enVirowise
Practical Environmental Advice for Business

GG296

Cleaner product design: a practical approach

Cleaner product design: a practical approach

This Good Practice Guide was produced by Envirowise

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Summary

Businesses in the UK are under increasing pressure from both legislation and their customers to reduce the environmental impacts of their products. Cleaner product design (cleaner design) is the design of a product to minimise its environmental impacts over its entire lifetime and meet customer requirements. Cleaner design can also give rise to cost savings, improved product quality and increased market share.

This Good Practice Guide provides a practical introduction to cleaner design for businesses of all sizes, with an emphasis on product disassembly and redesign. It describes the drivers for cleaner design, defines what it is, gives examples of its application in business and explains how to implement it. The Guide also includes instructions for carrying out a dismantling exercise using a standard household item, such as a kettle or an iron, to highlight the key aspects and benefits of cleaner design. This approach will form a good starting point for any individual or business wishing to implement cleaner design.

In addition, the Guide is designed for use by business support organisations wishing to run a workshop on cleaner design. Companies aiming to run an in-house workshop to raise awareness of cleaner design may also find it helpful. The material in Section 2 of the Guide is repeated in a Microsoft® PowerPoint® slide presentation, which can be downloaded from the Envirowise web site at www.envirowise.gov.uk/product_design[1] and used as the basis for the workshop.

Practical advice for organisers on how to run a workshop on cleaner design is provided, together with guidance on health and safety issues. Useful forms and checklists are given in the Appendices at the back of the Guide.

Further advice and support are available from Envirowise through the Environment and Energy Helpline on freephone 0800 585794.

[1] If you do not have access to the Internet or have problems downloading this file, please contact the Environment and Energy Helpline on freephone 0800 585794 and ask for the file to be sent to you on a CD-ROM.

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Introduction

Cleaner product design (cleaner design) is the design of a product to minimise its environmental impacts over its entire lifetime and meet customer requirements. The result is often a product that is cheaper to make and cheaper to use. Cleaner design involves identifying how a product gives rise to environmental impacts during its life-cycle (raw materials, manufacture, distribution, use and end-of-life) and then investigating how these impacts can be reduced through design. A product's environmental impacts can be reduced by addressing key environmental considerations. The goals of cleaner design include reduced raw material use, elimination of hazardous materials, reduced use of energy and water, less waste and pollution, increased service life and greater potential for recycling.

Cleaner design can be incorporated into the traditional design process and can be applied to the redesign of existing products or the development of new ones. The cleaner design cycle aims to promote continual improvement and involves four elements: researching the product; identifying cleaner design priorities; designing the cleaner product (function and form); and design review. One practical way of approaching cleaner design is to dismantle the product and then consider how to redesign it to reduce its environmental impacts.

1.1 The benefits of cleaner design

The potential benefits of cleaner design include:

- lower production costs;
- improved product functionality and quality;
- increased market share;
- improved environmental performance;
- improved customer/supplier relationship;
- continued compliance with legislation;
- easier disassembly and increased potential for recycling;
- longer product design life.

Table 1 highlights some of the benefits that small and medium-sized enterprises (SMEs) in the UK have achieved through implementing cleaner design. More details of these Industry Examples are given in Section 2.4.

Table 1 Industry Examples of cleaner design

Company	Business	Example benefit of cleaner design
Varian Medical Systems UK Ltd	Electronic equipment manufacturer	Cost savings of £162 000/year
Intruplas Limited	Mixed plastics recycler	Reduced waste to landfill, local environmental and social benefits
Avad Contemporary Furniture	Manufacture of high-quality contemporary furniture	Product with significantly lower environmental impact
Crawford Hansford & Kimber Ltd	Manufacture of electronic sub-assemblies	Reduced use of lead solder, screws and fasteners
Holmes Mann & Company Ltd	Packaging manufacturer	Reduced material use

Examples of how larger businesses have benefited from implementing cleaner design can be found in Good Practice Guide (GG295) *Cleaner Product Design: Examples from Industry*[2].

1.2 The purpose of this Guide

This Good Practice Guide is intended to complement Good Practice Guide (GG294) *Cleaner Product Design: An Introduction for Industry*[2], by encouraging practical discussion and further action.

The Guide has two main aims:

- to provide a practical introduction to cleaner design for businesses, including advice on how to carry out a dismantling exercise to highlight the benefits of disassembly and redesign;
- to help businesses and business support groups to run introductory workshops on cleaner design.

Organisations that may find this Guide useful include:

- Business Links, local enterprises and other business support organisations;
- businesses that are interested in carrying out cleaner design;
- businesses that are being asked by their customers to improve the environmental performance of their products.

[2] Available free of charge through the Environment and Energy Helpline on freephone 0800 585794 or via the Envirowise web site (www.envirowise.gov.uk).

1.3 The structure of this Guide

The Guide is divided into two further Sections:

Section 2, which forms the main part of the Guide, describes the drivers for cleaner design, defines what it is, gives examples of its application in business and explains how to implement it. Instructions for running a practical disassembly/redesign exercise are included.

As well as providing an introduction to cleaner design, the material in Section 2 forms the basis of a Microsoft® PowerPoint® slide presentation. The slide numbers relevant to the topics discussed in Section 2 are given in the margin at the appropriate point. The PowerPoint® presentation (GG296B) *Cleaner Product Design: A Practical Approach - Workshop Slides* can be downloaded from the Envirowise web site at www.envirowise.gov.uk/product_design[3].

Section 3 provides practical advice to organisers on how to run a workshop on cleaner design. Guidance on health and safety matters is included. Useful forms and checklists are given in the Appendices at the back of the Guide.

[3] If you do not have access to the Internet or have problems downloading this file, please contact the Environment and Energy Helpline on freephone 0800 585794 and ask for the file to be sent to you on a CD-ROM.

Cleaner design

This Section introduces cleaner design and highlights the benefits of dismantling products to identify ways to improve their design.

The main points of the text are illustrated in a PowerPoint® slide presentation that can be used as the basis of a practical workshop on cleaner design. This workshop includes a disassembly/redesign exercise using common household items, such as irons and kettles. The slide numbers relevant to the text are indicated in the margins. General advice on how to run the workshop is given in Section 3.

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2.1 Introduction

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2.1.1 Why focus on products?

Product manufacture and use are responsible for a range of environmental impacts. In particular, the manufacture and use of products consume and waste enormous amounts of materials. One study[4] has shown that:

- 93% of production materials do not end up in saleable products;
- 80% of products are discarded after a single use;
- 99% of materials used in the production of, or contained within goods, are discarded in the first six weeks.

[4] *Factor Four: Doubling Wealth - Halving Resource Use.* von Weizsacker, E; Lovins, AB; Lovins, LH. Earthscan Publications (1997). ISBN 1853834076.

2.2 The need for cleaner design

Current drivers for cleaner design can be classed under the following headings:

- economic;
- market;
- European and UK Government policy;
- legislation.

Cleaner design can also be the next logical step for companies that have implemented a systematic waste minimisation programme or developed an environmental management system (EMS).

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2.2.1 Economic drivers

Significant financial benefits can be achieved through cleaner design. These can be both direct and indirect.

Cleaner product design can improve efficiency, leading to:

- increased profits;
- reduced material and resource consumption and thus lower material costs;
- a reduction in the amount of waste generated during production and thus lower waste disposal costs;
- reduced production and labour costs.

Cleaner design can lead to indirect economic benefits by:

- improving customer/supplier relationships;
- providing a useful marketing tool;
- encouraging innovation and product development.

It is the potential for significant cost savings, as well as environmental benefits, that encourages many companies to carry out cleaner design.

Businesses benefit from cleaner design

Case Study (NC201) *Electronic Equipment Manufacturer Benefits from Cleaner Design* describes how Varian Medical Systems UK Ltd achieved cost savings of £162 000/year by implementing cleaner design techniques. More details of these cost savings and the significant environmental benefits obtained from this demonstration project are given in an accompanying report (NR201).

Case Study (GC236) *Driving Down Waste Puts the Brakes on Costs* describes how Continental Teves UK Ltd applied cleaner design techniques to reduce the weight of a brake caliper by 26% and reduce overall production time by 42%.

To obtain a free copy of these publications, contact the Environment and Energy Helpline on freephone 0800 585794 or visit the Envirowise web site (www.envirowise.gov.uk).

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2.2.2 Market drivers

UK businesses are currently under pressure to improve their environmental performance. This pressure is perhaps more noticeable at the consumer end of the supply chain, with larger, well-known companies publicising their environmental policies and commitment to the environment. These companies are exerting pressure down the supply chain to the smaller companies in a number of different ways, eg:

- by dealing only with suppliers that have a certified EMS such as ISO 14001 or EMAS;
- by asking their suppliers to manufacture their products or materials in an environmentally responsible manner.

In order to remain in the supply chain, many businesses are having to address environmental issues. A survey carried out for Envirowise found that 52 out of 65 larger companies questioned involved their supply chain in their cleaner design activities.

Cleaner design can also present opportunities for new markets by tapping the growing number of 'green' consumers. Producing new products or redesigning existing products to reduce their environmental impact during their life-cycle can help to increase market share.

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2.2.3 European policy

The EU has made significant progress towards establishing guidelines and recommendations for the environmental performance of various products and sectors, eg packaging. This trend is expected to continue.

The European Commission is keen to encourage companies to be more responsible and to reduce the environmental impacts arising throughout the entire life-cycle of their products. There is a shift in emphasis with forthcoming legislation to focus more on products than processes.

One of the policies currently gaining favour within the Commission is Integrated Product Policy (IPP). One possible definition of IPP is 'public policy which explicitly aims to modify the environmental performance of product systems'. Various items of EU legislation, eg the Packaging Waste Directive and the draft Waste Electrical and Electronic Equipment (WEEE) Directive, aim to satisfy IPP.

Other EU policies and legislation that attempt to 'green' industry include:

- **Product taxes.** Economic incentives to discourage people from buying certain unsustainable materials have often been discussed at European level. An example from the UK is the higher taxes imposed on petrol and diesel in an attempt to reduce greenhouse gas emissions.
- **Banned materials.** EU Directive 76/464/EEC on dangerous substances in water created two lists of substances that have the potential to harm the environment. List I (the Black List) contains chemicals whose use must be phased out by Member States. List II (the Grey List) contains those materials whose use must be reduced by Member States. These lists are being continuously updated to cover more substances. Directive 94/62/EC on packaging and packaging waste also set limits for the concentrations of lead, cadmium, mercury and chromium(VI) in packaging.
- **EU Eco-labelling scheme.** This scheme was introduced in 1992 to promote the design, production, marketing and use of products that have a reduced environmental impact during their entire life-cycle, and to provide consumers with better information on the environmental impact of products. As of February 2000, ecological criteria had been developed for 12 types of product ranging from washing machines to bed linen and T-shirts. Several Member States have created their own eco-label scheme, such as Germany's 'Blue Angel' mark.

2.2.4 UK Government policy

The Earth Summit at Rio de Janeiro in 1992 resulted in a worldwide agreement to adopt the principles of sustainable development. This is defined in the Brundtland Report as 'meeting the needs of today without compromising the needs of future generations'. The UK Government is committed to the promotion of sustainable development and this forms the cornerstone of all its policy-making. The UK was one of the countries that agreed to binding targets for reductions in emissions of carbon dioxide and other greenhouse gases at the Kyoto Conference in 1997.

Industry is under increasing pressure from the Government to improve its environmental performance by reducing pollution and waste. Where stricter legislation is introduced, reactive companies may suffer from increased costs and reduced profits, while proactive ones will maintain or increase their market position and achieve financial benefits.

Cleaner design can help companies to improve their environmental performance while achieving cost savings and increased market share.

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2.2.5 Legislative drivers

Cleaner design can help companies to comply with the following current and forthcoming legislation.

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Packaging waste regulations

These regulations require obligated companies to ensure that a certain percentage of their packaging waste is recovered and recycled. The amounts set by the Government are intended to help the UK comply with its targets under the EU Directive (94/62/EC) on packaging waste. The directive also set essential requirements for packaging placed on the market, ie limits on the levels of certain hazardous substances that can be present and a condition that the packaging is produced in a way that minimises resources and facilitates recycling.

For more information about the packaging waste regulations, contact the Environment and Energy Helpline on freephone 0800 585794.

Integrated Pollution Prevention and Control (IPPC) Directive

The IPPC Directive (96/61/EC), which is being implemented in the UK[5], aims to achieve a higher degree of environmental protection than the integrated pollution control (IPC) regime introduced in the UK by the Environmental Protection Act 1990. The IPPC regime, which will require companies to significantly improve their environmental performance, affects more sectors than IPC. Implementing cleaner design can help a company reduce its environmental impacts and thus comply more easily with the legislation.

Climate Change Levy

The Climate Change Levy aims to encourage companies to use energy more efficiently by imposing a tax on energy consumption. This cost can be reduced if the company reduces its energy consumption. Cleaner design can help a company become more energy efficient.

End-of-life vehicles directive

The directive (2000/53/EC) concerning end-of-life vehicles aims to reduce the number disposed of to landfill and sets targets for the recovery, re-use and recycling of vehicles and their components. It also aims to encourage European car manufacturers to design new vehicles that have a greater potential for recycling. This legislation will also affect companies that supply the automotive industry.

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[5] For England and Wales via the Pollution Prevention and Control (England and Wales) Regulations 2000. For Scotland via the Pollution Prevention and Control (Scotland) Regulations 2000.

Draft waste electrical and electronic equipment directive

This directive was proposed by the European Commission in response to the growing amount of waste electrical and electronic equipment. This directive aims to promote its recovery, re-use and recycling, and to minimise the environmental impact of its disposal. It contains targets for recovering and recycling electronic equipment before it is disposed of to landfill. Any business manufacturing electrical or electronic equipment, or supplying these industries, will be affected by this legislation.

Draft electrical and electronic equipment directive

This directive specifies provisions for the design and manufacture of electrical and electronic equipment in order to minimise the impact of the equipment on the environment over the whole life-cycle. It aims to incorporate cleaner design strategies into mainstream manufacturing of electrical and electronic equipment.

Contact the Environment and Energy Helpline on freephone 0800 585794 for the latest information on EU and UK environmental legislation affecting your company.

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2.3 What is cleaner design?

2.3.1 Definition of cleaner design

Cleaner design is the design of a product to minimise its environmental impacts over its entire lifetime and to meet customer requirements. Cleaner design can be a way of addressing environmental issues, such as resource depletion, waste and pollution. It is a proactive form of environmental management that aims to reduce the environmental impacts of a product throughout its life-cycle.

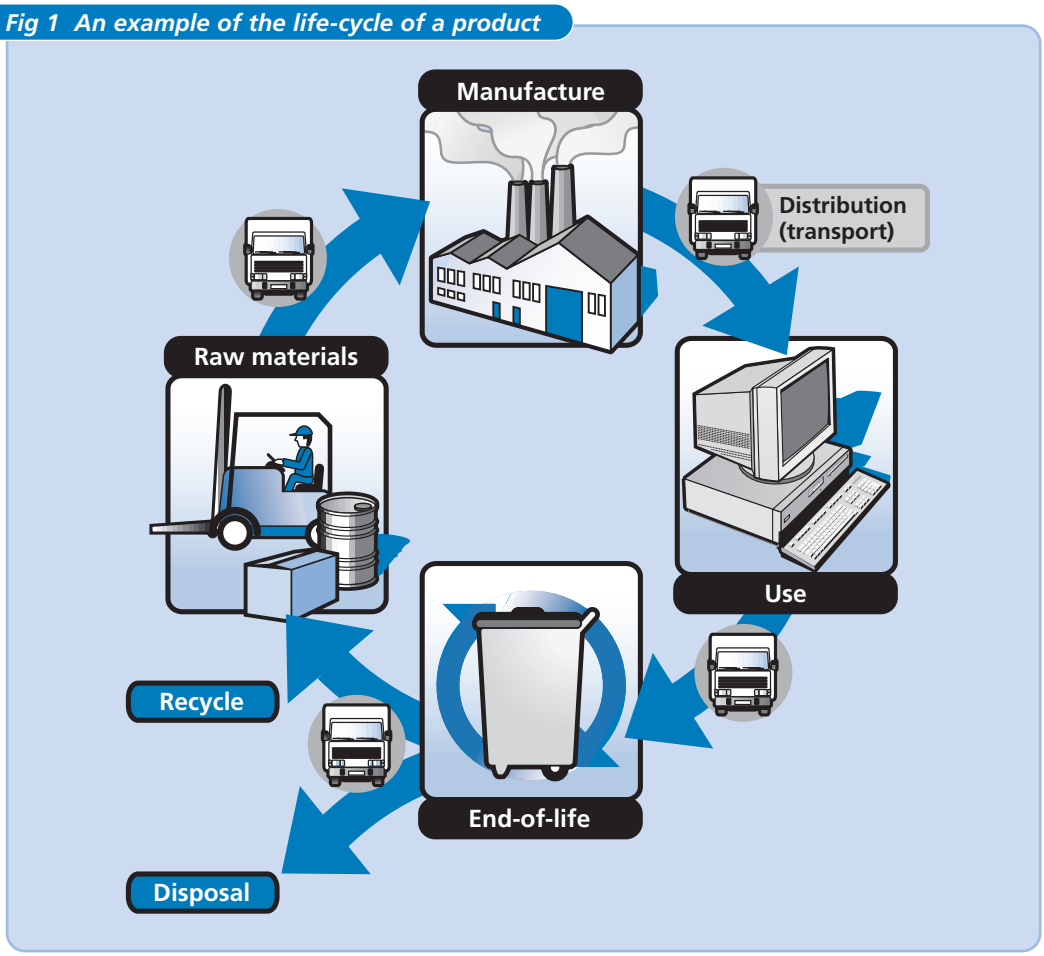
Cleaner design can be applied to all stages of the design process. However, it is best implemented at the start of the design process. Adding environmental considerations later is likely to lead to higher design costs and poorer environmental choices.

2.3.2 Product life-cycle

Successful cleaner design requires the environmental impact of the product to be examined across its entire life-cycle (see Fig 1).

Issues such as raw material use, waste production, energy consumption and emissions to atmosphere should be considered at each stage of the product life-cycle. The potential benefits of extending the life of the product through re-use, repair or recycling of the whole product or its components should also be considered.

Fig 1 An example of the life-cycle of a product



2.3.3 Key environmental considerations

The environmental performance of a product can be improved by taking account of ten key environmental considerations covering the various stages of its life-cycle. Table 2 summarises these key considerations.

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Table 2 Key environmental considerations for cleaner design

Life-cycle stage	Key environmental considerations
Raw materials	■ Use less material. ■ Use materials with less environmental impact.
Manufacture	■ Use fewer resources. ■ Produce less pollution and waste.
Distribution	■ Reduce the impacts of distribution.
Use	■ Use fewer resources. ■ Cause less pollution. ■ Optimise functionality and service life.
End-of-life	■ Make re-use and recycling easier. ■ Reduce the environmental impact of disposal.

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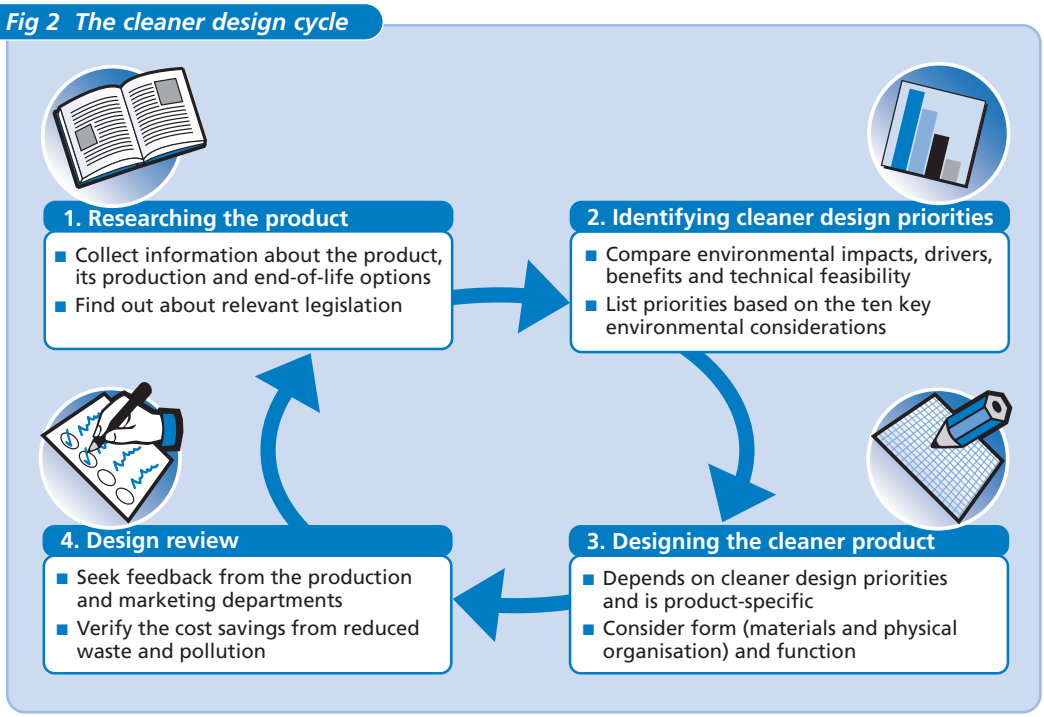
These key environmental considerations are described in more detail in Good Practice Guide (GG294) *Cleaner Product Design: An Introduction for Industry*.

2.3.4 The cleaner design cycle

Cleaner design can be incorporated into the traditional design process and can be applied to the redesign of existing products or the development of new ones.

The decision-making process for cleaner design has four elements in a continuous improvement-type process (see Fig 2). More than one cycle may be undertaken before your final product is manufactured and sold. Alternatively, all stages of the design process are covered by one cycle, which begins again to take account of feedback from customers and the sales department.

Fig 2 The cleaner design cycle



The aim of this decision-making process is to:

- improve product environmental performance;
- reduce life-cycle impacts;
- increase market share;
- reduce costs.

2.4 The benefits of cleaner design in industry

The benefits of cleaner design are illustrated with Industry Examples from five businesses that have implemented cleaner design.

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2.4.1 Varian Medical Systems UK Ltd

Varian Medical Systems UK Ltd, a subsidiary of Varian Medical Systems Inc in the USA, manufactures sophisticated x-ray equipment for simulating radiotherapy treatment.

The main reasons that Varian adopted cleaner design were:

- to maintain a competitive advantage;
- forthcoming legislation - particularly the proposed WEEE directive;
- a corporate policy requirement for improved environmental performance - the company's strong sense of environmental responsibility is demonstrated in its certified EMS.

A cleaner design approach was applied to the collimator unit of Varian's main product, a radiotherapy simulator for cancer treatment.

The main benefits of cleaner design for Varian included:

- cost savings of £162 000/year from changes in component numbers and materials;
- 65% reduction in the number of components used per collimator;
- 29% reduction in the number of fasteners used per collimator;
- 27% reduction in assembly time;
- elimination of the use of glass reinforced plastic (GRP) which prevented re-use;
- use of water-based paints instead of solvent-based paints to minimise solvent emissions into the air;
- a more modular design, allowing easier upgrading to extend product life;
- improved customer relations.

More details of the demonstration project are given in Case Study (NC201) *Electronic Equipment Manufacturer Benefits from Cleaner Design* and the accompanying Report (NR201)[6].

Varian sees cleaner design as an integral part of its continuing design strategy and has developed procedures to integrate cleaner design into its EMS, which is certified to ISO 14001.

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[6] The Case Study and Report are available free of charge through the Environment and Energy Helpline on freephone 0800 585794 or via the Envirowise web site (www.envirowise.gov.uk).

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2.4.2 Intruplas Limited

Intruplas Limited is a plastics recycling company which was set up with local and European funding to meet the increasing need for plastic waste recycling in Yorkshire and to create new business and employment opportunities for both able-bodied and disabled people in the area.

The company uses an innovative technology developed in Europe to recycle mixed waste plastics and waste plastic contaminated with labels, etc. Intruplas aims to recycle 5 000 tonnes/year of contaminated plastic waste which would otherwise have been disposed of to landfill.

Intruplas has used cleaner design to create a range of sustainable outdoor furniture and fixtures made from 100% recycled materials. These products are attractive and durable, and can be recycled at the end of their useful lives.

Since its launch, Intruplas has seen significant demand for its products from local authorities keen to choose sustainable goods and thus meet their obligations under Agenda 21. The company has recently identified a number of potentially lucrative new markets for its products within the industrial and amenity sectors. These markets depend on the use of recycled polymer and cleaner design to manufacture sustainable products.

2.4.3 Avad Contemporary Furniture

Avad is a small company set up to manufacture high-quality contemporary furniture. Avad's ethos is the effective use of resources. The company found that this could be achieved by the use of sustainably managed hardwood and the development of original construction methods, including joints that do not require adhesives or additional fixing materials. This resulted in production savings, minimal use of non-sustainable materials, increased longevity and greater material re-use at 'end-of-life'.

These cleaner design features have helped to develop Avad's market position due to increased consumer demand for contemporary, environmentally sustainable products.

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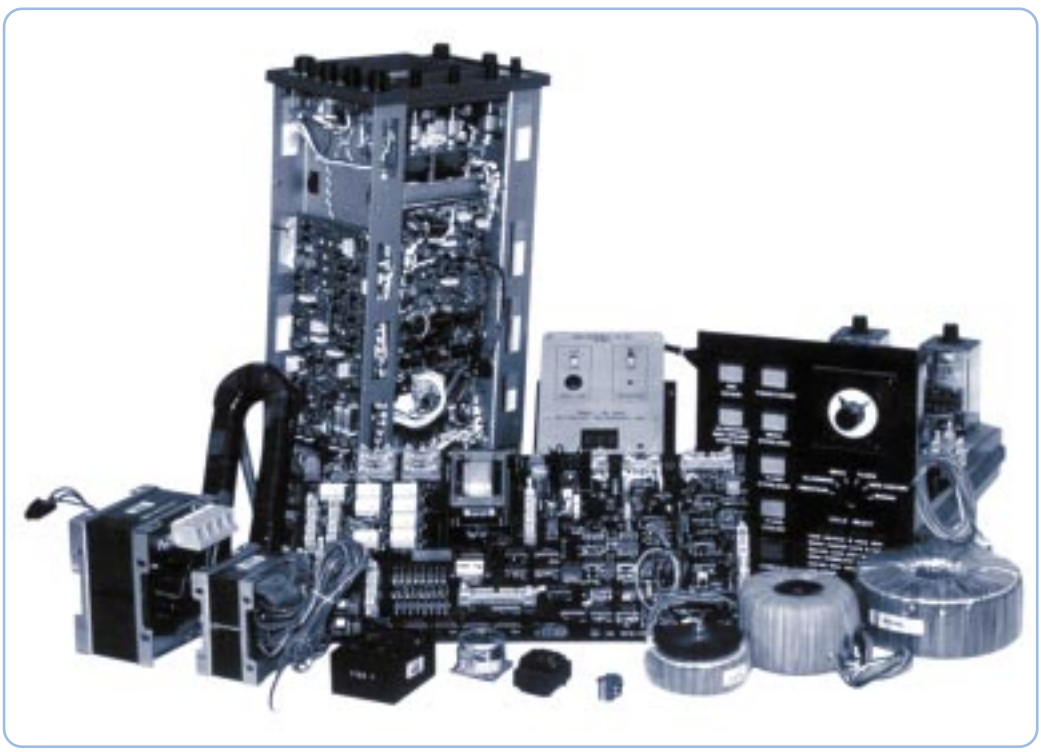
In 2000, Avad commissioned a life-cycle assessment (LCA) (see Section 2.5.9) to support its marketing claims of sustainability. The LCA found that there was a 45% lower environmental impact embodied in the company's product than with that of the nearest comparable products.

2.4.4 Crawford Hansford & Kimber Ltd



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Crawford Hansford & Kimber Ltd (CHK) is a small company manufacturing a range of electronic sub-assemblies, containing printed circuit boards (PCBs), electrical components and associated housing.

CHK implemented a cleaner design programme with the aim of reducing unit production costs and increasing the potential for recycling the product. The company believes that the proposed WEEE directive could potentially increase its costs as product design and processes are changed to comply with the legislation. Although this legislative driver was the main reason for implementing cleaner design, the company also identified a growing customer demand for cleaner products.

The main benefits of the cleaner design programme at CHK were:

- Improved production efficiency.
- Increased competitiveness and improved product development.
- A reduction of approximately 80% in the use of lead solder. Replacement of lead solder with a non-hazardous, tin-based alternative has significantly increased the potential for recycling of the company's products.
- A reduction in the number of metal fixings and moulded fixtures used to construct the PCB casings. This has significantly reduced the time taken to disassemble the product and increased its recycling potential.
- Improved relationships with suppliers.

The company has identified a potentially significant market for cleaner electrical goods and intends to increase production to accommodate this market.

CHK's move towards the use of lead-free solder in its products has encouraged its main supplier of PCBs to take a similar approach. Greater use of lead-free PCBs by its customers meant that the supplier could change its production process to a more cost-effective one based primarily on silver. This switch also allowed the supplier to recycle the silver and copper content of the process effluent in-house.

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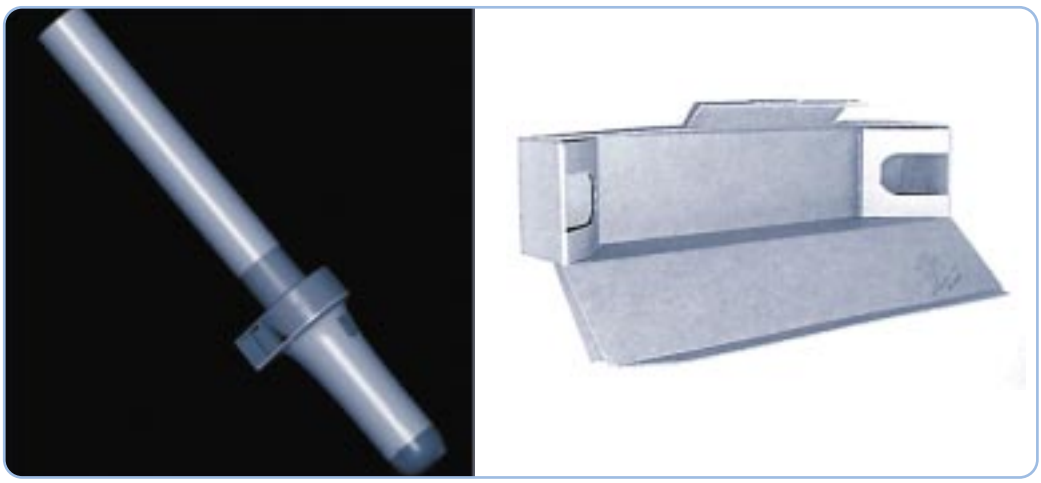
2.4.5 Holmes Mann & Company Ltd



Holmes Mann & Company Ltd is a small packaging manufacturing company employing 53 people (in 2000). A wide range of packaging materials are produced, including corrugated cases, wooden pallets and cardboard tubes. The company's EMS is certified to ISO 14001.

The company chose to undertake a cleaner design programme to improve its environmental performance, reduce costs and as a response to the packaging waste regulations. Holmes Mann also recognised that cleaner design could give it a significant competitive edge as it would facilitate the development of cheaper, high-quality packaging with reduced environmental impact.

The company has worked with its customers on a number of different cleaner design projects. In one project, Holmes Mann was approached to produce effective, cheap and environmentally friendly packaging for a product that had been developed using cleaner design. Holmes Mann designed and produced a colourful, printed box for retail distribution and a plain, stronger box for catalogue distribution. Both boxes were constructed using cleaner design and were cheaper and had less environmental impact than their standard equivalents.

Cleaner design has allowed Holmes Mann to:

- achieve cost savings;
- reduce the amount of material used in its packaging products;
- develop a design technique that delivers efficient packaging with reduced environmental impact at little or no extra cost;
- enter the growing market for sustainable packaging;
- improve its environmental performance;
- comply with the packaging waste regulations.

2.5 Implementing cleaner design: researching the product

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This Section covers in greater detail the first step of the continuous improvement cycle as illustrated in Fig 2 (Section 2.3.4). Researching the product is an important step and highlights many of the key issues in cleaner design. Identifying cleaner design priorities, designing the cleaner product and design review are all covered in Good Practice Guide (GG294) *Cleaner Product Design: An Introduction for Industry*.

2.5.1 Key topics for research

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The aim of product research is to understand which issues cause the greatest environmental impacts and what opportunities might be available to address them.

- Consider the product's life-cycle, eg by carrying out a life-cycle assessment (LCA) (see Section 2.5.9).
- Examine the materials used in the product, eg find out which ones are used by dismantling it (see Section 2.6).
- Find out how the product is made. Is its manufacture energy-intensive and/or polluting? Are large amounts of waste generated during its production?
- Find out how the product is packaged, stored and distributed.
- Find out how the product is used. Does it use lots of energy and/or cause pollution? How long is its service life?
- Find out what typically happens to the product when it reaches the end of its useful life. Is it recycled or is it landfilled? If it is typically landfilled, could it be re-used or recycled?
- Talk to suppliers and customers. They may suggest opportunities for improvement.

This list is not exhaustive and companies may need to consider additional issues. For example, companies in the electronics sector may wish to investigate forthcoming legislation that will ban or restrict the use of certain materials.

These topics are discussed below and during the disassembly/redesign exercise (see Section 2.6).

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2.5.2 Consider the product's life-cycle

As cleaner design is intended to be a holistic approach to reducing environmental impacts, it is important that the entire life-cycle of the product is considered in order to identify all major environmental impacts. The aim is to create a list of impacts that can then be prioritised and, where possible, reduced.

Possible methods include:

- Life-cycle assessment (LCA). This method involves generating quantifiable data for each of the environmental impacts of a product throughout its life history. See Section 2.5.9 for more information about LCA.
- Using generic checklists and LCA data available on the Internet and other sources[7].
- Using the cleaner design checklist in Appendix 5. This can be used to identify significant environmental impacts and highlight important issues. However, further research may be required to identify other important impacts. The checklist is designed to be generic and is, therefore, not product-specific.

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2.5.3 Examine the materials used in the product

One of the main considerations within cleaner design is the choice of materials used in the product. Many materials currently used in products cannot be recycled and create significant environmental impacts during their production.

One example is lead, which constitutes a significant proportion of the solder used by the electronics industry. In many cases, lead-free solder could be used without compromising quality, while reducing the product's environmental impact[8].

Crawford Hansford & Kimber Ltd

"Using cleaner design, we were able to reduce the quantity of lead used in the solder by 80%. This reduced the environmental impact and increased the recycling potential of our product."

A good starting point for assessing material suitability is to prepare a list of all the materials used to make the product. Research can then be undertaken to find alternatives with lower environmental impacts, eg:

- those containing recycled materials;
- those obtained from sources and suppliers that are environmentally conscious;
- those that can be recycled at the end-of-life.

Suppliers and customers may be able to suggest alternative materials or potential opportunities for recovery, re-use and recycling.

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[7] Visit the Envirowise web site (www.envirowise.gov.uk/product_design) for links to useful web sites on cleaner design.

[8] *Lead-free Solder: the Issues* (EN287) provides an overview of the key considerations and consequences for materials, assembly and reliability. EN287 is available free of charge through the Environment and Energy Helpline on freephone 0800 585794 or via the Envirowise web site (www.envirowise.gov.uk).

As well as looking at the types of materials used in the product, it is important to look at the quantities and diversity of materials used. There may be opportunities to:

- redesign the product to reduce the weight and thickness of components;
- use one recyclable material throughout the entire product.

2.5.4 How is the product manufactured?

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Many modern production processes cause significant environmental impacts in the form of liquid, solid and gaseous waste that can have a detrimental effect on the environment. For example, in 1999 the industrial sector alone produced 50 million tonnes of solid waste in the UK.

The following questions may help to identify areas for potential improvement:

- Is the process energy intensive?
- Are there opportunities to reduce energy use?
- Could an energy audit be undertaken to reveal potential areas for improvements?
- How much waste does the process produce?
- How many different types of waste does the process produce?
- Is any of the waste produced by the process classed as hazardous (special waste)?
- Are natural resources (eg water and fossil fuels) used?
- Can the use of resources be reduced?

2.5.5 How is the product distributed?

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Product distribution, ie transport, storage and packaging, can result in significant environmental impacts.

The answers to the following questions may suggest opportunities for reducing these environmental impacts:

- What type of packaging is used?
- How much packaging is used?
- How is the product stored before dispatch?
- Does the product require special storage conditions?
- How far are the products transported?

For advice on reducing packaging use and costs, contact the Environment and Energy Helpline on 0800 585794 or visit the Envirowise web site (www.envirowise.gov.uk).

2.5.6 How is the product used?

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It is important to look beyond simply what the product is designed to do. Useful information can often be obtained from consumers about what they actually do with a product. One example of 'product habit' is to leave a kettle to boil and then return later to reboil the hot water - a process that uses a lot of energy that design can help to reduce.

Feedback from suppliers and/or customers may also reveal opportunities for reducing functions or parts of the product or packaging that they regard as unnecessary, eg surplus modules and attachments.

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2.5.7 What happens at the end of the product's life?

Examination of the current method of disposal could reveal opportunities for increasing the product's recycling potential.

- Is the product typically disposed of to landfill? This can give rise to environmental impacts through the production of leachate and landfill gas.
- Could the product be re-used or recycled instead of being sent to landfill?
- If products with only minor faults are typically discarded, is it possible to salvage some of the parts or components?
- Is there potential for re-using modules or parts of the product at the end of its useful life?
- Does the product contain materials or components that can be easily recovered and recycled?
- Could various modules or parts be stamped with labels indicating their recycling potential?
- Could the product and/or its modules be serviced to increase their life-span?
- Could a product take-back service be developed?

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2.5.8 Talk to your suppliers and customers

Involving suppliers and customers in the cleaner design programme can help to secure the company's position in the supply chain and lead to cost savings.

Group discussions and meetings can help to identify additional opportunities for cost savings and improvements. A joint cleaner design project could improve or secure long-term business relationships, while sharing information enables a more efficient approach to cleaner design.

An example could be the removal of a type of packaging normally supplied with the product, which the customer finds redundant and has to recycle or dispose of. Case Study (GC236) *Driving Down Waste Puts the Brakes on Costs*[9] describes how Continental Teves UK Ltd achieved net cost savings of over £81 000/year by switching to re-usable packaging to supply most of its brake calipers to customers. This success was achieved despite initial customer perceptions that the move would lead to increased costs and result in logistical difficulties.

[9] Available free of charge through the Environment and Energy Helpline on freephone 0800 585794 or via the Envirowise web site (www.envirowise.gov.uk).

2.5.9 Life-cycle assessment

One of the main tools used to identify a product's environmental impacts during its entire life-cycle is life-cycle assessment (LCA). Many large companies now use LCA and some are requiring their suppliers to provide data for use in an LCA of the final product.

Additional information on LCA is given in (ET257) *Life-cycle Assessment - An Introduction for Industry*[10].

What is an LCA?

LCA is a process that identifies the main environmental impacts of a product throughout its production, distribution, use and disposal, ie from cradle-to-grave. It can also identify which of the materials used in the product carries the greatest environmental impact. This allows companies to prioritise their research and resources.

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LCA can help companies to identify ways of improving the environmental impact of their products. As well as the environmental benefits, companies can also reduce their operating costs.

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An LCA examines material, energy and waste flows of a product over its entire life-cycle. There are a number of ways of undertaking an LCA study, such as the use of computer software models. For more information, contact the Environment and Energy Helphline on freephone 0800 585794 or see (ET257) *Life-cycle Assessment - An Introduction for Industry*.

What can you gain?

Conducting an LCA can help companies to identify:

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- areas with the greatest potential for environmental improvement and cost savings;
- improvements and changes that have led to increased efficiency in the use of materials and energy;
- issues which result in increased quality and, as a result, increased market share.

As well as material and financial gains, businesses may find that they are responding to customer demands and so benefit through increased customer satisfaction. LCA can also help to:

- provide scientific weight to back up environmental marketing claims;
- fulfil demands by larger companies that their suppliers improve their environmental performance;
- promote innovation and creativity in design.

LCA is a decision-aiding tool - it does not make decisions. Before beginning, it is important to appreciate why the study is being undertaken and what is being included.

Possible barriers and solutions

A number of possible barriers to LCA and their potential solutions are summarised below.

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- **Time and resources.** In the past, LCA has been complex and expensive but this is changing with the development of new methods and tools. There are a number of simplified LCA approaches available that use generic data and so simplify things considerably. One option is to look for previous studies on similar products. Another possibility is to use a cleaner design checklist (see Appendix 5).

[10] Available free of charge through the Environment and Energy Helpline on freephone 0800 585794 or via the Envirowise web site (www.envirowise.gov.uk).

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- **Lack of expertise.** A number of tools and methods are now available that allow a 'non-expert' to undertake an LCA. However, a 'base' of expertise is needed to carry out the study efficiently and effectively. Again, look for similar studies or, alternatively, employ a consultant. For SMEs, Envirowise may be able to provide advice - contact the Environment and Energy Helpline on freephone 0800 585794.
- **Lack of data.** The amount of available LCA data has increased dramatically over the last decade. Generic LCA data are now available for different materials, manufacturing and disposal activities. Considerable amounts of data are now available cheaply or from the Internet. Visit the Envirowise web site at www.envirowise.gov.uk/product_design for an up-to-date list of useful web sites with LCA data.

Cleaner design requires good product research to be effective. LCA can be used as a tool to find those areas of a product with the greatest environmental impact and thus help to target resources for redesign.

2.6 Practical disassembly exercise

This exercise is intended to highlight the relative complexity of everyday products and how this complexity leads to opportunities for redesign to give cleaner, cheaper and more efficient products. The exercise can be undertaken by one person on their own as a demonstration for colleagues or in a workshop situation.

2.6.1 Disassembly process

Taking the product apart in a systematic manner should reveal various issues regarding the product. These can then be prioritised for redesign to reduce the product's overall environmental impact and encourage its development.

2.6.2 Why disassembly?

The main advantage of disassembly is that it brings home the issues discussed in real terms.

The purpose of any disassembly exercise is to examine the finished product and then disassemble it into as many of its component parts as possible. This should provide an indication of how well the product is manufactured and whether there are any potential areas for cleaner redesign.

Physically taking apart a product, such as a kettle, iron or telephone, enables the range of materials, components and techniques used in its manufacture to be better appreciated. Issues such as number, amount and mix of materials can be easily demonstrated.

Dismantling a product also makes it possible to see how different components are physically joined together and located within the product. This, in turn, should facilitate a greater understanding of the factors influencing the ease of disassembly and, therefore, recycling.

Excessive use of materials may also be identified. This leads on to questions regarding the potential for recycling, efficiency, etc. For example, the more components and materials used, the more difficult it becomes to recycle economically. Cleaner design can help to address these problems and, therefore, increase materials recovery at the end of a product's life.

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2.6.3 Disassembly issues

The following issues should be considered during the practical exercise. Information obtained during the exercise should be recorded on the cleaner design checklist (see Appendix 5).

- Is there any packaging? If so, what kind?
- What is the product's function?
- Is the product easy to disassemble without damaging it? Are there lots of screws, joints, etc?
- Are many materials used? Can they be identified? Are the plastics marked?
- If materials of different types are joined together, can they be separated for recycling, ie are things clipped together rather than glued?
- Is it possible to identify any hazardous materials in the product? Is it clear what they are and what to do with them? Can they be removed easily?
- Many products are over-complex. Can the product be simplified by using fewer materials or components?

Packaging

The packaging of a product can have a direct environmental impact arising from the use of materials in the packaging itself. In addition, there can be an indirect impact in terms of how the packaging affects the transportation of the product. Bulky, irregular-shaped packaging can lead to inefficient transportation, which in turn can lead to an increase in vehicle emissions.

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- Has the minimal amount of packaging material been used?
- Are different materials used in the packaging?
- Can the packaging be recycled or does it contain recycled materials?
- Does the packaging contribute significantly to the overall weight of the product? If so, could the packaging be redesigned to reduce this weight?
- Does the packaging allow for efficient storage and transportation?

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Product use

Use of a product can give rise to significant environmental impacts, eg household electrical items that consume electricity and thus cause the emission of greenhouse gases.

- Does the product consume resources and energy efficiently?
- The quality of a product is important. A high-quality product would be expected to last longer, and thus reduce the environmental impacts arising through the production of additional units and its disposal.
- If the product has been designed to be disposable, ie have a short lifespan, has it been over-designed?
- Could the product be maintained or repaired to increase its lifespan? Is this possibility hindered by complex construction?
- Many products are disposed of early due to premature failure. Is it possible to replace the components that may fail or is it necessary to replace the whole product?

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Production

The environmental impacts associated with production will vary from product to product depending on its nature. They may be the biggest throughout its life-cycle.

Disassembly provides a picture of how the product was manufactured and how easily it could be recovered or re-used at the end of its useful life.

- How is the product held together in terms of screw, fixings, etc? Can the number be reduced?
- Are any materials fixed together with the use of glues, screws or snap-fits?
- Are the product or its components painted or coated with materials that may cause problems during disposal or recycling?
- Have materials been used efficiently or have they been used to increase the weight of the product to give an impression of added value?

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Materials

Dismantling a product makes it easier to investigate material use.

- Has too much material been used? Can it be reduced?
- Are the materials from a renewable resource? If so, are they easily identifiable?
- Are there any hazards arising from the product's construction? Would the product release hazardous substances if it were disposed of to landfill or incinerated?
- Have virgin materials been used instead of recycled materials? If so, are they labelled for identification?

Appendix 6 lists the main types of polymer currently in use together with their agreed symbols, typical uses and an indication of their potential for recycling.

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Disposal

Product disposal can cause significant environmental impacts, eg through landfill leachate and emissions to the atmosphere from incineration.

Various drivers (see Section 2.2) call for an increasing percentage of products to be recycled or recovered at the end of their useful life. Recycling or recovering all or some of a product will significantly reduce the total environmental impact arising from its disposal.

- Could the product or its components be recycled?
- Are any parts of the product biodegradable? This is important if it is expected to end up in a landfill.
- Could the product or its components be refurbished or recovered? Is the product designed in such a way as to allow this? Which components may need replacement? Is it economically viable?
- Is it possible to introduce a product return and service system for the product and/or its packaging?

2.6.4 Aims of cleaner redesign

The main aim of cleaner redesign is to identify practical solutions to the issues raised by disassembly.

In order to achieve this, attention should be given to:

- identifying cleaner design priorities;
- developing redesign actions.

2.6.5 Design priorities

The key to successful cleaner redesign is the identification of appropriate design strategies and the prioritisation of these strategies to gain most environmental benefit. For example, if 80% or more of a product's environmental impact over its lifespan is caused by the consumption of resources in use (eg in the case of a washing machine - energy, water and detergent), then design resources should be targeted at this particular impact.

To prioritise these strategies, designers need to consider the characteristics of the product, eg:

- For how long will the product be used, eg days, weeks or years?
- Is the product made from one, simple material or a complex mixture of materials?
- Does the product consume energy during use or is more energy used during its production?
- Will the product be recycled? Does the infrastructure exist to achieve this? Will people recycle it?

An LCA (see Section 2.5.9) can help to prioritise environmental impacts, but it is not essential.

2.6.6 Achieving cleaner redesign

Once the issues have been prioritised, the product can be redesigned to improve its environmental performance and meet customer expectations. In order to achieve this, the following actions should be taken:

- develop design goals and decide how to achieve them;
- prepare an action plan that presents the redesign priorities and outlines the potential design solutions;
- consider both form (materials and physical organisation) and function (what the product does).

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2.6.7 Tips for success

Developing appropriate design strategies is the key to cleaner design. For example, try to identify strategies that will make a significant improvement and those that are easy to implement.

Some practical, achievable solutions are crucial. It may be possible to apply these solutions almost immediately, achieving both reduced environmental impacts and cost savings.

Comparing different design goals is not straightforward, but can be achieved by considering the particular characteristics of the product.

Once the product has been redesigned, remember to complete the cleaner design process by seeking feedback from the production and sales teams. Their comments and the reaction of customers can be fed into the cleaner design cycle to achieve continual improvement. More information about this final phase of the cleaner design process is given in Good Practice Guide (GG294) *Cleaner Product Design: An Introduction for Industry*[11].

2.7 Exercise safety and method

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The issue of health and safety is paramount. Before undertaking the exercise, ensure all concerned are aware of relevant health and safety issues (see Section 2.7.1). Advice for those organising a workshop based on this Guide is given in Section 3.6.1. An example risk assessment form is given in Appendix 9.

Before beginning, it is also helpful to read the cleaner design checklist in Appendix 5. If a kettle, iron or telephone is being dismantled, the sample questions in Appendix 7 may stimulate discussion.

2.7.1 Health and safety issues

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A number of health and safety issues arise when dismantling products. Such an exercise is covered by a number of pieces of legislation.

The workshop co-ordinator must ensure that the proposed exercise is safe. Individual delegates are also responsible for their own safety and the safety of others. Further important information is given in Section 3.6.1 which must be read prior to organising a workshop.

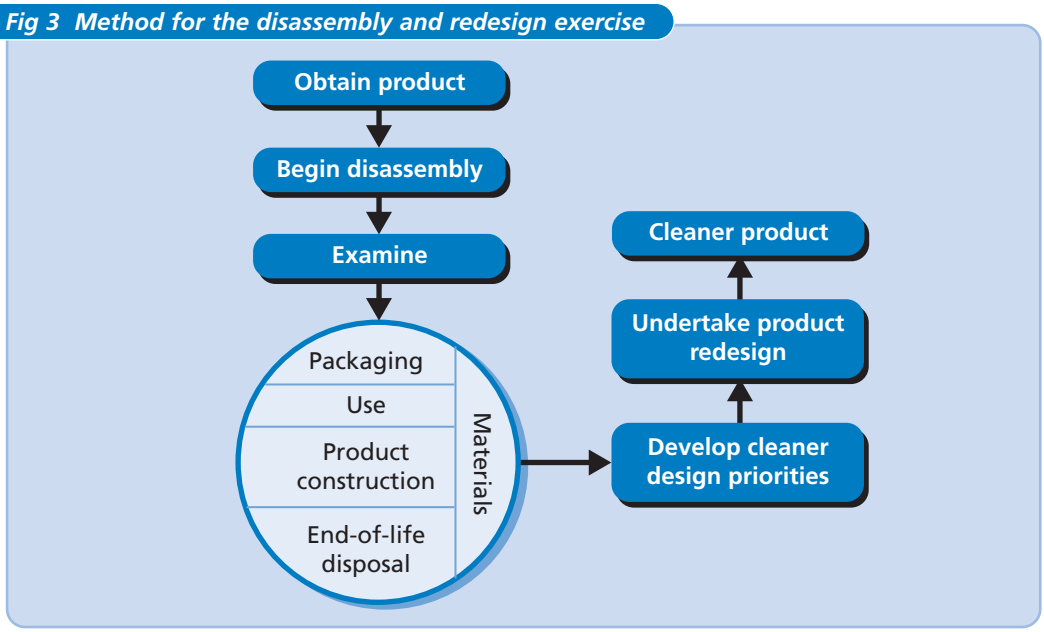
- Carry out a risk assessment and ensure that everyone is aware of any potential dangers before beginning to dismantle the product. For example, injuries could occur through the improper use of hand tools and from flying plastic and components.
- Ensure that everyone present while the product is being dismantled is wearing the appropriate personal protective equipment (PPE). Safety glasses must be worn.
- Only one person should dismantle the product at any one time.
- Ensure that products are not forced or prised apart.
- Ensure all tools are in good working order and appropriate for the task.
- Exercise caution when using hand tools. The use of hand tools falls under the Provision and Use of Work Equipment Regulations (PUWER) 1998 and the Health and Safety at Work Act 1974.
- Ensure that participants take care of sharp edges, eg metal, wires and plastic fittings.
- Printed circuit boards should not be disassembled.
- Do not connect any of the products to an electricity supply.

[11] Available free of charge through the Environment and Energy Helpline on freephone 0800 585794 or via the Envirowise web site (www.envirowise.gov.uk).

2.7.2 Method

A flow chart showing the different stages of the exercise is shown in Fig 3. Advice on possible items to dismantle and possible tools is given in Appendix 1.

Fig 3 Method for the disassembly and redesign exercise



The aim of the disassembly stage is to:

- Dismantle the product carefully and separate it (as far as is possible) into its constituent parts and materials.
- Group similar materials and, if possible, identify the types of plastic and metal used. The polymer identification guide in Appendix 6 may help.

Anything that cannot be identified should be segregated and grouped (this will raise labelling, identification and other issues). The fact that materials cannot be identified may make recycling and recovery more difficult.

At the end of the disassembly stage of the exercise, the product should be separated into materials and/or components, along with its fasteners, etc.

Disassembly should have highlighted a series of issues related to the design of the product. It is important to identify the good aspects of the design as well as those that need improvement.

Now use the cleaner design checklist in Appendix 5 to identify major environmental impacts. Prioritise these impacts and consider ways of redesigning the product to reduce them. The cleaner design checklist contains sections where cleaner design priorities and the cleaner design strategy can be recorded. For example, if increased recyclability is important, then consider whether this can be achieved by reducing the amount of fasteners used, and using clips and snap-fits rather than screws and glues, etc.

2.8 The next steps

One of the main drivers for cleaner design is the potential economic benefit. Many companies that have carried out cleaner design have realised these benefits, and are now using cleaner design to secure and expand their business and increase their market share. As well as direct financial benefits, there can also be benefits from the development of new products using innovative designs and production methods.

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National, European and global environmental legislation is becoming increasingly stringent and, as such, is demanding more and more from industry as a whole. This legislation is generally aimed at improving environmental performance and the recycling potential of products. Adopting a proactive cleaner design strategy is a way of meeting current legislation and preparing for any future legislation. You may consider:

- Contacting Envirowise for advice and more information about cleaner design (see Section 2.8.1).
- Running a workshop in-house to develop interest in cleaner design.
- Involving colleagues and senior management, eg ask the marketing department about customer interest in environmental issues or supply chain pressure for improved environmental performance.
- Identifying which drivers for cleaner design affect your company.
- Looking at your company's products.
- Working out how your company could benefit from cleaner design?

2.8.1 Help from Envirowise

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Envirowise is a Government programme offering free, independent advice to UK businesses on practical ways to minimise waste and increase profits.

Envirowise offers a range of free services including:

- up-to-date advice on environmental issues and environmental legislation through the Environment and Energy Helpline;
- publications, eg Case Studies, Good Practice Guides and videos;
- on-site waste reviews (for SMEs) from independent Envirowise consultants (Fast Track visits) that help businesses identify and realise savings;
- best practice seminars and workshops;
- tools to help companies implement waste minimisation;
- support for local and regional waste minimisation clubs.

Contact the Environment and Energy Helpline on freephone 0800 585794 or visit the Envirowise web site (www.envirowise.gov.uk). The web site gives the latest information on Envirowise seminars, workshops, publications and links to other web sites on cleaner design.

Envirowise Guides and Case Studies that are relevant to cleaner design include:

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- *Cleaner Product Design: An Introduction for Industry* (GG294);
- *Cleaner Product Design: Examples from Industry* (GG295);
- *Life-cycle Assessment - An Introduction for Industry* (ET257);
- *Electronic Equipment Manufacturer Benefits from Cleaner Design: a demonstration at Varian Medical Systems UK Ltd* (NR201);
- *Driving Down Waste Puts the Brakes on Costs* (GC236) - a Case Study at Continental Teves UK Ltd.

Ultimately, cleaner design can save you money and increase profits by reducing waste, increasing product efficiency and encouraging innovative product development.

Running a workshop

This Section provides practical advice to help you run a workshop on cleaner design. Useful forms and checklists are given in the Appendices at the back of this Guide for you to photocopy and use as required.

The slides for the presentation can be downloaded as a Microsoft® PowerPoint® file from the Envirowise web site (www.envirowise.gov.uk/product_design). If you do not have access to the Internet or have problems downloading this file, please contact the Environment and Energy Helpline on 0800 585794 and ask for the file to be sent to you on a CD-ROM.

The slide numbers relevant to the topics discussed in Section 2 are given in the margin at the appropriate point. A miniature image of all the slides is given in Appendix 10.

You may have useful examples and information to add to the workshop. Do you know of any local companies that have benefited from cleaner design? Local experiences could be added at the end of the workshop or in Session 4 'Examples of cleaner design'.

3.1 Who does what?

Each workshop is likely to need:

- a co-ordinator to organise and administer the workshop;
- speakers to make presentations;
- people (syndicate leaders) to facilitate the disassembly/redesign exercises.

One person may be able to undertake all three roles, but it is advisable to have at least two people available for the entire workshop. Groups of up to eight delegates per syndicate leader are recommended for the disassembly/redesign exercises. The speakers can act as syndicate leaders, thus reducing the total number of people required.

3.1.1 The co-ordinator's role

The job of the co-ordinator is to:

- plan the workshop and the half-day programme;
- identify the speakers and syndicate leaders, and then organise their involvement in the workshop;
- identify and recruit delegates;
- organise the venue;
- liaise with Envirowise regarding support material;
- liaise with other business support organisations to avoid duplication of effort.

Experience has shown that early planning and good communication are essential to the smooth running of the workshop.

Before organising one of your own, you may find it helpful to attend a similar workshop. For details of other events, contact the Environment and Energy Helpline on freephone 0800 585794. The Helpline can also provide you with telephone support or put you in contact with a cleaner design consultant.

An equipment checklist for co-ordinators is given in Appendix 1. This lists the equipment needed to run the workshop and suggests items that could be used for the disassembly exercise. More information about this exercise is given in Section 3.6.

The co-ordinator will also need to order the appropriate number of Envirowise publications for the delegate packs (see Section 3.5). An order form is given in Appendix 2. This form can also be used to order any other Envirowise publications you wish to display at the workshop or give to delegates.

The feedback questionnaire given to delegates in the registration pack (see Section 3.5) provides an opportunity to ascertain the level of interest in cleaner design and the success of the workshop. Please ask delegates to fill it in before they leave.

Envirowise[12] must be given details of all delegates who receive its publications. This allows Envirowise to monitor its impact. It would be delighted to receive copies of the completed feedback questionnaires together with a list of delegates. Please include a covering note giving details of the event.

3.1.2 Speakers

Co-ordinators may find it necessary to ask other people to deliver various sections of the workshop. Having more than one speaker not only gives the co-ordinator a break, it also helps to maintain delegates' interest and to generate discussion.

The electronic version of the slide presentation contains speaker notes, which are intended as prompts and reminders for the co-ordinator and other speakers. Reduced versions of the slides are given in Appendix 10.

Speakers should have a reasonable understanding and knowledge of cleaner design. As well as reading this Guide and familiarising themselves with the PowerPoint® presentation, speakers can:

- read Good Practice Guides (GG294) *Cleaner Product Design: An Introduction for Industry*[13] and (GG295) *Cleaner Product Design: Examples from Industry*[13];
- contact the Environment and Energy Helpline on freephone 0800 585794 for a list of useful web sites on cleaner design;
- ask the Helpline to send them on loan two videos of interviews with representatives from Avad Furniture and Crawford Hansford & Kimber Ltd, two of the companies featured in this Guide (see Section 2.4);
- visit the Envirowise web site at www.envirowise.gov.uk/product_design to obtain a list of useful web sites on cleaner design.

3.1.3 Syndicate leaders

The role of a syndicate leader is determined by the co-ordinator. If there are more than eight delegates at the workshop, a syndicate leader should be appointed in advance to lead each disassembly/redesign group.

Syndicate leaders do not need to have great experience of cleaner product design to ensure the smooth running of the disassembly/redesign exercises. However, they should read Good Practice Guide (GG294) *Cleaner Product Design: An Introduction for Industry*[13] and this Guide to develop an appropriate level of knowledge. Syndicate leaders should also be aware of the sample questions in Appendix 7.

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[12] Envirowise, Harwell International Business Centre, 156 Curie Avenue, Harwell, Didcot, Oxfordshire OX11 0QJ.

[13] Available free of charge through the Environment and Energy Helpline on freephone 0800 585794 or via the Envirowise web site (www.envirowise.gov.uk).

Syndicate leaders have a safety role in supervising the products' disassembly.

Ideally, syndicate leaders should possess the following skills:

- background knowledge of cleaner design;
- confidence in front of an audience;
- ability to listen and summarise ideas;
- ability to draw on knowledge within the group.

The syndicate leaders have to strike a balance between asking questions, directing the group and allowing the group to interact and generate its own ideas. They should also be instructed on safety aspects of the event and be prepared to stop any unsafe practices (see Section 3.6.1).

3.2 Venue

The co-ordinator will need to select a suitable venue. The choice of venue will depend on:

- the number of delegates;
- the number of disassembly/redesign groups;
- availability;
- cost;
- convenience for target audience.

The disassembly exercise requires delegates to be seated around tables 'cabaret' style, with ideally 5 - 7 people per group. Delegates should also be able to comfortably hear the presentations, which should preferably take place in the same area.

3.3 Programme

The workshop is designed to last for half a day, with a 20-minute break for tea/coffee. An example of a typical agenda is given in Appendix 3 with timings for a morning event. This agenda can be varied to suit local factors and resources.

3.4 Invitation letters

Invitation letters, together with a copy of the agenda[14], should be sent out approximately five weeks before the date of the workshop. Samples of the letter and fax back form are given in Appendix 4. As a general rule, you will need to send out 10 - 20 invitations to get one delegate. You may wish to add details of the speakers at the workshop.

You may find that you get a better response by targeting companies:

- certified to ISO 14001;
- that have implemented a systematic waste minimisation programme;
- affected by the legislative drivers of cleaner design, eg electronics companies and suppliers to the automotive industry.

[14] Printing the agenda on the back of the invitation letter will save paper.

It may also be helpful to telephone about a fortnight before the event to confirm attendance or to remind prospective delegates about the workshop.

3.5 Registration

On arrival, each delegate should be given a pack containing:

- a copy of this Guide (GG296);
- the agenda (see Appendix 3);
- the delegate list;
- a cleaner design checklist (see Appendix 5);
- a polymer identification guide (see Appendix 6);
- a feedback questionnaire (see Appendix 8);
- a list of free publications available from Envirowise.

You may wish to add publicity material about your organisation and include copies of Good Practice Guides (GG294) *Cleaner Product Design: An Introduction for Industry* and (GG295) *Cleaner Product Design: Examples from Industry*.

Use the order form in Appendix 2 to obtain sufficient copies of this Guide and the Envirowise publications for the delegate packs.

3.6 Disassembly/redesign exercise

Part of the workshop consists of a practical exercise to assess and redesign a common household product, eg an iron or kettle, using the principles of cleaner design.

Several products are required to carry out this exercise successfully.

- Provide one item for each group of delegates (maximum of eight in a group).
- Health and safety are paramount (see Section 3.6.1). Avoid unnecessarily complicated items that are glued or bonded together as these are difficult to take apart without force.
- Many items under £10 are suitable. See Appendix 1 for some suggestions.
- Do not try to find the 'perfect' item, but choose the cheapest and most readily available. Cheap, mass-produced products often help to illustrate many of the issues of cleaner design.

A number of aids are provided to help you during the exercise. These are:

- **Cleaner design checklist** (see Appendix 5). This allows delegates to take a structured approach to the dismantling exercise and indicates issues to look for during disassembly.
- **Polymer identification guide** (see Appendix 6). This shows polymer codes that delegates may encounter during the exercise and indicates the recycling potential of different materials.
- **Sample questions** (see Appendix 7). This list contains questions appropriate for kettles, irons and telephones. They are intended to raise issues and to lead to further discussion. Syndicate leaders should be aware of these questions and ask them during the disassembly exercise.

3.6.1 Health and safety considerations

Running this workshop raises a number of important health and safety issues. For example, there are potential dangers associated with the improper use of hand tools and from flying plastic and other components during dismantling. However, following the guidelines below carefully, in conjunction with the rest of the Guide, should allow for a safe and enjoyable exercise.

The co-ordinator is responsible for the overall safety of the delegates attending the workshop[15].

Co-ordinators should ensure that:

- they obtain advice on the planned exercise from their health and safety manager or advisor;
- enough syndicate leaders are available to supervise each group to prevent unsafe disassembly;
- all syndicate leaders have been instructed on safety issues;
- delegates are warned of any potential risks before undertaking the practical exercise and are made aware of their responsibility to take reasonable care for the safety of themselves and other members of the group.

The following health and safety legislation applies to the workshop:

- Health and Safety at Work Act 1974. ISBN 0-10-543774-3[16];
- The Management of Health and Safety at Work Regulations 1999 (SI 1999 No. 3242). ISBN 0-11-085625-2[17] (particularly Regulation 3 'Risk Assessment');
- The Provision and Use of Work Equipment Regulations (PUWER) 1998 (SI 1998 No. 2306). ISBN 0-11-079599-7[17];
- The Personal Protective Equipment at Work Regulations 1992 (SI 1992 No. 2966). ISBN 0-11-025832-0[17].

Provided you follow the precautionary measures recommended in this Guide, you should satisfy the requirements of this legislation.

The co-ordinator must be satisfied that safety issues have been addressed before running a workshop. This is not the responsibility of Envirowise.

A number of measures can be taken to reduce the risk of potential injury to those present at the workshop.

Purchase and analysis of disassembly items

Appendix 1 gives some examples of the types of product that could be used, together with a list of useful tools.

When buying items for disassembly, the co-ordinator should:

- consider how easy they would be to dismantle;
- be aware of the potential dangers from items containing glass, chemicals, batteries, etc;
- choose products that are suitable for dismantling, eg achievable by removing screws rather than requiring excessive force;

---

[15] Envirowise accepts no responsibility for the safety of delegates attending a workshop organised and run by a third party.

[16] Available from The Stationery Office (Tel: 020 7242 6393 or www.clicktso.com).

[17] Available on www.hsebooks.co.uk

- avoid the need for delegates to use sharp knives or other such implements.

The method of disassembly should be determined before the workshop begins. This allows the safety risks to be assessed and the need for specialist tools (eg to remove screws and fixings) to be identified. This process, which is performed at the disassembler's own risk, may involve reading any disassembly instructions, or disassembling and reassembling the product. Disassembly and reassembly should be undertaken only by someone who understands the product and the risks involved, and has the necessary knowledge to carry out the task safely. If the product proves impossible to take apart safely, an alternative must be found.

Risk assessment

A risk assessment should be completed for each product to determine the potential risks and appropriate safety measures. This is a legal obligation under the Management of Health and Safety at Work Regulations 1999. An example form is given in Appendix 9.

The results of the risk assessment should be used at the workshop to:

- Explain the hazards to delegates.
- Explain how to avoid hazards by using safe working procedures and by wearing appropriate personal protective equipment (PPE), eg safety glasses.
- Ensure that the people undertaking the disassembly understand the potential dangers and the safety measures. For example, you could ask everyone who will be dismantling the item to sign the risk assessment form to confirm they have understood the procedures.

Personal protective equipment (PPE)

It may be necessary to obtain PPE for the disassembly/redesign exercise. In particular, safety glasses are recommended to protect against eye injuries. These can be bought from local DIY merchants. Safety glasses should be inspected before the exercise begins to ensure they are clean and undamaged.

At the beginning of the exercise

Before the disassembly/redesign exercise begins, co-ordinators should ensure that delegates:

- are provided with appropriate PPE;
- are shown and understand the risk assessment;
- appreciate the hazards identified by the risk assessment;
- are aware that the products will come apart without excessive force;
- understand that the PPE specified by the risk assessment must be worn;
- appreciate that they are responsible for each other as well as themselves.

At the end of the exercise

A significant quantity of components and materials may be removed during the dismantling exercise. Brushes and bin bags will be needed to clear these away. The co-ordinator should arrange for this waste to be disposed of safely and appropriately.

If you have any questions regarding health and safety issues relating to this workshop, seek advice from your company's health and safety manager, the local Health and Safety Executive (HSE) office or the HSE Info Line on 08701 545500.

Equipment checklist

Workshop

The following items are required for the workshop:

- slide projector, overhead projector or laptop computer and suitable LCD projector;
- suitable power source for the electronic equipment and usually an extension cable;
- pens and pencils;
- attendance list;
- name badges;
- sufficient copies of the cleaner design checklist, polymer identification guide, sample questions, feedback forms and Good Practice Guides GG294 and GG295 which may be obtained using the form in Appendix 2.

Disassembly/redesign exercise

Possible items for the disassembly/redesign exercise (one per group) are shown in Table A1. Choose items suitable for your audience and remember to carry out a risk assessment (see Section 3.6.1 and Appendix 9).

Table A1 Possible items for the disassembly/redesign exercise

Item	Comments
Telephone	■ Good example, can usually be levered gently apart after removal of all screws.
Iron	■ Specialist screws and fixings sometimes have to be removed before the product can be dismantled. ■ You need to be aware of the potential for flying plastic. Sometimes there may be difficulty in removing the hot plate from the plastic housing.
Torch	■ Normally simple to disassemble and, as such, the risks are reduced.
Kettle	■ Again, normally simple to disassemble. ■ May have a specialist screw in its base. This can generally be removed with pliers and a little persistence.
Child's toy	■ Any clockwork or mechanical child's toy can be used. ■ Child safety measures mean there may be specialist screws and fixtures. This problem should be considered before purchase.

Delegates will require a range of disassembly tools. Make sure there are enough to go round. Possible tools include:

- Phillips and slot screwdrivers of the appropriate sizes;
- spanners;
- Allen keys;
- pliers.

Delegates will also need appropriate PPE, eg safety glasses are recommended to protect against eye injuries.

Brushes and bin bags may be required to collect up the parts and other components from the dismantled items.

Things to do before the disassembly/redesign exercise

Purchase items to be dismantled	❑
Perform risk assessment	❑
Determine safe method of disassembly	❑
Determine tools required	❑
Determine PPE required	❑
Obtain tools	❑
Obtain PPE	❑
Check condition of tools	❑
Check method of disassembly (if required)	❑
Organise sufficient facilitators to supervise the activity	❑
Brief all facilitators on safety role during disassembly	❑

Things to remember during the disassembly/redesign exercise

- Explain the risks, and ways to avoid them, to the delegates.
- Explain that the delegates are responsible for the safety of themselves and colleagues.
- Explain that delegates and others must wear the PPE provided.
- Suggest that only one person is responsible for dismantling at any one time.
- Intervene to ensure safe working practices whenever you see potential for harm.

Order form for Envirowise publications

The following order form is provided for you to obtain sufficient copies of this Guide and other Envirowise publications for the delegate packs.

To: **Environment and Energy Helpline**
Fax: 01235 433961

From:

Name: _____

Position: _____

Organisation: _____

Address: _____

_____

_____

Postcode: _____

Tel: _____

Fax: _____

E-mail: _____

Workshop details

Date: _____

Venue: _____

Expected numbers: _____

Who are your target audience? _____

_____

Publications in bold are essential (need one of each per delegate).
These are supplied free of charge on the understanding that Envirowise will be told the name, company name and address of every delegate that receives them.

List of Envirowise publications	**No. of copies**
Are You Throwing Profit Away? (EN285) (Information about Envirowise)	
Cleaner Product Design: A Practical Approach (GG296)	
Cleaner Product Design: An Introduction for Industry (GG294)	
Cleaner Product Design: Examples from Industry (GG295)	
Life-cycle Assessment - An Introduction for Industry (ET257)	
Driving Down Waste Puts the Brakes on Costs (GC236)	
Electronic Equipment Manufacturer Benefits from Cleaner Design (NC201)	
Electronic Equipment Manufacturer Benefits from Cleaner Design (NR201)	

Workshop agenda

Cleaner product design: a practical approach

LOCAL ORGANISATION

Venue: _____

Date: _____

Time: _____

AGENDA

8.45 - 9.15	*Coffee and registration*	
9.15	Introduction and welcome	
9.20	The need for cleaner design	■ Legislative and business drivers for cleaner design
9.30	What is cleaner design?	■ The life-cycle of a product ■ The elements of the cleaner design cycle
9.40	Examples of cleaner design	■ Five examples of cleaner design from different industrial sectors
10.00	Implementing cleaner design: researching the product	■ Different tools, eg LCA
10.20	*Coffee*	
10.40	Implementing cleaner design: disassembly and redesign	■ Looking at the issues in real terms ■ Good and bad aspects of the design ■ Addressing issues identified during disassembly
11.10	Practical exercise	■ Disassembly and redesign of an item provided by the workshop organiser
12.10	Discussion of the findings from the disassembly/redesign exercise	
12.40	Summary	

Sample invitation letter

Organisation logo

Address

Tel:

Fax:

Date

Dear Sir/Madam,

Free half-day workshop
Cleaner Product Design: A Practical Approach

You are invited to a **free** half-day workshop to learn about the principles of cleaner design and how a cleaner design programme can lead to reduced production costs, increased efficiency and increased profits. The workshop focuses on the disassembly and redesign aspects of cleaner design, and includes a practical exercise to dismantle a common household item.

Cleaner design can help companies deal with ever stricter environmental controls and the prospect of meeting producer responsibility legislation and product take-back obligations driven by European directives. This legislation will require companies to look closely at the environmental impacts of their products and to take action.

The workshop is being organised by *local organisation*, using material developed by Envirowise. It will be held at *venue* on *date* at *time*.

Please reply using the fax back form. A copy of the workshop agenda is *printed on the back of this letter/enclosed*. If you are unable to attend, you can find out more about cleaner design by phoning the Environment and Energy Helpline on freephone 0800 585794 or visiting the Envirowise web site (www.envirowise.gov.uk).

Yours faithfully,

Name
Position
Organisation

FAX BACK FORM

Free half-day workshop

Cleaner Product Design: A Practical Approach

Local organisation

Date

Venue

Name: _____

Position: _____

Organisation: _____

Address: _____

_____

Postcode: _____

Tel: _____

Fax: _____

E-mail: _____

Please delete as appropriate:

I would like to attend the workshop.

I am unable to attend the workshop.

Please send me details of similar workshops in the future.

Fax to: *name and fax number for workshop co-ordinator*

FAX BACK

Cleaner design checklist

The following checklist is provided in an order that corresponds to the way delegates will approach the product in the disassembly and redesign exercise.

Distribution	Yes	No
Does the product have packaging?		
Has the amount of packaging been minimised?		
Is the packaging coloured/bleached/coated?		
Is recycled packaging used?		
Is the packaging labelled for recycling potential?		
Is the packaging designed for easy dismantling/recycling?		
Does the product require refrigeration?		
Can the product be made close to the point of use?		
Can the product be made in response to demand (ie minimum storage)?		

Additional comments

Use	Yes	No
Does the product consume energy during use?		
Could its energy consumption be reduced, eg stand-by mode?		
Does the product use additional resources during use, eg batteries and inks?		
Could the consumption of these resources be reduced?		
Is the product durable or disposable?		
Does the product produce waste and, if so, could it be reduced?		
Can the product be maintained and repaired?		

Additional comments

Manufacture	Yes	No
Is the product made from one material only?		
Is the product easily dismantled?		
Are there numerous modules/components?		
Are there numerous screws/fixtures/fittings?		
Are any hazardous substances used in its manufacture?		
Does production use a large amount of energy?		
Are the amounts of raw materials used kept to a minimum?		
Are hazardous wastes produced during production?		
Are paints/solvents used to coat the product?		

Additional comments

Raw materials	Yes	No
Are the minimum number of materials used in the product?		
Are a number of different materials used in the product?		
Can any of these materials be recycled easily?		
Are these materials easily dismantled/separated?		
Are the materials stamped/labelled with recycling information?		
Are they obtained from environmentally friendly sources?		
Additional comments		

End-of-life	Yes	No
Can the product be serviced to increase its life?		
Can the product be re-used?		
Can the parts/modules of the product be re-used/recycled?		
Does the product/packaging give recommendations for disposal?		
Is the product biodegradable?		
Are hazardous substances released to the environment as the product degrades after disposal?		
Additional comments		

Your redesign priorities

eg reduce electricity consumption because this has the greatest environmental impact

1

2

3

Your cleaner design strategy

eg increase product efficiency and thus reduce energy consumption

1

2

3

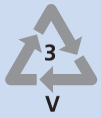
Polymer identification guide

The British Plastics Federation (BPF) and the Association of Plastics Manufacturers in Europe (APME) recommend use of the triangular marking system developed by the Society of Plastics Industry (SPI) in the USA.

The labels shown in Table A2 should be moulded into the plastic item so that they are easy to see during sorting.

GG296 published by Envirowise (www.envirowise.gov.uk)

Table A2 Uses and recycling potential of some common polymers

Code	Label	Polymer	Typical uses	Recyclability
Type 1 - PETE and Type 1 - PET		Polyethylene terephthalate (PET)	Soft drink and water containers Some waterproof packaging	Commonly recycled and facilities are common
Type 2 - HDPE		High density polyethylene (HDPE)	Milk, detergent and oil bottles Toys and plastic bags	Commonly recycled and facilities are common
Type 3 - V		Polyvinyl chloride (PVC)	Food wrap, vegetable oil bottles and blister packages	Can be recycled but may not be practical
Type 4 - LDPE		Low density polyethylene (LDPE)	Plastic bags Shrink wrap, garment bags	Can be recycled but may not be practical
Type 5 - PP		Polypropylene (PP)	Refrigerated containers, bags, bottle tops, carpets, food wrap	Can be recycled but may not be practical
Type 6 - PS		Polystyrene (PS)	Throwaway utensils, meat packaging, protective packing	Can be recycled but may not be practical
Type 7 - OTHER		Includes polycarbonate (PC), acrylic, ABS	Usually layered or mixed plastic	Difficult to recover material and recycle

Helpline 0800 585794

Sample questions for product disassembly

These questions/issues can be raised during the disassembly/redesign exercise or during the subsequent discussion. If the groups have not already mentioned them, try to bring the issues to their attention. They should help delegates to get the most out of the exercise and hopefully lead to further discussions.

Although questions are given for only three items, similar issues will arise with other items.

Kettle

- Consumption of electricity for boiling water is the biggest environmental impact during a kettle's life.
- Common problems are boiling too much water and reboiling (ie walking away and then returning to the already boiled kettle and switching it back on again).
- How can we reduce the amount of electricity used? Possibilities include:
  - improved water level indicators so that users do not boil more water than they actually need;
  - design a variable temperature kettle (for when the water doesn't need to be boiling);
  - insulate the kettle (so that heat is not lost so quickly);
  - install a temperature gauge on the kettle so the user can see the temperature of the water and decide whether they need to reboil it;
  - educate users to use kettles more efficiently.

  All of these measures could significantly reduce the environmental impact of the kettle over its lifetime.

Iron

- As with kettles, the biggest environmental impact during the life of an iron is consumption of electricity during use.
- With irons, it may be possible to reduce energy consumption during use by:
  - improving heat transfer by using different soleplate materials;
  - reducing the heat loss to air (when the iron is left standing);
  - more accurate temperature control.
- There are many issues surrounding the function of the product, ie ironing clothes. The following could be raised:
  - Can clothes be made of materials that are easier to iron or that do not require ironing at all?
  - Can something be added to the wash to eliminate the need for ironing?

  These issues may help delegates to see the wider picture in terms of the service the iron provides, rather than just focusing on the product itself.

Telephone

- Telephones tend to be a complex mixture of materials and this constitutes their greatest environmental impact. Telephones do consume energy, but unless they are cordless and have a transformer, energy use is minimal.
- Some issues or questions may be:
  - reduce material use (mobile phones provide good examples of miniaturisation);
  - reduce the mix of materials;
  - for ease of recycling, use fewer screws, etc.
- One interesting point is to look at why phones are replaced as they are reliable and rarely break or need repair. The main reason tends to be fashion; people change because they want a different colour or a more modern style. This opens up an interesting option:
  - Can phones be designed so that the cover (ie outside appearance) can be changed as fashions change? A number of mobile phones allow this, so why not provide this option for land phones?

  Changing the cover will be much less environmentally damaging and reduce the amount of waste to be recycled or sent to landfill.
- The voice mail service now offered by some telecom providers raises an interesting issue relating to answerphones. Do we actually need answerphones if we could pay for a service instead? Which has the lower environmental impact - a service or a product?

Feedback questionnaire

Please complete the following questionnaire and give it to the workshop organiser before you leave.

Workshop organisers: Please send the completed feedback questionnaires to:

Envirowise,
Harwell International Business Centre,
156 Curie Avenue,
Harwell,
Didcot,
Oxfordshire OX11 0QJ

Thank you for your help and co-operation.

Local organisation
Date
Venue

Name: _____

Position: _____

Organisation: _____

Address: _____

_____

Postcode: _____

Tel: _____

Fax: _____

E-mail: _____

Q1 How much did you know about cleaner design before the workshop?

No prior knowledge	
Some knowledge	
Detailed knowledge	

Additional comments

Q2 Which of the following is likely to affect your organisation?

WEEE directive	
End-of-life vehicles directive	
Climate Change Levy	
Packaging waste regulations	
Integrated Product Policy	
Supply chain pressures	
Company policy	
Any other	

Additional comments

Q3 What are the main barriers to cleaner design within your organisation?

Lack of technical ability	
Lack of awareness	
Lack of market	
Lack of finance	
Lack of resources	
Any other	
Additional comments	

Q4 Quality of the workshop from 1 (poor) to 10 (excellent)

Content	
Relevance	
Delivery	
Organisation	
Additional comments/suggested improvements, eg helpful....., enjoyable....., too complex....., too long.....	

Q5 What action will you take as a result of this workshop?

Raising awareness within your organisation or company	
Raising awareness within other organisations	
Stimulating action in your company	
Encouraging action by others	
Additional comments	

Q6 Would you like to receive further information about cleaner product design from Envirowise?

If yes, please tick to indicate which publications you would like:	
Another copy of *Cleaner Product Design: A Practical Approach* (GG296)	
Cleaner Product Design: An Introduction for Industry (GG294)	
Cleaner Product Design: Examples from Industry (GG295)	
Life-cycle Assessment - An Introduction for Industry (ET257)	
Case Study at Varian Medical Systems UK Ltd (NC201)	
Report at Varian Medical Systems UK Ltd (NR201)	
Case Study at Continental Teves UK Ltd (GC236)	

Example risk assessment form

Before the workshop, the workshop co-ordinator should complete a risk assessment form for each of the products used in the disassembly/redesign exercise. This form should be shown to the syndicate leaders, the delegates and anyone else who volunteers to disassemble the product. They should sign the form to confirm that they have understood its requirements.

A blank and a completed form are provided as an example. The blank form is provided as a recommended format for you to photocopy and use if you wish.

The completed risk assessment form should be accompanied by notes on how to disassemble the products safely and outline the tools required.

Example risk assessment

Workshop: Train the Trainers, Design Week 2000, Design Council **Date:** 2 November 2000

Disassembly item: steam/spray iron

Name of risk assessor: Richard Swannell, Envirowise

Probability factor:
1 = Improbable occurrence
2 = Possible occurrence
3 = Occasional occurrence
4 = Likely occurrence

Severity factor:
1 = Trivial injury
2 = Minor injury
3 = Major injury
4 = Death

NB The values in the boxes above provide examples only. Other values should be used if they are more applicable to the activities being assessed.

Activity/task	Hazard	Probability (P)	Severity (S)	Risk rating (P × S)	Method/controls required	PPE required
Removing screws	Screwdriver slips causing injury to hand	3	2	6	Correct size of screwdriver Instructions on use	None
Prising covers open or components out	Splinter in eye or flesh	2	3	6	Avoid prising Use gentle leverage only Ensure supervisors are briefed	Safety glasses
Removing covers and undoing internal components	Injury from sharp items inside product, eg wires, springs and metal foils	2	2	4	Exercise care during disassembly Brief facilitators and supervise	None
Removing covers and undoing internal components	Electrical hazard	1	4	4	Ensure not connected to mains	None
Removing covers and undoing internal components	Contact with hazardous substances	1	2	2	Do not open sealed containers Supervision	None
Handling small parts	Choking	2	3	6	Do not place parts in mouth	None

Signed: Tony Brown **Name:** TONY BROWN

GG296 published by Envirowise (www.envirowise.gov.uk)

Risk assessment

Workshop: ..... **Date:** .....

Disassembly item: .....

Name of risk assessor: .....

Probability factor:
1 = Improbable occurrence
2 = Possible occurrence
3 = Occasional occurrence
4 = Likely occurrence

Severity factor:
1 = Trivial injury
2 = Minor injury
3 = Major injury
4 = Death

NB The values in the boxes above provide examples only. Other values should be used if they are more applicable to the activities being assessed.

Activity/task	Hazard	Probability (P)	Severity (S)	Risk rating (P × S)	Method/controls required	PPE required

Signed: ..... **Name:** .....

Slide templates

This Appendix contains a miniature image of all the slides used in the workshop.

The slides for the presentation can be downloaded as a Microsoft® PowerPoint® file from the Envirowise web site (www.envirowise.gov.uk/product_design).

If you do not have access to the Internet or have problems downloading this file, please contact the Environment and Energy Helpline on 0800 585794 and ask for the file to be sent to you on a CD-ROM.

The slide numbers relevant to the topics discussed in Section 2 are given in the margin at the appropriate point.

The need for cleaner design

5

Why do cleaner design?

- Economic drivers
- Market drivers
- European policy
- UK Government policy
- Legislative pressures

6

Economic drivers

- Reduced material and resource consumption
- Reduced waste generation
- Reduced costs
- Improved competitiveness
- Increased profits

7

Market drivers

- Supply chain pressures
- Green consumers
- Innovation and development of new markets

'62 of the 65 larger companies participating in an Envirowise survey involved their supply chain in their cleaner design activities'

8

European policy

- Integrated Product Policy (IPP)
- Product taxes
- Banned materials
- EU Eco-labelling scheme

9

Government policy

- Achieving sustainable development
- Improved protection for the environment
- Reduced greenhouse gas emissions
- Improved environmental performance by UK industry

10

Legislative drivers

- Packaging waste regulations
- Integrated Pollution Prevention and Control Directive
- Climate Change Levy
- End-of-life vehicles directive
- Waste electrical and electronic equipment directive

Cleaner design can help you to comply with this legislation

11

The need for cleaner design

- Increase profits
- Develop innovative products
- Legislative requirements
- Create new markets/increase current market share
- Respond to consumers' 'green' demands
- Increase value of product
- Help to achieve and conform to an EMS

12

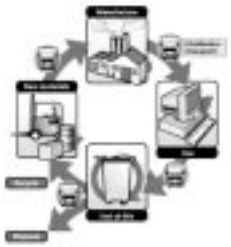
What is cleaner design?

13

Cleaner design is the design of a product to minimise its environmental impacts over its entire lifetime and to meet customer requirements

14

Life-cycle of a product



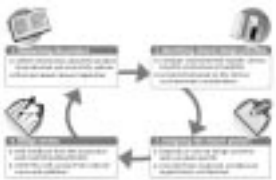
15

Key environmental considerations

- Use less material
- Use materials with less environmental impact
- Use fewer resources
- Produce less pollution and waste
- Reduce the impacts of distribution
- Optimise functionality and service life
- Make re-use and recycling easier
- Reduce the environmental impact of disposal

16

Using the cleaner design cycle



17

Examples of cleaner design

18

Industry Examples

- Varian Medical Systems UK Ltd
- Intruplas Limited
- Avad Contemporary Furniture
- Crawford Hansford & Kimber Ltd
- Holmes Mann & Company Ltd

19

Varian Medical Systems UK Ltd

- Manufactures sophisticated x-ray equipment for simulating radiotherapy treatment
- Identified three drivers for cleaner design
  - maintaining competitive advantage
  - forthcoming legislation
  - corporate policy

20

Varian Medical Systems UK Ltd

Main benefits:

- Cost savings of £162 000/year achieved at a cost of £24 620
- 65% reduction in number of components used
- 29% reduction in number of fasteners
- 27% reduction in assembly time
- Elimination of glass reinforced plastic (GRP)
- Switch to water-based paints

21

Intruplas Limited

- Company uses novel technology to recycle up to 5 000 tonnes/year of contaminated plastic waste
- Produces attractive outdoor furniture
- Focusing on uses for recycled plastics in industry and amenity sectors
- Significant demand for these sustainable products
- Supports employment for the disabled
- Reduces waste going to landfill

22

Intruplas Limited

- Identified new markets for recycled goods
- Marketing cleaner design with significant success

23

Avad Contemporary Furniture

- Produces high-quality, bespoke furniture
- Uses reclaimed or sustainably sourced hardwoods
- Developed new jointing and production techniques, some of which use no glue or metal

24

Avad Contemporary Furniture

- Life-cycle assessment (LCA) shows that, in the example studied, the nearest comparable techniques have almost twice the environmental impact
- Planning marketing programme to promote cleaner products
- Identified local sustainable timber source
- Continued research into sustainable design

25

Crawford Hansford & Kimber Ltd

- An SME manufacturing electronic sub-assemblies for industry
- Identified WEEE directive as requiring change and potentially increasing costs
- Adopted proactive approach using cleaner design as a method of increasing product recyclability and reducing unit costs

26

Crawford Hansford & Kimber Ltd

- Use of lead solder reduced by 80%
- Reduced number of screws and fixings used
- Additional markets for cleaner products
- Benefits to supplier
  - reduced cost
  - reduced environmental impact of production

27

Holmes Mann & Company Ltd

- Packaging manufacturer
- Used cleaner design to:
  - reduce costs
  - develop a cleaner product using less material
  - comply with the packaging waste regulations
  - improve its environmental performance

28

Holmes Mann & Company Ltd

Example of a product and its packaging produced using cleaner design

29

Implementing cleaner design: researching the product

30

Researching the product

- Consider the product's life-cycle
- Examine the materials used in the product
- How is the product manufactured?
- How is the product distributed?
- How is the product used?
- What happens at the end of the product's life?
- Talk to your suppliers and customers

31

Consider the product's life-cycle

- Life-cycle assessment
  - aims to identify environmental impacts arising throughout the product's life history
- Life-cycle thinking
  - generic LCA information
  - use cleaner design checklist

32

Examine the materials used in the product

- Create a list of all the materials used
- Look at the environmental impacts of these materials
- Identify alternatives
  - use fewer materials
  - only use materials that can be recycled
  - use materials containing recyclates
  - obtain from more sustainable sources
  - talk to suppliers/customers

33

How is the product manufactured?

- Is the process energy intensive?
- Does it produce a lot of waste?
- Are natural resources (eg water and fossil fuels) used?
- Can resource use be reduced?

34

How is the product distributed?

- What type of packaging is used?
- Could less packaging be used?
- Could re-usable packaging be used?
- How is the product stored before dispatch?
- How far are the products transported?

35

How is the product used?

- Talk to consumers to find out if they have developed 'product habits'
- Do customers feel that any components or functions are unnecessary?

36

What happens at the end of the product's life?

- Does the product typically go to landfill?
- Could the recycling potential be increased?
  - material selection
  - stamping and labelling
- Can modules or parts be re-used?
- Service potential

37

Talk to your suppliers and customers

- Are they aware of cleaner design?
- Ask them to join the design team
  - helps to maintain business relationships
  - can share information/benefits
- Can they suggest alternatives/ideas?

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Tools to aid life-cycle thinking

39

What is an LCA?

- Tool for assessing the environmental impacts of a product or system
- Examines material, energy and waste flows of a product over its entire life-cycle
- Identifies areas of highest impact, thus allowing redesign activities to be prioritised

40

What can you gain?

- Identification of environmental impacts
- Increased efficiency
  - materials
  - energy
- Improved quality
- Information to back marketing claims
- Increased competitiveness

41

Possible barriers and solutions

- Time and resources
  - simplify boundaries of the study
  - use checklists, abridged LCAs, etc
- Lack of expertise
  - case studies
  - consultants
- Lack of data
  - internet
  - generic LCA data

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LCA summary

- Conducting an LCA can demonstrate increased environmental awareness
- Brings business benefits
- LCA can be complex and time-consuming
- New tools and methods help to simplify this
- LCA is a platform for innovation

More information in *Life-cycle Assessment - An Introduction for Industry* (ET257) from Envirowise

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Practical disassembly exercise

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Disassembly
Design priorities
Redesign
Feedback

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Why disassembly?

- Discover all the components used in construction
- Identify (if possible) the mix of materials present
- See how the different components are assembled
- Identify issues related to cleaner design

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Disassembly issues

- Is there any packaging?
- What is the product's function?
- How is it produced?
- What materials are used?
- How is it disposed of?
- How easy is the product to disassemble?

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Specific issues

- **Packaging**
  - Is the product in some form of packaging?
  - Is the packaging minimal?
  - Are lots of different materials used?
  - Can the packaging be recycled or does it use recycled materials?
  - Is the weight of the packaging significant?
  - Can it be reduced?

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Specific issues

- **Product use**
  - How efficiently does the product use energy and resources?
  - Is the product of the appropriate quality?
  - Is it durable or disposable?
  - Can it be easily repaired or maintained?

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Specific issues

- **Production**

  When the product is assembled are:
  - Permanent or semi-permanent fixings used?
  - Materials joined with screws, glues or snap-fits?
  - Coatings used which may cause problems in disposal or recycling?
  - Materials used efficiently, etc?

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Specific issues

- **Materials**
  - Is there minimal use of materials?
  - Are they from renewable resources?
  - Are hazardous components or materials present?
  - Are virgin or recycled materials used?
  - Are the different materials identifiable?

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Specific issues

- **Disposal**
  - What is the probable disposal route?
  - Can the product be recycled easily?
  - Is it biodegradable?
  - Is refurbishment a possibility?
  - Can the product be re-used?
  - Can the product's lifespan be increased?

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Aims of cleaner redesign

- To identify solutions to the issues raised by disassembly
- To achieve this, attention should be given to:
  - identifying cleaner design priorities
  - developing redesign actions

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Design priorities

- The key to cleaner redesign is the identification of design priorities, eg is it more important to reduce the materials used or increase recyclability?
- Issues can be prioritised by considering the product's characteristics

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Achieving cleaner redesign

- Develop design goals
- Convert these goals into actions and design requirements or specifications
  - decide how these will be achieved in practice
  - outline the new 'cleaner' features of the redesigned product
- Prepare an action plan
- The redesigned product must meet customer expectations
- Consider form and function

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Tips for success

- Successful cleaner design requires the development of design strategies
- Comparison of different goals is not always straightforward
- Practical ways of achieving the strategies must be clearly identified and be feasible
- Seek feedback from the production and sales departments

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Exercise safety and method

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Health and safety 1

- Safety glasses must be worn during the exercise
- Only one person should disassemble the product at any one time
- Do not connect any of the products to an electricity supply
- All products can be disassembled by removing screws or other simple fastenings
- Do not force or prise products apart - this is unnecessary

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Health and safety 2

- Exercise caution when using hand tools and only use the tools supplied
- Be careful of sharp edges, eg metal, wires and plastic fittings
- Do not disassemble printed circuit boards
- If in any doubt, please ask a facilitator

Above all, enjoy the exercise safely

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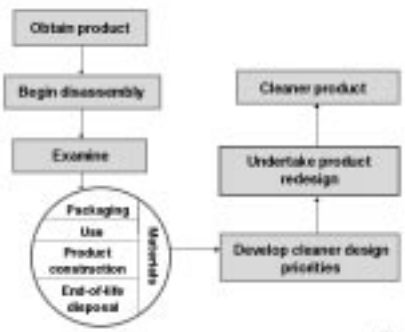

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Discuss your findings

- You should now have a series of issues from the disassembly
- What are the good and bad aspects of the design?
- Prioritise these issues in order of importance
- Produce a simple specification for a cleaner redesign

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The next steps

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Workshop summary

- Why undertake cleaner design?
  - legislative and supply chain pressures
- What is cleaner design?
  - examine life-cycle of product, eg using LCA
  - redesign to reduce environmental impacts and improve product
- What are the benefits?
  - increased profits, product innovation, new markets
- How do I carry out cleaner design?
  - product research, disassembly, redesign

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What is Envirowise?

- Helps industry reduce waste and save money
- Government-funded
- Free, independent advice for UK industry
- Less waste equals more profit

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How can Envirowise help?

- Environment and Energy Helpline, freephone 0800 585794
- Free publications
- Fast Track visits
- Events
- www.envirowise.gov.uk
- FREE

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Your next steps

- Contact Envirowise
- Run your own workshop
- Involve colleagues and senior management
- Look at your product

Cleaner design can be applied to any product or business

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Ultimately, cleaner design can save you money and increase profits by reducing waste, increasing product efficiency and encouraging product development

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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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