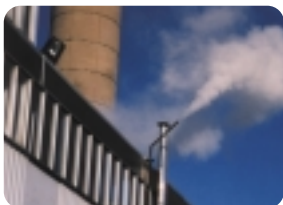


Resource Efficiency



A management guide

Foreword

The practice of using resources efficiently has always been fundamental in maintaining business competitiveness in a dynamic market place, by driving down costs throughout the supply chain. However, it is now in the spotlight as a 'win-win' route for businesses to minimise their impact on the environment as well as maximise their business efficiency.

Written with business leaders in mind, this guide provides a comprehensive introduction to the economic and business case for implementing effective resource efficiency throughout your business.

By highlighting best practice initiatives which make sense in their own right, and not just in response to environmental regulations or taxes, the aim is to maximise your ability to meet the challenges of competition in the 21st Century.

Altering the production process to enable better use of resources may require initial investment, but if the business case is properly thought through, the benefits to your stakeholder relationships and ultimately your bottom line could be substantial.

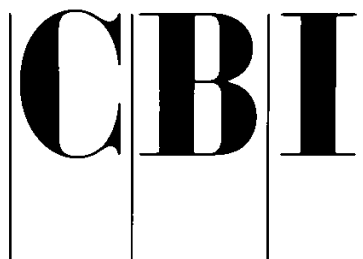
Covering the opportunities and challenges of resource efficiency, this latest guide from Envirowise makes a useful contribution to running your business.



Digby Jones

Director-General

Confederation of British Industry



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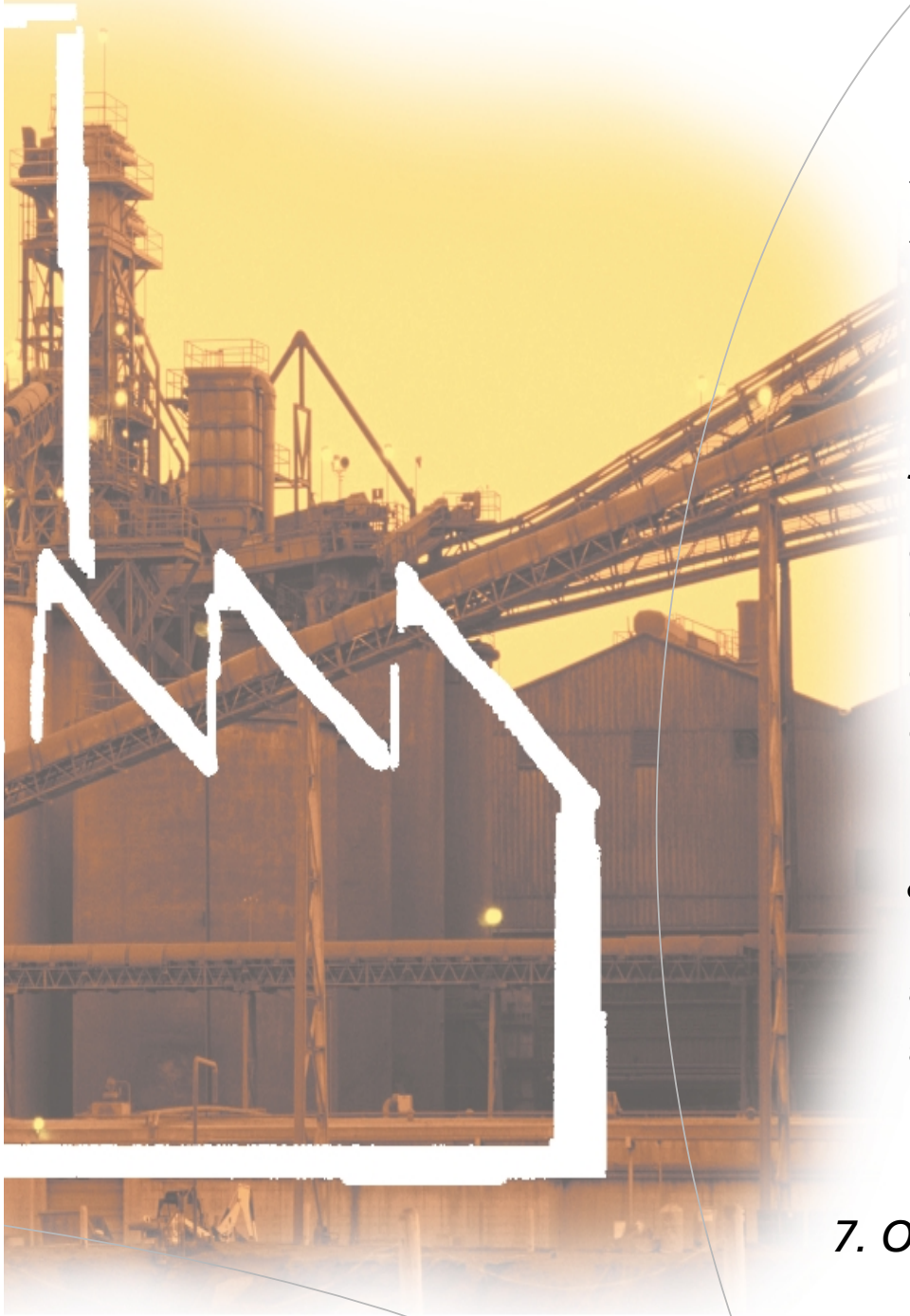
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Introduction

Companies are constantly searching for ways to become more efficient.

Resource efficiency – maximising output of product or service from a given level of materials and energy – is about increased productivity, and hence profits; about ensuring the greatest return on investment; and about the identification and exploitation of competitive advantage.

Resource Efficiency: a management guide, via a simple industrial model, offers an initial foray into where, how and when such objectives may be realised.

Much has been made of the business/environment 'win-win' scenario, not least via the Envirowise programme itself. We know that environmental improvement measures *can* serve business ends. Businessmen are not altruists, however; such measures do not exist in a vacuum, but rather must withstand rigorous commercial scrutiny on grounds of return of capital employed, payback terms and strategic vision.

Can measures ostensibly geared towards environmental improvement stand up to such scrutiny? The Government's Cabinet Office Performance and Innovation Unit has noted that resource efficiency offers "the potential to increase levels of economic output and rates of economic growth for a given level of resource use, or to reduce the environmental impacts of economic activity through reduced resource consumption in achieving the same level of economic output". Meanwhile, the UK's productivity and competitiveness are lower than that of many other OECD countries, including the US, France and Germany.

Resource Efficiency: a management guide offers an insight into the potential offered by improved asset utilisation. To do this, the guide is split into three broad sections:

Inputs identifies changing pressures on the supply of materials and utilities.

Production measures are split into investment cycles – short, medium and long-term.

Outputs addresses everything that leaves the plant – to air, water, land or as finished product.

Many of the issues presented in this guide may seem straightforward. The real message is one of making sure that the obvious ways of reducing waste and saving money are not overlooked. Often, the simplest of actions produces the greatest rewards. Even if some of the ideas presented here are not new, are they common practice? The Environment and Energy Helpline, on freephone 0800 585794, can give you free, up-to-date information on a wide range of cost-saving issues, legislation and technologies. If you are a small company (fewer than 250 employees) you may be offered a free Counselling or Fast Track Visit from one of the helpline's expert panel of 40 environmental professionals.

1. Inputs: materials

1.1 Sourcing and management

The product a business sells, whether in the manufacturing or service sector, determines the raw materials it uses. However, within that limitation a business can exercise choice in sourcing materials and in how it manages materials usage. The last century has witnessed an explosion in our knowledge and understanding of materials; traditional materials have been improved, and new materials have been synthesised.

There is, therefore, a large and ever-increasing pool of materials available to product designers: glass can be stronger than steel; ceramics remain rigid whilst white-hot. A product designer needs to know what materials are available, how they behave in use and how they can be worked or processed during manufacture and construction.

In assessing your own materials usage, a good starting point is to conduct a product analysis – an examination of a range of existing products, including that of competitors – and ask yourself whether alternative materials might offer previously unconsidered benefits. Lightweight materials in the transportation/automotive sector, for example, such as plastics and aluminium alloys, reduce the amount of fuel and hence operating cost, required.

The following Envirowise publications provide further information:

GG25 Saving money through waste minimisation: Raw Material Use
GG194 Increasing Profit through Improved Materials Additions

Publications which address materials usage on a sector-specific basis are also available via the Envirowise website or the Environment and Energy Helpline.

1.2 Life-Cycle Analysis

Life-Cycle Analysis (LCA) is a well-developed theory used in many product manufacturing lines, such as the automotive industry. The obvious advantage of LCA is that it enables companies to view the wider, holistic approach to the environmental impacts of their products. In simple terms, LCA has been linked with the term 'Cradle to Grave', whereby a product is traced back to its individual materials through to its end-life, e.g. recycling.

The idea of LCA is simple: to get as much as practically possible out of the product with the least environmental impact over its lifetime.

LCA can help an organisation understand its processes and product lines, in order not only to reduce its overall environmental impact, but also to raise awareness and competitive drive down the supply chain.





A typical LCA can be simply viewed with the following guidelines:

- Target a product line
- Identify the overall scope of the product (who is involved at the initial stages?)
- Assess the overall impact of the different elements of the product throughout its life-cycle
- Target those areas where the impact is high, such as disposal, and develop strategies to reduce those impacts. Can the product be re-used or recycled, for example?
- Engage the viewpoints and ideas of those involved in the manufacturing process (including suppliers), as well as other stakeholders such as consumers and act on those
- See LCA as an opportunity to improve product specification whilst reducing costs, as well as significantly improving company image to consumers, investors and other stakeholders through the management of environmental impacts

The following Envirowise publication provides further information:

ET257 Life-Cycle Assessment – An Introduction for Industry

It is available free of charge from the Environment and Energy Helpline on freephone 0800 585794.

1.3 Supply Chain Management

Supply Chain Management (SCM) provides the opportunity for organisations to control and reduce resource flows to a far wider extent. It is becoming more commonly accepted, and financially prudent, to investigate and interact with those involved further down the chain. Most organisations have reaped benefits from such interaction without recourse to heavy-handed tactics, instead fostering a commitment from both ends to strengthen and enhance business ties in particular business fields or commodities.

Such co-operation represents a natural progression and can have tangible benefits in terms of reduced costs, quicker transfer times and fewer quality failures. Less tangible benefits include solidified business links and a greater understanding and awareness throughout the supply chain. Investigating modern and innovative methods of delivering products can also bring benefits. Older process lines are often extremely inefficient (fuel, maintenance, etc), and as such capital expenditure is usually paid back quickly, with the increased dividends of lower future costs and reduced environmental impact.

2. Inputs: Water

2.1 A cheap and plentiful resource?

Water has for many years been considered a cheap and plentiful resource, and depositing wastewater to drain a cheap method of disposal. It has been common practice for systems to be designed and operated with little attention to water losses. Charges for water consumption and for the discharge of effluent from industrial sites have risen dramatically, however, as water companies seek to recover the 'true' costs of the services they provide.

Putting it bluntly, there is no industry without water. Water is the most common solvent, heat transfer medium and cleaning fluid, and often forms a significant proportion of any finished product. Most suppliers have fitted meters to the supply of industrial customers in order to make the charging system fairer. If you do not have a meter fitted to your supply, however, you can contact your water supplier who will arrange the necessary work – for a small charge.

- In the speciality chemicals sector alone, annual costs for water supply, treatment and effluent discharge amount to over £600m
- Water usage in heat transfer applications is estimated to account for 40 per cent of total industrial use, amounting to over 200 million litres per day
- By recycling and the use of appropriate waters, a 20% reduction in industrial water use is a realistic target

The following Envirowise publications provide further information:

GG026 Saving Money Through Waste Minimisation: Reducing Water Use

GG067 Cost-effective Water Saving Devices and Practices

GG152 Tracking Water Use to Cut Costs

GC22 Simple Measures Restrict Water Costs

GC110 Water and Cost Savings from Improved Process Control

Many additional guides and sector-specific good practice information is also available free of charge from the Environment and Energy Helpline on freephone 0800 585794.

2.2 Measurement and usage

In many cases, water charges can be dramatically reduced with simple changes in operating practices or maintenance procedures. Developing a water reduction programme – which involves drawing up a water mass balance to identify water use and wastage, allocating consumption, identifying water saving ideas, maintaining savings and reporting success – can deliver substantial cost savings. It is also quite possible that an effluent stream from one process may be a suitable feed stream for another process. Similarly, an effluent stream can be modified to make it suitable for use either as a feed stream for the same or alternative process. This approach typically involves the use of some form of hardware, e.g. reverse osmosis or filtration.



2.3 Quality and usage

The efficient use of water also involves matching available water sources with water use. For example, a cheaper industrial water is often best suited for use in an open, evaporative cooling system where the use of potable water would be unnecessary. On the other hand, the feed water for a high pressure boiler must be of high quality with as little contamination as possible to assure ongoing safe operation of the system.

As water becomes more expensive, the use of alternative sources begins to prove economically viable. Boreholes, rivers and canals are all potential sources of so-called 'grey waters' which can be used in some systems where potable water may currently be in use. However, care must be taken when considering a change to the feed water of any industrial system.

The mechanical issues associated with use of alternative water sources are often fairly simple, involving the installation of pipes, pumps and other associated hardware. The chemistry issues, however, can be very complex and it is important to carefully consider this before any changes are made. If inappropriate water is used in a system the consequences can lead to system downtime, increased costs and, in extreme cases, plant can be irreparably damaged.

Case study

Hanson Brick

Hanson Brick manufactures bricks, including the famous Stock bricks of Southern England. The 'Soft Mud' brick-making process used at its Tilmanstone works in Kent requires large quantities of water in order to wash the used sand from the brick moulds. To reduce water consumption and enable the sand to be recovered, a new recycling system has been installed by Hanson Brick in association with VisionInvest, which supplied the system.



Two-year payback

The new process, awarded a commendation in the 'Industry and Business' category of the 2000 Water UK and Environment Agency Water Efficiency Awards, separates the water from the sand, ensuring that the water can be reused in the soft mud plant. The recovered sand is then reused as facing sand to line brick moulds. Installing the new system has meant that daily water consumption has been reduced from 1,150m³ to 330m³, an annual saving of almost 300,000m³ of water, or 71 per cent. Sand consumption has been reduced by 700 tonnes per year, reducing the environmental impact of the company's core product. Financial savings are estimated at £40,000 per year. This means the initial investment of £84,000 will be paid back in just over two years.

3. Inputs: Energy

3.1 Opportunities for improving efficiency

Through Government policies to meet the UK commitments to the Kyoto Protocol we are all being urged to use energy more efficiently. Whilst many environmental policies and regulations can lead to extra costs being borne by industry, the opportunities for improving energy efficiency are almost always cost-effective in their own right and lead to an excellent win-win opportunity for businesses. Energy consumption and costs can be reduced through the implementation of projects with short payback periods and, at the same time, harmful emissions of greenhouse gases can be reduced.

Until recently energy efficiency has been somewhat neglected by many businesses. In the last ten years we have seen relatively low fuel prices and there have been excellent opportunities to reduce costs by good negotiation with the recently privatised energy industry. In the 1990s the focus of business effort had moved away from reductions in energy consumption to the often more lucrative opportunity to obtain reductions in energy price.

We are entering a new era, in which it is essential that energy-related CO₂ emissions are reduced. The focus must return to reducing energy consumption and improving utility system efficiency. The Government has laid down a clear signal of the importance of this via the Climate Change Levy, which typically increases the price of energy by some 15 per cent. It has also set up the Carbon Trust, funded directly from money raised through the levy, to help focus on reducing carbon emissions through initiatives like the Energy Efficiency Best Practice Programme.

By adopting a positive and structured approach most companies can achieve these cost-effective energy savings with little or no risk. The technologies required to improve the efficiency of most equipment and processes has already been developed – we are not reliant on risky new ideas or equipment requiring further research and development. There is plenty of good equipment and experience available in the energy efficiency market to help make improvements.



ENERGY EFFICIENCY

The Energy Efficiency Best Practice Programme (EEBPP) is the UK Government's principal energy efficiency information, advice and research programme for organisations in the public and private sectors. Since it was established in 1989, it has helped many organisations to save up to 20 per cent of their energy bills, and stimulated UK energy savings of around £650m per year. It also maintains the biggest library of independent information on energy efficiency in the UK.

For further information on services offered by the EEBPP, or on specific energy efficiency measures, contact the Environment and Energy Helpline on 0800 585794.





3.2 Energy management

A two-stage approach will usually maximise both the level of energy savings and the cost-effectiveness of the initiative. This consists of:

- Implementation of a comprehensive energy management system
- Investment in carefully selected capital projects

The energy management system is critical to success. A well constructed energy management system will save between five and ten per cent of energy consumption with a payback period of less than one year. The vital second benefit of such a system is considerably improved data about the way that you use energy. This makes it possible to quickly and effectively focus attention on those parts of the process that are most in need of capital investment. With good data you can begin to build a coherent investment strategy to enable you to buy items of equipment that will further reduce your energy consumption. Typically you will then be able to save a further ten to 15 per cent on projects with payback periods varying between two and three years.

There are literally thousands of ways in which businesses can make improvements to their use of energy. This can, however, become a barrier as energy users might be confused about which investments to make, particularly if they are receiving conflicting information from equipment suppliers. You can avoid some of these concerns by adopting the approach described above, which should provide sufficient data for you to make confident investment decisions.

3.3 Investment opportunities

The types of equipment you may be considering could vary from small components such as controls to large investments involving the complete replacement of plant. A good approach is to review an energy-using system with four categories of investment opportunities in mind:

- Can the system be replaced with something fundamentally more efficient?
- Does the system design suit the application?
- Are individual components selected for optimum efficiency?
- How can operation and maintenance lead to maximum efficiency?

Eligibility criteria for the Enhanced Capital Allowance (ECA) scheme, introduced for energy efficient technologies in April 2001, are available on the internet at www.eca.gov.uk. ECAs offer a 100 per cent first year allowance for selected energy efficient technologies, compared to the normal capital allowance of 25 per cent on the balance brought forward each year. The criteria will set the standards for the eight eligible technology areas – combined heat and power, variable speed drives, pipework insulation, boilers, motors, refrigeration, lighting and thermal screens.

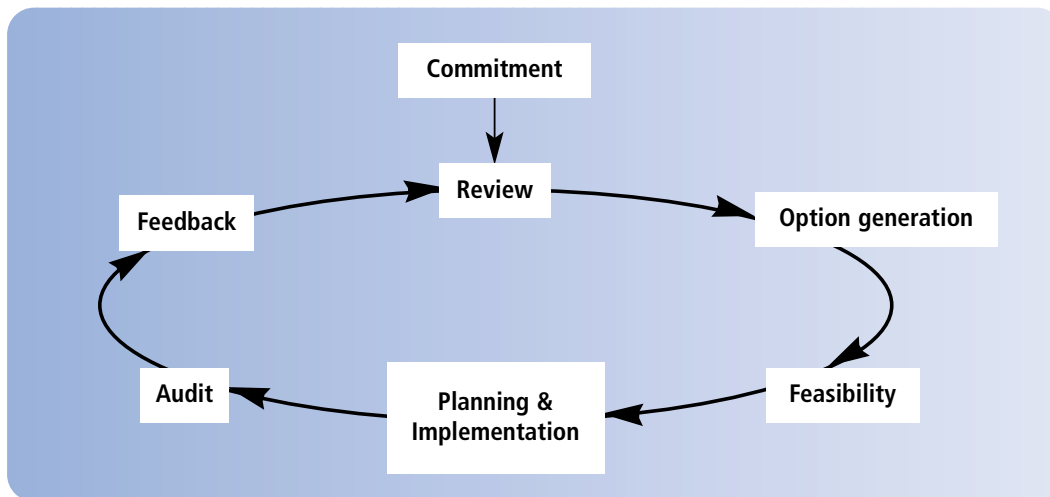
4. Operations: Short term

4.1 Waste minimisation

Waste minimisation is a systematic management technique for reducing waste. If applied effectively, it is a powerful tool for reducing resource use. For waste minimisation to bring the greatest environmental and cost benefits, it needs to include all wastes and focus on reducing waste at source by employing the waste hierarchy (see section 9).

Waste minimisation will often lead to rapid cost savings with very little input. As a general rule, manufacturing companies can expect to save about £1,000 per employee through effective waste minimisation. Indications from waste minimisation clubs are that about 60 per cent of the cost-saving projects companies have undertaken involved little or no capital cost.

The steps in a typical waste minimisation programme




As with almost any project, a successful waste minimisation programme starts with commitment – someone senior in the organisation has to support the project. This commitment has to be visible to all concerned. The waste minimisation team will vary over time and for different tasks. However, most companies that have been very successful have had a waste minimisation ‘champion’ who co-ordinates the overall programme and motivates staff to take part. The champion can come from any part of the company but they have to be seen to have the backing of senior management.

4.2 Waste arisings

It is important to determine where waste is arising in your company and how much it costs. There are a number of techniques that companies have used to undertake this. The simplest is to walk around the site looking at where waste is accumulating and seeing where it arises. Most staff will want to help reduce waste and it is essential to talk to them to find out where and why waste occurs.





Another approach to identifying waste is to produce a flow sheet for each identifiable process. Staff working in each section will naturally know more about their process than anyone else. By bringing them together and working out the inputs and outputs at each process, you will be able to identify most wastes. It is usually an eye-opening exercise. Few people realise how many wastes arise even from simple processes.

One of the best ways of generating options to eliminate waste is to run a brainstorming session, including, but not limited to, people involved in the process – outsiders can often bring a new perspective.

4.3 Targets and cost savings

It will not be possible to do all the options for waste minimisation at once and some may never get done. The important thing is to determine which options are feasible, set priorities for action and then get started. Good project management will help to ensure that waste minimisation delivers cost and environmental benefits. Within an overall programme, it is often possible to define discrete projects. The project will need to have targets for waste reduction and cost savings.

The project manager will be responsible for making sure that the project plan gets implemented. Although good project planning will help to ensure that projects progress, it is almost inevitable that production or other business issues will hinder progress at some stage and plans often need to be adapted or amended to account for unavoidable delays. After a waste minimisation programme has been running for some time, you will need to measure its progress against targets. This is usually termed auditing. Unfortunately, auditing often has threatening connotations – who, after all, looks forward to being audited? When auditing the programme, remember that the aim is to determine where successes have occurred and where problems or weaknesses have been encountered, so that they can be overcome.

It is very important that successes are communicated widely throughout the company. This will help motivate people who have been involved and encourage others to take part or at least be supportive. It will also help to confirm commitment.

The following Envirowise resources provide further information:

ET219 Waste Mapping: Your Route to More Profit and Video

V217 A Fresh Pair of Eyes

GG38c Cutting Costs by Reducing Waste

ET30 Finding Hidden Profit

The experience of other organisations can also be very useful in generating options and Envirowise has many case studies to learn from. In the UK, many companies have joined waste minimisation clubs, where they can share experiences. The Envirowise web site includes a map of waste minimisation clubs and the programme has produced a number of publications to help clubs. Visit www.envirowise.gov.uk

5. Operations: Medium term

5.1 Process optimisation

Shareholder return and business viability are fundamental management concerns and, on the whole, are the driving forces behind management decisions. Whilst historically environmental issues may not have been significant for companies, there is increasingly a link between environmental performance and company performance. Such environmental trends include:

- Cost increases imposed through legislation or financial instruments aimed at reducing environmental impacts
- Easier access to capital for companies with a record of good environmental performance
- Loss of customers based on environmental decisions
- Increased market share through opportunities based on green or ethical consumerism

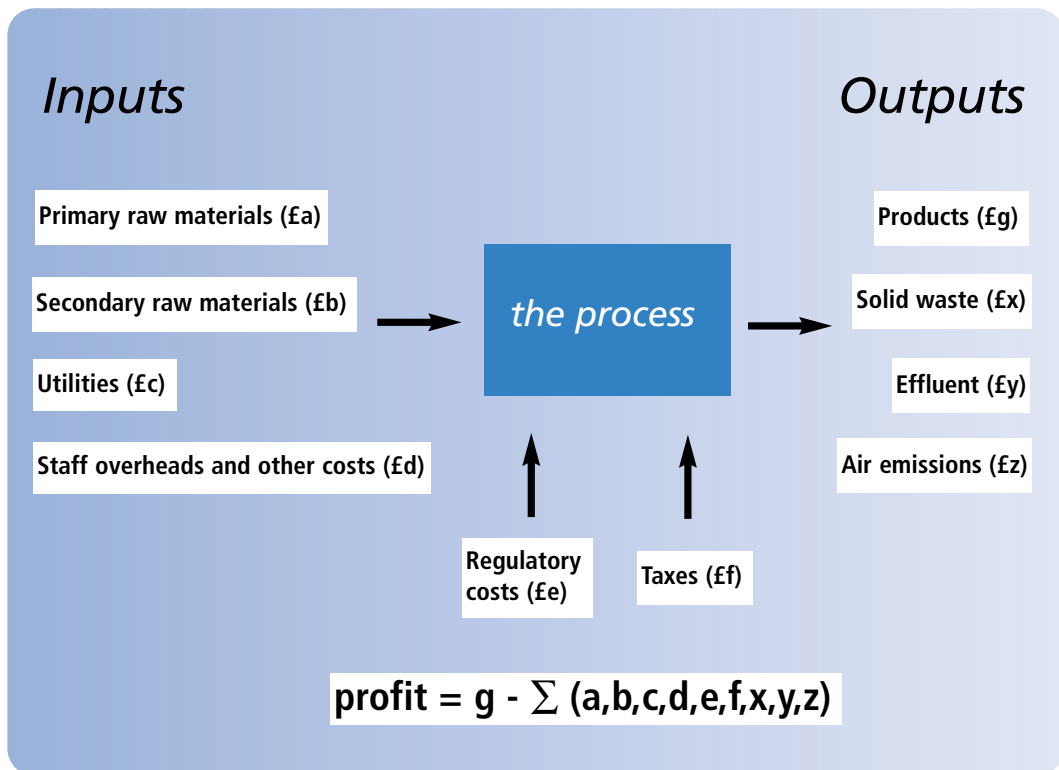
Significant savings can be made through low cost measures, but frequently environmental improvements demand new technologies and process adjustments with greater financial implications. This process of achieving maximum output from minimum input is sometimes referred to as process optimisation. With current environmental trends set to continue, companies may well find that a more comprehensive approach to environmental cost assessment in the investment planning and decision making process is commercially beneficial. As with all capital expenditure, appropriate financial justification needs to be made and options need to be reviewed. Methods of investment analysis through, for example, discounted cash flows, return on investment or pay-back period are used to make commercial judgements. Businesses often require payback within two to three years. However, in the case of process optimisation, the payback period is frequently impacted by environmental costs. Commercial judgements regarding process optimisation expenditure can therefore be skewed if environmental cost information is not available.

Companies which have analysed their environmental costs have found these can form a considerable proportion of operational costs and can be considerably higher than expected – sometimes up to 50 per cent higher. As a result, returns on investment to reduce environmental costs are frequently underestimated. The diagram overleaf demonstrates the implications of environmental cost on company profit. Simplistically, if environmental costs decrease profit will increase.

Few companies account for their environmental costs separately or comprehensively, therefore environmental costs for a particular process are frequently not available. In the same way that without individual water meters on process lines it is difficult to know where water use is significant, without environmental costs associated with a particular process line being identified, it is impossible to know the true environmental costs associated with a process.



The implications of environmental cost



5.2 Extracting costs

Environmental costs linked to a particular process, but frequently difficult to extract from management accounting information, include:

- Waste disposal and treatment
- Raw material inputs and losses from the process
- Staff time spent undertaking environmental activities
- Energy and water costs required to maintain the process
- Regulatory expenses including monitoring and testing
- Future compliance costs
- The wider business implication of process optimisation

In addition to the reduction of direct operational costs, process optimisation can support a company in achieving wider, often intangible, business goals. As a significant part of reducing environmental impact, process optimisation can be used to manage environmental risks and assist in achieving business strategies.

Superior environmental management resulting from process optimisation can lead to improved environmental compliance. This can reduce possible legal and recurring regulatory costs. Additionally, although difficult to calculate, the costs of protecting or enhancing corporate image, maintaining staff loyalties and satisfying other stakeholders through improved environmental management and performance should be considered.

Further points to consider:

- Investment in technologies can support business strategy goals. Carbon is a particular example where commitments to reach greenhouse gas (GHG) emission reduction targets, either through emissions trading or to retain a climate change levy rebate, may require process optimisation if production rates are to be maintained or increased.
- High levels of environmental performance and environmental risk management is frequently demanded and, in some cases audited for, by customers. Process optimisation can play a part in satisfying the demands of customers.
- Shareholders examine environmental performance for inclusion of companies into the increasing volume of socially responsible investment portfolios, but also increasingly as a demonstration of good business management for fund management decisions in general.

bpi.industrial

Case study


Plastics company bpi.industrial is saving more than one million pounds every year by eliminating waste at source. The company has implemented an ongoing waste minimisation and efficiency programme, focused primarily on raw material and motor efficiency. The environmental and economic benefits of the scheme have been significant:

- *a 1,500 tonne reduction in annual polymer utilisation has resulted in annual savings of over £445,000*
- *switching to solvent-free inks has delivered savings of £50,000 per year and reduced bpi.industrial's capital outlay by £1 million*
- *smaller, high efficiency motors are saving £20,000 and 500,000 kWh/year of electricity. The new motors have also delivered a 7% increase in machine utilisation and boosted potential production by 1,000 tonnes per year.*



5.3 Environmental Management Systems (EMS)

Environmental management systems can enable the identification of opportunities for process optimisation and improved resource efficiency. A good EMS can provide a robust framework for the evaluation of opportunities for cost saving, through better operational control of inputs, processes and outputs.



The avoidance of risk (environmental, financial, liabilities and health and safety related) and identification of business opportunities (product innovation, market differentiation) inherent in an EMS is recognised by investors who are increasingly citing the existence of a thorough management system as evidence of the quality of a company's management and of its longer-term performance.

As well as generating a culture of proactive rather than reactive management, an EMS encapsulates organisational best practice, leading to better knowledge management – e.g. if key personnel leave the organisation, the management processes, training programmes, data and records minimise any resultant business interruption. Additional benefits include:

- Improved access to investment funding and reductions in insurance premiums through more effective risk management
- Improved supply chain relationships (moving away from purchasing and towards mutually beneficial partnerships), including management of supply chain-based impacts and risks
- Improved long-term business and financial planning
- Improved legal and contractual compliance (cost avoidance)
- Ability to link to product systems – paving the way for longer-term product re-design
- Ability to demonstrate environmental improvement to a broad range of stakeholders – e.g. regulators, investors, shareholders, employees and local communities
- Ability to identify a range of no-cost or low-cost performance improvements
- Enhancement of waste minimisation and waste management

The following Envirowise publications provide further information:

GC049 Environmental Management System Improves Performance
ET189 EMS in Printing: Assessing the Significance of Your Environmental Impacts
GG251 Environmental Management Systems for the Plastics Industry
GG118 Environmental Management Systems Workbook for Metal Finishers
GG137 How to Set Up Environmental Management Systems in the Textiles Industry
GG151 Environmental Management Systems in Paper Mills
GG043 Environmental Management Systems in Foundries
EG123 Speciality Chemicals Manufacture: Staying Competitive Through EMS
GG205 Environmental Management Systems Workbook for Engineering Manufacturers
GC144 Profiting from Systematic Environmental Management

Many additional guides and sector-specific good practice information is also available free of charge from the Environment and Energy Helpline on freephone 0800 585794.

6. Operations: long term

6.1 Long-term competitiveness

Together with innovation and human resource development, resource productivity (the amount of physical resources used per unit of value produced) will be critical to the long-term competitiveness of most companies. Using raw materials more wisely and reducing waste may not always bring dramatic cost savings in the short term, but will make a significant contribution over time.



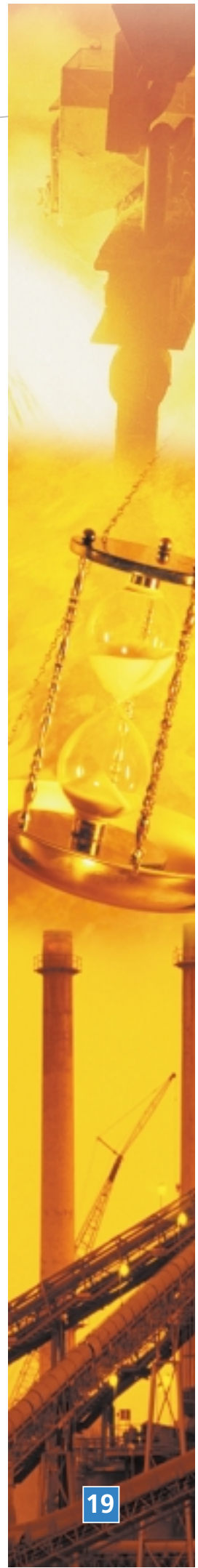
Companies also innovate through continuous improvement, or by making more radical changes to their products and services. Here quality and price are typically the main considerations, but again the wise use of resources can be vital. By searching for ways of delivering function and value to the customer using fewer resources a company may find a more innovative solution to a design

problem, while also capturing cost and reputational benefits. All companies can now benefit from this perspective, not just those that would have been green niche players in the past.

6.2 Low-resource innovation

Continuous improvements in resource productivity and smarter low-resource innovations do not come out of a vacuum; they depend on management commitment and a clear strategy. A strategy on resource productivity needs to be something that is integrated across the whole organisation, including the innovation, production, marketing and financial control functions. The objective would be to achieve radical improvements in resource productivity and to move towards the use of less damaging resources (renewable and non-toxic materials, for instance). The strategy would take account of the full life cycle of products – resource-efficient processes producing low-resource and low-waste products.

Performance measurement and target-setting will be critical to an effective and credible strategy towards radical improvements in resource productivity. Many companies have targets for improving environmental performance. Far fewer have resource productivity targets that set ambitious goals. Some targets will be set through policy – such as the agreements on energy efficiency improvements reached under the Climate Change Levy – while others will be set internally by the company. There is common agreement that most industrial activities could be made more productive in their use of resources. Some commentators argue that 5-10 fold productivity improvements are achievable over the longer term (10-20 years). Ambitious companies will see this as a benchmark against which to measure their own progress.



6.3 Product redesign

Companies can become more efficient in what they do, but in the long term their real contribution to improving the way we use resources will depend on their ability to innovate and provide more sustainable solutions to the final consumer. Beyond promoting efficiency in existing operations, a strategy for resource productivity would also emphasise the market potential of new products. Sustainable design challenges innovators and generates products consumers increasingly want. Some simple design rules have been developed that emphasise the use of low-carbon, low-toxicity and renewable materials in energy efficient products.

The GEM Venturi Steam Trap

Case study

The reliability of steam traps vary considerably, but they all represent a drain on maintenance resources because they all fail. If a trap fails open it loses excessive amounts of steam. In fact, surveys have found that more than 40 per cent of all steam traps jam, and estimate that the UK loses around £3bn of steam per year as a result. If, however, a steam trap fails closed it causes, at best, impaired heat output and productivity or, at worst, water hammer and explosions.



Nineteen per cent savings on fuel, 19 per cent reduction in CO₂ and NO_x emissions, low maintenance and no major operational problems: these are the findings of an independent ETSU case study examining the performance of the GEM Venturi Steam Trap. Invented by Tim Gardner and manufactured by Gardner Energy Management of Bristol, the revolutionary trap works by releasing a continuous flow

of condensate from steam lines through a specially configured venturi orifice. Condensate, which is 1,000 times denser than steam, is ejected through the venturi but the column of condensate awaiting ejection holds steam safely inside the system.

The ETSU study covers the traps' performance over one year at the laundry of Withington Hospital in Manchester, where continual and costly testing and replacement of steam traps had never managed to curb the growth of "an unsightly plume of some 500kg/hr of steam from the vent pipe on the condensate receiver, and associated energy losses". The study showed that, after replacing 11 of the 65 steam traps in the laundry with GEM traps, the vent steam flow was down to 59kg/hr, an overall reduction of 89 per cent. Annual savings totalled £10,350 (£8,570 on energy and £1,780 on treated water make-up).

7. Outputs: Air



7.1 Emissions management

All polluting industrial operations require some form of licence, which normally require emissions monitoring either on a regular or continuous basis. Typically, emissions will include sulphur dioxide (SO₂), oxides of nitrogen (NO_x), carbon monoxide (CO), oxygen (O₂), volatile organic compounds (VOCs) and particulates. Some industries have to monitor emissions for a more comprehensive range of hazardous pollutants, such as hydrogen sulphide (H₂S), hydrogen fluoride (HF) and hydrogen chloride (HCl). Condensed water plumes, too, from cooling towers and drying processes, are not only potentially visibly intrusive but can have impacts on crop yields and road safety.

Monitoring, besides providing information for regulators, can, in the case of VOCs, help in the reduction of solvent consumption and identify opportunities to reduce solvent costs and emissions as part of a solvent management programme.

The following Envirowise publications provide further information:

GC146 Detecting and Reducing Fugitive Emissions Saves Money

GG071 Cost-effective Reduction of Fugitive Solvent Emissions

GC068 Filter Out Black Smoke Emissions


GG203 Monitoring VOC Emissions: Choosing the Best Option

Many additional guides and sector-specific good practice information is also available free of charge from the Environment and Energy Helpline on freephone 0800 585794.

7.2 Fugitive emissions

Fugitive Emissions are often interpreted to be clouds of dust, smoke or vapour coming out of doorways and windows; fine material can be blown away from open storage areas, such as bays and stockpiles, particularly when the material is being moved by vehicles or open conveyor belts delivering or taking away the product. Similarly, materials can blow off the sides of open vehicles or conveyor belts. The solution to this problem is enclosing the areas, or the use of covers or binding materials.





Where liquids are delivered to bulk storage tanks, the material should be pumped into the bottom of the tank to reduce turbulence and airborne losses. This can also utilise a back venting system, for example, such that headspace vapours in the tank are returned to the delivery vehicle and not released to air. Deliveries and usage of materials can be metered, such that losses from tankage and piping are immediately identified. Where possible all ductwork and storage tanks should be bunded such that any losses are retained. Pipework should be regularly inspected and maintained to ensure that losses are minimised (from damaged pipes, leaking joints or valves). A programme of leak testing should be a part of the maintenance programme.

7.3 Loss prevention

When major losses are discovered investigations should be implemented to determine whether or not the material lost can be reclaimed. These types of losses do not only affect process raw materials, they can also involve utility supplies (water, gas, LPG), and saleable product materials. Here loss prevention/reduction parallels energy usage, in that in all cases the loss can be directly quantified in monetary terms. Effectively, where a company does not properly control its materials, products, energy or utilities, it may as well pour some potentially large proportion of its profits down the drain.

Fugitive losses from process lines, abatement systems or anywhere else may represent a nuisance or major hazard to the workforce, general population, environment, or all three. Government agencies are charged with ensuring that manufacturers provide safe working conditions for their employees, and a safe environment.

APW Electronics Ltd

Case study



A ten-year copper reduction and recovery programme by APW Electronics Ltd has produced cost savings of over £43,000 per year and significantly reduced copper levels in the company's trade effluent and the amount of copper waste requiring disposal. Savings were achieved by installing three electrolytic recovery cells, reducing the amount of copper-bearing waste water generated, recycling copper from deflash and taking action to reduce water use.

8. Outputs: Water

8.1 Increasing costs

Environmental awareness has increased rapidly in recent years and this is reflected in both the growth of legislation and the rapid escalation in effluent disposal charges. The cost of water supply and subsequent effluent treatment is proportional to the amount used/generated; and reducing resource use and waste generation has become one of the greatest challenges facing industry. These costs, previously regarded as insignificant or unavoidable, could now potentially affect commercial viability.

There are a number of drivers that will cause an increase in disposal costs for industry. The most important are:

- Trade effluent consents
- Legislation
- Public pressure

Water company prices for industry discharges to sewer are closely linked to domestic sewage disposal charges through the mechanism of parity. Parity is intended to ensure that industrial and domestic customers who discharge effluent of similar 'strength' should pay a similar charge. Before the introduction of parity, domestic customers effectively subsidised trade effluent discharges. In recent years parity has been a major driver for the increase in trade effluent charges, as water companies have phased in increases to meet requirements set by regulators.

The following Envirowise publications provide further information:

GC024 Effluent Costs Eliminated by Water Treatment
ET190 Developing a Toolkit for Effective Effluent Management
GG175 Improving the Performance of Effluent Treatment Plant
ET196 Are your profits going down the drain?
CS94 Cost-effective metal recovery and recycling from industrial effluents
NC055 Water Pinch Study Pays Major Dividends

Many additional guides and sector-specific good practice information is also available free of charge from the Environment and Energy Helpline on freephone 0800 585794.

8.2 Integrated solutions

It is no longer accepted that pollution is inevitable. The public is aware that improvements are possible and believes that investment should be made to reduce discharges. Besides reduced disposal costs, the payback is also improved public relations associated with environmental stewardship.

Industry frequently solves an end-of-pipe problem with an end-of-pipe solution, instead of taking a more holistic approach and considering 'in-process' solutions. A good integrated solution can do more than save water, it can



Beacon Press

Case study



A gradual conversion of its presses to waterless printing has helped Beacon Press eliminate waste at source and develop a genuine competitive edge with its proprietary printing system pureprint®.

Waterless printing has delivered a range of benefits including eliminating the use of isopropyl alcohol from the printing process; reducing water consumption by 26m³ per year; cutting weekly effluent

waste from 100 litres to 2 litres; reducing paper wastage by 30%; increasing capacity by reducing press downtime; and improving print quality.

reduce capital investment and recover valuable raw materials. Measures include good housekeeping and a range of management techniques such as water use audits, improved monitoring and metering, water pinch analysis (see box below), re-use and recycling and changes to production scheduling. It may also be worth investing in technical options such as triggered hoses, improved pipework, cooling towers and vessel washing systems.

The value to business of good environmental credentials should not be underestimated. It is likely that costs of not only water disposal, but also treated water will rise and the traditional approach to solving industrial effluent problems with end-of-pipe treatment needs to be re-considered. It would therefore make economic sense to minimise effluent generation and maximise resource efficiency by adopting an holistic longer-term approach.

Process integration techniques based on pinch analysis have been successfully applied in improving chemical and process industries for many years, and have now been developed for water conservation and effluent minimisation. Pinch analysis identifies water savings, water reuse and recycling opportunities within a process. Typical reductions in effluent flows that can be achieved are in the range of 20 to 60 per cent. To put these savings in a financial context, water supply and disposal costs per tonne of product for a selection of industries are given in the table below.

Envirowise publication: NC055 Water Pinch Study Pays Major Dividends

Industry	Typical current costs (£/tonne product)				Potential savings from pinch analysis (£/t product)
	Water used (l/t product)	Water supply	Effluent disposal	Total	
Synthetic textile	42,000	26	210	236	47–142
Brewing	15,000	9	172	181	36–109
Meat packing	18,000	11	52	63	13–38
Paper pulp	225,000	139	117	256	51–154

9. Outputs: Land

Improving resource efficiency often requires a change in attitude. People need to think about how they are using resources and about the waste they produce. The waste hierarchy is a simple yet powerful approach that helps people think about how materials are used in normal working life. It is a well-proven approach to dealing with waste and resources.

The hierarchy is essentially the way that you should think about every resource that you use and what waste it would produce. The waste hierarchy is explained here, using packaging to illustrate how it might be applied.

9.1 The waste hierarchy

Elimination of waste is best for your business and for the environment. If waste doesn't occur, it won't cause pollution and you will use fewer resources.

Start with the question: Why is there waste at all? Does the waste really have to be produced? Can the waste be eliminated?

Apply this to packaging by asking: Is the packaging on all of your goods inward necessary? Can some of it be eliminated? If so, your suppliers won't have to pay to buy it or spend so much effort in putting it on. You won't have to get rid of it or spend time removing it. Similarly, can you eliminate packaging on your own products?

If waste cannot be eliminated, how can it be reduced? Ask the question: Why is there so much of this waste? Where does it come from? What steps can we take to reduce it? Obviously, if you can reduce waste, you won't have to pay so much to dispose of it or to purchase the materials that end up as waste.

Packaging is often essential for the protection and handling of products. However, is your packaging really serving its function without waste? Could the same thing be achieved without so much packaging? Nortel in Cwmcarn looked carefully at their packaging with one of their suppliers and reduced the number of components from 12 to four while still meeting all of their protection and handling needs.

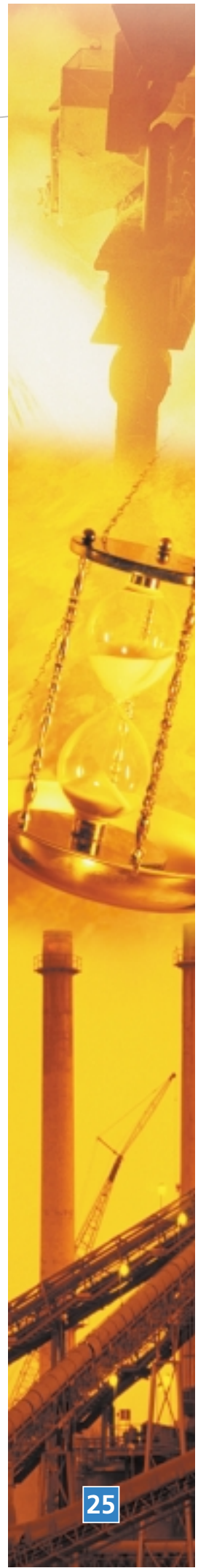
The following Envirowise publications provide further information:

CH267 Sustainability Drives Waste Reduction

GG038C Cutting Costs by Reducing Waste: A self-help guide

GG125 Waste Minimisation Pays: Five business reasons for reducing waste

Many additional guides and sector-specific good practice information is also available free of charge from the Environment and Energy Helpline on freephone 0800 585794.



9.2 Reusing waste

Reuse should not be confused with recycling. Reuse does not require reprocessing or re-engineering of an article but some cleaning may be needed. Reusing things on the same site is usually better than reusing them elsewhere because there is less need for handling and transport.

Ask the question: Can we use this for anything else? What other purpose could it serve? Could we recapture it and use it again?



Many forms of packaging can be reused. You are probably already reusing some boxes where you work. Many companies reuse filling materials from goods inwards in protecting their own goods but a surprising number of companies don't! Poole-based laboratory supply company Merck discovered that the high quality steel containers in which it received liquid crystals could be used for both dispatching some of its own products and as containers for waste storage.

9.3 Recovering waste

Recovery includes composting, recycling and recovering energy from waste. It is usually far better financially and for the environment to recover something from waste than to simply dispose of it.

Recycling usually requires considerable energy and effort. It does, however, make good use of resources. Most people think that recycling is a good thing in itself. It is only good, however, if you have done all of the steps above it in the waste hierarchy before you recycle what is left!

There is an increasing trend towards recycling packaging. Paper, cardboard, wood and plastic are all good candidates for recycling under the right circumstances. The problem that many companies find is that they do not have enough waste or they are too far from recycling companies to make this option viable.

9.4 The bottom of the hierarchy

Only after you have worked down through the waste hierarchy, should you consider disposal. This is the worst option for the environment and usually the most expensive option for your business. The true cost of waste is often ten to 20 times that of disposal cost, when the cost of purchase of materials and the value added to materials is considered.

10. Outputs: Product

10.1 The company of the future

The company of the future provides high value services and is customer-focused. It will be less interested in producing units of product, and more interested in providing value for the consumer. Getting closer to consumers means becoming more sensitive to their attitudes about things like ethical, social and environmental performance. But it also gives companies tremendous opportunities to squeeze waste and inefficiency out of production and delivery systems. Some analysts believe that a shift towards a service orientation – consistent with changes already happening in many sectors – will drive more prudent use of resources. For instance, rather than selling pesticides by the tonne, a producer could offer crop protection services. In principle, this will give economic incentives for producers to minimise the amount of product used in delivering the service. Major agribusiness companies, such as Syngenta, have a strategy of moving towards more tailored service solutions to crop protection. One of the reasons for moving in this direction is to capture more profitable service markets.

10.2 Smarter products

Products and services across industry are being transformed by information and communication technologies (ICTs). In future, biotechnology may also have the same impact. ICTs are already having a major impact on labour productivity in many industries, and many economists believe that they lie at the heart of the period of rapid economic growth we are living through. They also have the potential to bring huge environmental and social gains. In particular, there is huge potential for knowledge-intensive products to generate resource productivity improvements. This may be through better sensing and control (as with engine management systems in cars) or through 'dematerialisation' of products (downloading music files using MP3 compared to buying a CD). By substituting 'bytes for bits' resources that would have gone into making and transporting the product are 'virtualised'. The true potential for resource savings as a result of applying information and bio-technologies is only just becoming clear. More intelligent, adaptive products more closely matched to the needs of consumers offer ways of making resource use more sustainable. The great risk is that these opportunities will not be grasped, and that the result, paradoxically, is an acceleration in resource use, as has happened during previous industrial revolutions.



Envirowise – Practical Environmental Advice for Business – is a Government programme that offers free, independent and practical advice to UK businesses to reduce waste at source and increase profits. It is managed by AEA Technology Environment and NPL Management Limited.

Envirowise offers a range of free services including:

- ✓ Free advice from Envirowise experts through the Environment and Energy Helpline
- ✓ A variety of publications that provide up-to-date information on waste minimisation issues, methods and successes
- ✓ Free, on-site waste reviews from Envirowise consultants, called Fast Track Visits, that help businesses identify and realise savings
- ✓ Guidance on Waste Minimisation Clubs across the UK that provide a chance for local companies to meet regularly and share best practices in waste minimisation
- ✓ Best practice seminars and practical workshops that offer an ideal way to examine waste minimisation issues and discuss opportunities and methodologies

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