICATIONS

The following list contains current publications of relevance to engineering manufacturers. **These publications are available free of charge through the Environment and Energy Helpline on 0800 585794.**

Publications specific to the engineering industry

- A series of Environmental Performance Guides that provide benchmarking data on material use in the metal finishing industry. Advice is given on how to optimise material use and improve performance compared to your competitors.
  - Environmental Performance Guide (EG44) *Acid Use in the Metal Finishing Industry*
  - Environmental Performance Guide (EG45) *Water Use in the Metal Finishing Industry*
  - Environmental Performance Guide (EG46) *Acid and Water Use in Galvanizing*
  - Environmental Performance Guide (EG72) *Paint and Powder Coating Use in the Metal Finishing Industry*
  - Environmental Performance Guide (EG74) *Solvent Use for Vapour Cleaning in the Metal Finishing Industry*

- Good Practice Guide (GG101) *Reducing Vacuum Costs.* Operating your existing vacuum system could reduce your running costs by at least 10% through reduced water consumption and effluent production. This Guide provides practical advice to help companies achieve cost savings and other benefits by optimising their vacuum systems.

- Good Practice Guide (GG43) *Environmental Management Systems in Foundries.* This Guide provides practical advice to foundries wishing to take advantage of the benefits offered by an environmental management system (EMS). A set of forms is provided, with worked examples, for foundries to photocopy and use to develop their own EMS.

- Good Practice Guide (GG118) *Environmental Management Systems Workbook for Metal Finishers.* This Guide provides metal finishers with the tools needed to implement an environmental management system (EMS). A set of forms is provided, with worked examples, for metal finishers to photocopy and use to develop their own EMS.

- Good Practice Case Study (GC49) *Environmental Management System Improves Performance.* This Case Study at Wolstenholme International Ltd demonstrates the economic and environmental benefits of implementing an environmental management system (EMS) at a medium-sized manufacturing company.

- Good Practice Case Study (GC59) *Environmental Improvements Reduce Costs.* This Case Study at RHP Bearings Ltd demonstrates how incorporating environmental issues into existing management systems can result in cost savings and environmental benefits.

- Good Practice Case Study (GC161) *Minimising the Use of Die Lubricant in Casting Operations.* Minor changes to process equipment at Honda of the UK Manufacturing Ltd's Swindon site dramatically reduced the consumption of die lubricant when casting aluminium, resulting in significant financial and environmental benefits.

- Good Practice Case Study (GC22) *Simple Measures Restrict Water Costs.* A series of good housekeeping measures identified by short-term monitoring of water use helped N T Frost, a medium-sized electroplating company, to significantly reduce its annual water costs.

- Good Practice Case Study (GC24) *Effluent Costs Eliminated by Water Treatment.* Installation of a closed-loop water treatment system based on ion exchange technology allowed Amphenol Ltd to reduce water use and eliminate trade effluent charges.

- New Practice Case Study (NC11) *Rinsing and Chemical Recovery System Achieves Large Savings.* Installation of an atmospheric evaporation system combined with countercurrent rinsing on automatic and manual electroplating lines at Goldrite Metal Finishing Ltd reduced consumption of water and plating chemicals and enabled the Company to satisfy new discharge consent limits.

- A series of four complementary Good Practice Guides to help paintshop and production managers steer clearly through the range of choices now available.
  - Good Practice Guide (GG50) *Cost-effective Paint and Powder Coating: Materials Management*
  - Good Practice Guide (GG51) *Cost-effective Paint and Powder Coating: Surface Preparation*
  - Good Practice Guide (GG52) *Cost-effective Paint and Powder Coating: Coating Materials*
  - Good Practice Guide (GG53) *Cost-effective Paint and Powder Coating: Application Technology*

- *Encore* (**En**vironmental **Co**ating **Re**commendations) (IT90). This PC-based tool is a simple-to-use advisory system for selecting low-solvent coatings for a wide range of metal finishing applications.

- Good Practice Case Study (GC34) *Emission-free Mixing Creates a Stir.* Use of a new paint mixing system based on vibration rather than stirring allowed BASF Coatings and Inks Ltd to improve yield, reduce mixing times, reduce energy consumption and virtually eliminate VOC emissions from the mixing process.

- Good Practice Case Study (GC136) *Small Company Benefits from HVLP Spray Guns.* New high volume low pressure (HVLP) spray guns and a fully enclosed spray gun cleaning unit allowed DB Partners Ltd to reduce solvent use and demonstrate compliance with environmental legislation.

- A number of Good Practice Case Studies describe the economic and environmental benefits of taking action to minimise solvent and paint use in vehicle paint shops.
  - Good Practice Case Study (GC108) *Profiting from Computer-based Solvent Management* (Ford Motor Company Ltd, Halewood site)
  - Good Practice Case Study (GC77) *Vehicle Refinisher Saves Money by Reducing Paint and Solvent Use* (Browns of Loughton Ltd)
  - Good Practice Case Study (GC162) *Paint Monitoring Software Reduces Paint and Solvent Use* (David Singer, Boston Car Care Centre)

- A number of Case Histories from regional waste minimisation projects demonstrate the benefits achieved by engineering companies that have implemented a systematic approach to waste minimisation.
  - Case History (CH165) *Waste Minimisation Leads to Business Growth* (Kawneer Europe Ltd)
  - Case History (CH115) *Engineering Process Optimised to Reduce Scrap Metal* (Apollo Sports Technologies Ltd)
  - Case History (CH75) *Packaging Redesign Increases Profits and Efficiency* (Iveco Truck Ltd)
  - Case History (CH64) *Increasing Quality and Profits by Designing Out Waste* (Swift Group Ltd)
  - Case History (CH65) *Statistical Process Control Saves Money* (Fenner Conveyor Belting)

- Innovative ways of improving the environmental performance of companies involved in coating and metal finishing activities are the subject of a number of Future Practice projects.
  - Future Practice Final Results (FP76) *Reducing Costs and Wastes In Industrial Coating Operations*
  - Future Practice Final Results (FP9) *Efficient, Emission-free Mixing*
  - Future Practice Introduction (FP91) *Designing Out the Costs of Hard Chrome Plating*
  - Future Practice Introduction (FP92) *Cost-effective Treatment of Waste Oily Water*
  - Future Practice Introduction (FP94) *Cost-effective Metal Recycling from Industrial Effluents*

Generic publications to help companies use solvents wisely

- Good Practice Guide (GG15) *Vapour Degreasing.* Large quantities of organic solvents are used for component cleaning during the manufacture of metal products. This Guide describes practical measures to reduce solvent consumption and thus reduce costs. Measures to protect the health and safety of employees are also emphasised.

- Good Practice Guide (GG28) *Good Housekeeping Measures for Solvents.* This Guide describes practical and affordable measures to help companies save money by reducing the quantity of solvents they use, and at the same time, reduce their VOC emissions.

- Good Practice Guide (GG114) *Reduce Costs by Tracking Solvents.* This Guide describes how to compile a solvent inventory and how to use a computer spreadsheet to prepare a simple solvent mass balance for your site. The Guide is supplied with a disk containing both an example and a blank computer spreadsheet.

- Good Practice Guide (GG13) *Cost-effective Solvent Management.* This Guide describes a six-step solvent management framework to help companies save money and reduce their environmental impact through effective management of organic solvents.

- Good Practice Guide (GG124) *Solvent Management in Practice: Industry Examples.* This Guide describes how 19 companies from a variety of industries and sectors have achieved cost savings and other benefits by taking action to reduce their use of solvents and solvent-based materials through improved solvent management. Five of the Industry Examples are from the metal finishing/engineering sector.

- Good Practice Guide (GG71) *Cost-effective Reduction of Fugitive Solvent Emissions.* This Guide describes techniques that can be used to reduce the cost of organic solvents lost as leaks from pipework components. It indicates the many sources of fugitive emissions and presents a fugitive emission control strategy.

- Good Practice Guide (GG12) *Solvent Capture for Recovery and Re-use in Solvent-laden Gas Streams.* This Guide describes proven technologies and techniques for the capture, recovery and subsequent re-use of organic solvents from solvent-laden gas streams. Adsorption, condensation and absorption (scrubbing) are considered in detail and recent developments outlined.

- Good Practice Guide (GG100) *Solvent Capture and Recovery in Practice: Industry Examples.* This Guide contains eight Industry Examples which demonstrate the cost savings and environmental benefits to companies from installing solvent recovery equipment.

Other generic publications useful to the engineering industry

- Good Practice Guide (GG82) *Investing to Increase Profits and Reduce Wastes.* This Guide describes the cost savings and other benefits associated with investment in technology that produces less waste. It explains how to assess the financial benefits of cleaner technology and outlines ways of financing capital investments. A simple worked example shows the use of investment appraisal techniques to select the cleaner technology options that generate the most financial benefit.

- Good Practice Guide (GG152) *Tracking Water Use to Cut Costs.* A water balance is a management tool which provides managers with an overview of the major uses of water on their company's site. This Guide describes a five-step procedure for constructing a water balance and explains how a water balance can help to identify water and cost saving opportunities.

- Good Practice Guide (GG67) *Cost-effective Water Saving Devices and Practices*. This Guide describes a range of cost-effective water saving devices and practices applicable to industrial and commercial sites. It highlights the typical water savings that can be achieved for industrial and commercial applications and explains how to identify the most appropriate devices and practices for specific equipment, processes or sites.

- Good Practice Case Study (GC61) *Low Cost Measures Save Water at a Multi-site Company*. Installation of push taps, cistern volume controls and flush controls helped to control water use at 109 sites operated by wholesale food distributors, Booker Belmont Wholesale Ltd. Significant savings were achieved without adversely affecting the day-to-day running of the business.

- Good Practice Guide (GG37) *Cost-effective Separation Technologies for Minimising Wastes and Effluents.* Using separation technologies as part of the production process can prove more cost-effective than using a larger effluent treatment plant. The Guide describes proven techniques for the separation of dissolved substances from liquids and the separation of gases from liquids.

- Good Practice Guide (GG54) *Cost-effective Membrane Technologies for Minimising Wastes and Effluents.* This Guide explains the basic principles and describes applications of the main membrane technologies - ultrafiltration, reverse osmosis, nanofiltration and microfiltration. Advice on membrane selection and details of other commonly available technologies are also given.

- Good Practice Guide (GG109) *Choosing Cost-effective Pollution Control.* This Guide describes a step-by-step approach designed to help companies save money by choosing the most suitable pollution control measures for their site as part of an overall waste management strategy. It is primarily concerned with airborne emissions and aqueous effluents.

- Good Practice Guide (GG140) *Cutting Costs and Waste by Reducing Packaging Use.* This Guide, which is applicable to companies of all sizes, provides practical advice on how to save money by managing packaging effectively. It explains the principles of packaging management, monitoring and minimising the amount of packaging waste produced.

- Good Practice Guide (GG141) *Choosing and Managing Re-usable Transit Packaging.* This Guide is intended to help companies achieve cost savings by redesigning packaging specifically for several journeys between particular suppliers and consumers. It also considers the logistics of managing a re-usable packaging scheme effectively.

- Good Practice Case Study (GC131) *Profit from Packaging Changes.* This Case Study at Polaroid (UK) Ltd demonstrates the significant financial and environmental benefits of making simple changes to reduce incoming and outgoing packaging.

Generic waste minimisation publications

- *Saving Money Though Waste Minimisation: Getting Started* (GS25). This leaflet helps companies take the first steps towards a waste minimisation programme. It describes how to carry out an initial review to determine - or at least estimate - the true cost of waste to the company.
- A series of three complementary Good Practice Guides on waste minimisation which describe a systematic approach that can be incorporated within existing management systems. Tools and techniques for identifying opportunities to reduce waste are described.
  - Good Practice Guide (GG25) *Saving Money Through Waste Minimisation: Raw Material Use*
  - Good Practice Guide (GG26*) Saving Money Through Waste Minimisation: Reducing Water Use*
  - Good Practice Guide (GG27) *Saving Money Through Waste Minimisation: Teams and Champions*
- *Finding Hidden Profit - 200 Tips for Reducing Waste* (ET30). This compilation of short practical tips based on industrial experience is intended to stimulate ideas for reducing waste.
- WMIT (**W**aste **M**anagement **I**nteractive **T**ools) (IT96). This PC-based software tool helps companies identify the sources of their waste, calculate its true cost and take practical steps to reduce it.
- Good Practice Guide (GG38C) *Cutting Costs by Reducing Waste: A Self-help Guide for Growing Businesses.* This Guide contains practical advice to help a company develop its own waste reduction programme.
- Good Practice Case Study (GC16) *Sites Set on Cost Savings.* This Case Study at Merck Ltd demonstrates the financial and environmental benefits of a corporate approach to waste minimisation.
- Good Practice Case Study (GC19) *Waste Minimisation Pays Major Dividends.* This Case Study at Walkers Snack Foods Ltd demonstrates the economic and environmental benefits of a structured approach to waste minimisation at a major manufacturing site.
- Good Practice Guide (GG125) *Waste Minimisation Pays: Five business reasons for reducing waste.* This Presenter's Guide contains everything you need to make a 40-minute presentation on the key financial reasons for making a commitment to waste minimisation. It includes handouts and overheads on templates and disk.
- Good Practice Guide (GG106) *Cutting Costs by Reducing Waste: Running a workshop to stimulate action.*
- Good Practice Guide (GG174) *Profiting from Practical Waste Minimisation: Running a workshop to maintain the momentum.*

- Approaches to stimulate environmental improvement down the supply chain are discussed in two draft Good Practice Guides, produced for trial purposes:
  - Good Practice Guide (GG112A) *Business and Environmental Improvement Through Supply Chain Partnership: Mentor Guide.*
  - Good Practice Guide (GG112B) *Business and Environmental Improvement Through Supply Chain Partnership: Supplier Guide*.