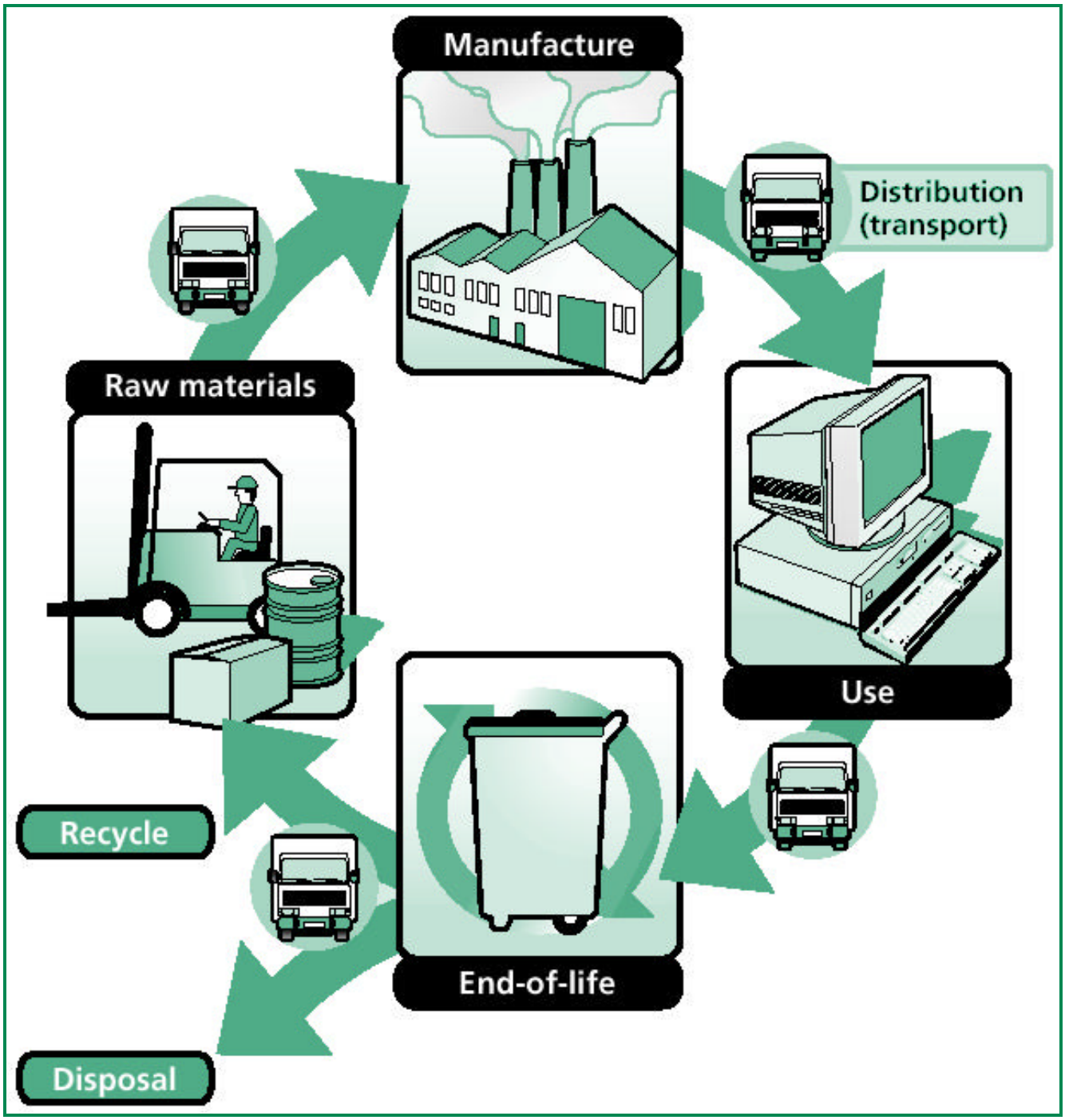
Resource efficiency in plastics processing

TANGRAM TECHNOLOGY

CONTENTS

Produced by Tangram Technology Ltd.: www.tangram.co.uk


Manufacture
Distribution (transport)
Raw materials
Use
Recycle
End-of-life
Disposal

Resource Efficiency

Introduction

The UK plastics industry is highly focused on the cost of labour and sees any growth in imported products as being due to the 'lower labour costs of overseas suppliers'. The reality is that labour costs are now a minor component of the overall cost of most plastics products. The cost of materials and overheads are far more important to the total product cost, but UK industry still focuses overwhelmingly on the labour cost.

Unless the UK industry addresses the real issues of resource usage and overhead management then business will continue to migrate offshore whilst the UK industry chases a mirage of 'labour cost reduction'. The first industrial revolution used machinery to increase labour efficiency and the UK became a world industrial power. The techniques of the industrial revolution and improved labour efficiency are now available worldwide and this might seem a recipe for accepting the loss of UK manufacturing industry, but the rules have changed.

The worldwide plastics processing industry is at the start of a 'second industrial revolution' where the key to success is in rapidly improving resource efficiency through 'Cleaner Design' to increase the effective use of all resources. This means:

- Improving resource efficiency through 'Cleaner Design' to reduce the resources used and converting those that are used into higher added value products in the most effective way.
- Improving resource efficiency through 'Cleaner Design' to reduce environmental impacts and improve profits.
- Improving resource efficiency through 'Cleaner Design' to provide the next competitive advantage for UK industry.

'Sustainability - development which meets the needs of the present without compromising the needs of the future.'

Gro Harlem Bruntland

What about labour efficiency?

The structure of costs in plastics processing is changing rapidly. Direct materials costs are remaining relatively static as a proportion of costs but direct labour costs are going down and overheads are rising. These changes in the cost components mean that labour efficiency is no longer the only key to industrial success.

The importance of the cost components may be changing but the efforts of most companies remain rooted in the 'labour efficiency' model and are out of proportion to the importance of the costs. Until the industry realises and accepts these fundamental changes then survival efforts will be directed at the smallest component of costs, will continue to be ineffective and the UK processing industry will continue to lose ground to lower cost competitors.

Despite this, the UK plastics processing industry can remain a competitive force by addressing the new cost structures and improving resource efficiency to achieve dramatic cost reductions.

What matters?

Today, the important things are profitability and simple survival. This involves focusing on reducing the important and real costs of direct materials and overheads (85 to 90% of the costs), adjusting the efforts to reflect the new reality and accepting that the basics of the whole industry have changed.

In the future, rapidly improving resource efficiency through 'Cleaner Design' will require management and control of the full product life cycle. The life cycle issues of the future will be:

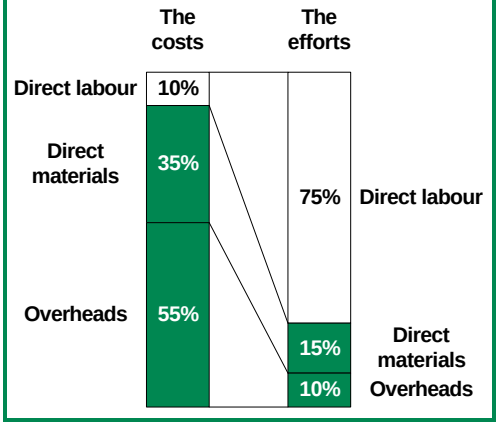
- Manufacturing
- Use
- End-of-life
- Raw materials

The product life cycle starts to provide a route map and a basis for planning the actions needed to guarantee future survival for the UK plastics processing industry.

Achieving continued profitability and survival in the future will mean taking charge of the company's destiny rather than allowing it to be dictated to you.

Why focus on products?

Cost category	1960	1986	1996
Direct labour	25%	12%	10%
Direct materials	60%	58%	55%
Overheads	15%	30%	35%



One study* 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.

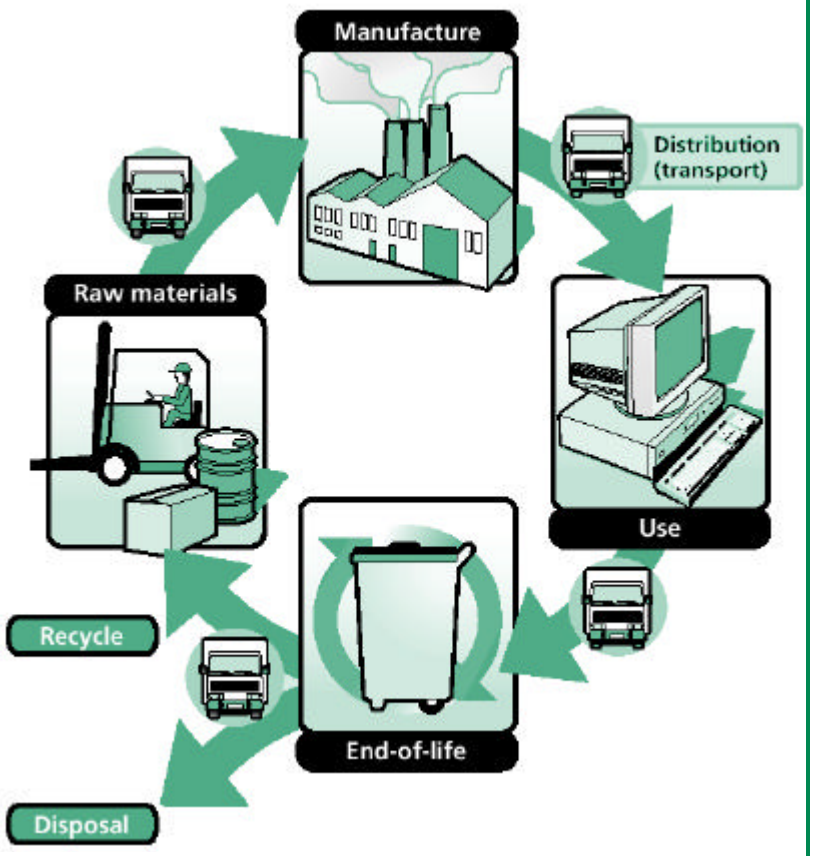
Products consume and waste vast amounts of materials and on average 80% of a product's overall cost and environmental impactis a result of the design decisions taken at the start of the design process. Focusing on product design improvements and using Cleaner Design concepts can produce remarkable improvements in resource efficiency and profitability as well as reducing a range of environmental impacts.

What is cleaner design?

Cleaner design is design to minimise the environmental impacts over the entire product life cycle and to meet customer requirements. It is a proactive environmental management tool to reduce the environmental impacts of a product throughout the life cycle. It is also a method of addressing wider issues, such as product cost, resource depletion, waste and pollution.

Cleaner design involves meeting the customers' requirements whilst using the minimum amount of resources and creating the minimum amount of environmental impact. Cleaner design aims to move from the traditional linear approach to product life (manufacture, use, dispose) to a more cyclical approach to allow material to be re-used or recycled at the end of its life.

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



The product life cycle - the key to the future

What next?

The tasks facing the industry will change in the future - past experience and methods will no longer be sufficient to meet the new challenges, legislation and demands.

Over the next few months we will look at the various aspects of Cleaner Design, try to define the important issues and tasks and most importantly try to provide a route map to the future for profitable and sustainable operations.

A route map to the future

Horizon	Keyword	Key Task
0 - 2 Years	Manufacture	Targeting efforts
2 - 5 Years	Use	Optimising Usage
5 - 10 Years	End-of-life	Minimising Outputs
10 - 15 Years	Raw materials	Minimising Inputs

More Information

- *Cleaner Technology - An essential guide for industry (GG288).*
- *Life-Cycle Assessment - An introduction for industry (ET257)*
- *Cleaner Product Design - An introduction for industry (GG294).*
- *Cleaner Product Design - Examples from industry (GG295).*
- *Cleaner Product Design - A practical approach (GG296).*

Available free from the Environment and Energy Helpline 0800 585 794

Manufacturing - Targeting Efforts

Short term results

In the short term (0 - 2 years), manufacturing is the key area and the key task is improving resource efficiency in operations by targeting the efforts on the areas with the most return.

This involves:

- Recognising the reality of the changing cost structures.
- Accepting responsibility for the cost of materials.
- Targeting actions to reduce the cost of materials.
- Accepting responsibility for the controllable overheads.
- Acting to reduce the controllable overheads such as utilities usage.

Targeting the efforts means changing the emphasis from reducing labour costs to more important areas. It means keeping the labour and sacking the kilogrammes (materials costs) and kilowatt-hours (utilities costs).

Keep the labour - sack the kilogrammes and kilowatt-hours.

Targeting the efforts means designing the product so that the manufacturing process uses less process materials, energy, water and other resources. Cleaner design focuses on the product to reduce waste and pollution during manufacture. This increases profits, increases resource efficiency and reduces the environmental impacts of production.

Cleaner products

Cleaner design reduces the amount of materials used and changes the type of materials used, actions that both directly reduce the product cost.

Reducing the amount of material used is a fundamental of good design and is not unique to cleaner design - techniques such as Value Engineering based on a full Product Design Specification, computer based mould design and Taguchi methods should be used to generate robust designs that deliver the functions that the customer has specified whilst using the least material.

'Minimising the number of manufacturing steps enables the company to

stay in business by taking out cost while keeping functionality.'

Marconi Applied Technologies

Cleaner design also looks at the type and number of materials used. Correct materials selection will create designs that meet the requirements of both the existing and the future legislation, e.g. easier disassembly and increased potential for recycling. Increasing the use of recycled materials can often significantly reduce the product cost with no detrimental effect on product properties or performance. As an additional benefit, using recycled materials will also reduce the overall environmental impact of the product.

Correct materials selection involves the use of materials that result in reduced waste and reduce energy consumption during manufacture and reduce or eliminate the use of hazardous materials during production.

Reducing the number of components and materials used will reduce raw material and assembly costs (an area for significant cost savings) and increase the recyclability of the final product.

The second, and most neglected area is the design of products to minimise the consumables needed and used during manufacture. Reducing production costs by product designs that use less energy, water or create less waste during manufacture not only reduces operating costs but also improves environmental performance. The next generation of product designers needs to consider not only the raw materials used but also the other consumables used during manufacture. Cleaner design considers the whole of the product and gives:

- Longer product design life.
- Cost savings.
- Products with reduced environmental impacts during their life cycle.
- Improved product function and quality.

Cleaner manufacturing

The design defines the manufacturing process used and any modern production process has significant environmental impacts. Cleaner design is design for both manufacture and assembly to:

- Lower the production costs.
- Reduce the use of raw materials and utilities.
- Reduce the use of hazardous materials.
- Reduce the amount of waste sent to landfill.

Designing the product so that less pollution and waste occur during manufacture will also reduce local environmental impacts and may lead to safer working conditions for employees.

Answering the following questions will help to identify potential areas for improvement:

- What are the opportunities for reducing energy use?
- How much waste does the process produce?
- How can the amount of waste be reduced?
- How many different types of waste does the process produce?
- How can the number of types of waste be reduced?
- Is any of the waste produced by the

process classed as hazardous (special waste)?
- What natural resources (e.g. water and fossil fuels) are used?
- Can the use of resources be reduced?
- Can improved technology be used to reduce resource usage?

Tip: Ask the production director for information and talk to operators about the sources of unnecessary waste.

Tip: Calculate the resource consumption and environmental impacts of different components or production processes. Review the product design to reduce these.

Manufacturing and the impacts it generates are not separate processes in cleaner design; they are integral to the process of reducing the cost and environmental impact.

Targeting the efforts

Targeting the efforts means a renewed focus on the cost of materials and the controllable overheads. The short-term actions should be:

- Set demanding but realistic objectives for reduced costs and impacts.
- Use the existing company records and product specifications to research products and resource usage.
- Get a copy of GPG292 (see More Information) and start internal work to reduce energy consumption.
- Get a copy of GG277 and start internal work to reduce waste.
- Get a copy of GG294 and start internal work on Cleaner Design to reduce the costs and environmental impacts.
- Dismantle current products (both internal and competitor's products) to see how easy they are to recycle.
- Start to use life-cycle assessment (LCA) and product specific checklists.
- Benchmark your product's environmental performance against previous products or competitors' products but be careful to compare like with like products.
- Keep abreast of forthcoming changes to legislation.
- Contact the Environment and Energy Helpline for information about typical resource use and waste in the sector.
- Contact the Environment and Energy Helpline for further information about free resources such as consultancy help for energy use, waste minimisation and cleaner design product reviews.

Horizon	Keyword	Key Task
0 - 2 Years	Manufacture	Targeting efforts
2 - 5 Years	Use	Optimising Usage
5 - 10 Years	End-of-life	Minimising Outputs
10 - 15 Years	Raw materials	Minimising Inputs

The route map

Drivers
- Continued profitability and survival.
- Increasing resource costs (e.g. Climate Change Levy) as an incentive for reducing resource usage.
- Increasing disposal costs (e.g. Landfill Taxes) as an incentive for reducing resource disposal.
- Integrated Product Policy (scheduled for the near future) drives consistent approach to resource usage and products.
- Increasing environmental legislation from the EU and the UK.

Strategies
- Improve relative resource efficiency for all resources used.
- Reduce the amount of resources used in absolute terms, e.g. materials, energy efficiency, waste minimisation.
- Introduce Cleaner Design concepts at the design level to reduce future costs.

Tactics
- Survey, measure and target the real resource usage costs.
- Work with customers to reduce materials usage and costs.
- Benchmark real resource costs against competitors to set future targets for reduced resource usage.
- Seek and implement the available free Government help from Envirowise.
- Invest in improved technology to reduce resource usage.

Results
- Real cost savings from improved resource efficiency.
- Energy bills reduced by 10-20% from no-cost and low-cost measures.
- Cost of waste reduced by 25% from no-cost and low-cost measures.
- Profits improved by 25-30%.

More Information

- *Cleaner Technology - An essential guide for industry (GG288).*
- *Cleaner Product Design - An introduction for industry (GG294).*
- *Cleaner Product Design - Examples from industry (GG295).*
- *Cleaner Product Design - A practical approach (GG296).*
- *Environmental Management Systems for the plastics industry (GG251).*
- *Finding and reducing waste in plastics processing (GG277).*
- *Energy in Plastics Processing - A Practical Guide (GPG292).*

Available free from the Environment and Energy Helpline 0800 585 794

Use - Optimising Usage

A new critical cost

In the medium term, the challenge will be to reduce the cost of ownership of products. Many current consumer products (such as cars, white goods, brown goods and windows) use more energy and resources during their usage stage than during the manufacture stage. This is even true of many industrial products e.g. running an electric motor for around 1000 hours costs as much in electricity as the capital cost of the motor.

Reducing the cost of ownership requires an additional consideration in design - the new issue is 'design for use' where the focus is on the best use of plastics to meet the user requirements and prolong the life of the product (and the resources embedded in it). Planned obsolescence is no longer an acceptable strategy, if it ever was in the long-term.

Many consumer products (such as cars, white goods, brown goods and windows) use more energy and resources during their usage stage than during manufacture.

Consumers are increasingly aware of the resource efficiency of competing products and the 'energy rating' of products from light bulbs to refrigerators is increasingly being used by consumers to inform and guide their choices. This consumer pressure is driving the development of better quality or more efficient products with reduced running costs.

Some processors will think that this is not their problem, they will see themselves as 'converters', but this will not be sufficient for future survival. Successful processors are increasingly producing complete assemblies to add value - cost in use is becoming a key indicator for success in any market. Any processor who ignores this is not planning for the future. The good news is that the unique properties of plastics give them exceptional advantages in 'cost in use' calculations compared to traditional materials.

In the medium term, cleaner design can be used optimise the resource efficiency of products throughout their life cycle and to reduce the environmental impacts of products and the manufacturing process.

Usage patterns

It is important to look beyond simply what the product is designed to do. Information is needed from consumers about what they actually do with a product, i.e. their 'product habits'. 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 can also reveal opportunities for reducing the functions or parts of the product or packaging that customers regard as unnecessary, e.g. surplus modules, features and attachments.

Functional and usage analysis of the product will become a key task and existing techniques such as Value Engineering and customer surveys (now part of ISO 9000) can be used to produce a Product Design Specification based on real 'critical' and 'desirable' functions rather than a design based simply on drawings and materials specifications.

Designers need to use cleaner design as an incentive and a tool to reduce the total resources used during the usage stage of the product life, to tune the product design to the real needs and usage patterns of the consumer and to increase the value added for the end-user.

Designing for use

Designers need to start to focus on new issues such as:

- Using fewer resources in use - Designing the product so that its use and maintenance requires less materials, consumables, energy and other resources to reduce the adverse impacts of the product and the costs of using the product, e.g. electricity and water consumption.
- Causing less pollution and waste in use - Designing the product so that it causes less pollution, produces fewer emissions, has less waste and has reduced environmental impact during use.
- Optimising functionality and service life - Optimising functionality to reduce the need for additional products or resources to achieve the same task and making the product more efficient in use.
- Giving the product a longer service life - This will increase repeat sales and will also require fewer products to be manufactured, thereby reducing the impacts associated with product production, delivery and disposal.
- Using customer surveys as an integral part of the design process - These can identify the important areas of the product's efficiency and whether it has any redundant functions that can be removed to reduce production and usage costs.
- Considering maintenance issues - Reducing maintenance or making it easier to carry out will prolong the product life and improve the intrinsic value to the consumer.

In the future the issue of resource efficiency during the usage stage must become part of the Product Design Specification and part of the basic design of any product.

Reducing environmental impact during use

Some opportunities to reduce resource consumption and environmental impacts during the product's use can be identified during initial product research (see GG294). Other general measures to improve resource efficiency and to reduce waste during use include:

- Providing instructions on how to use the product efficiently. Never assume that users will automatically use the product in the most efficient way.
- Fitting better controls (automatic or manual) to optimise energy and material use without user intervention.
- Improving the functionality and service life of the product through more durable design concepts such as making it easier to repair and service and making it adaptable to different tasks, related either by the technology or by the function.
- Asking customers to rank the product's efficiency and the various functions.
- Designing the product so that it lasts longer. A good place to start to identify weaknesses is to look at records of complaints and reasons for return.
- Improving the insulation on hot or cold elements.

Although such measures can sometimes (but not always) increase the product's purchase price, the user inevitably achieves long-term benefits from reduced energy and resource consumption. The rise of European Union labelling schemes on items such as refrigerators and washing machines are making users more aware of the lifetime benefits of efficient products. These benefits can form a core part of the actions to improve market share and profitability.

The future

The issues of cleaner design and resource efficiency in manufacturing and use are largely internal - most of the improvements required are driven by internal costs and the need to reduce these. In the medium and long-term future this will change. The major drivers will become largely external and will be legislation and the cost results of the legislation. Legislation is becoming a tool to internalise the social costs of products that were previously ignored by manufacturers. An example of this is the issue of 'plastic bag taxation' to reduce litter - litter is primarily a social problem that is external to the producers but the legislation in Ireland internalises this problem to the manufacturers and users. It is not going to get any easier.

Horizon	Keyword	Key Task
0 - 2 Years	Manufacture	Targeting efforts
2 - 5 Years	Use	Optimising Usage
5 - 10 Years	End-of-life	Minimising Outputs
10 - 15 Years	Raw materials	Minimising Inputs

The route map

Drivers

- Increased profitability.
- Continued growth of 'push-pull' taxes and legislative instruments such as the Climate Change Levy and Landfill Taxes.
- Increased market demands (from both customer and ultimate end-user) for improved and documented environmental performance.
- Introduction of 'Integrated Product Policy' requirements from EU.

Strategies

- Improve the design process and outputs to reduce the whole life cost of products, particularly the usage costs.
- Improve the manufacturing process to reduce the whole life cost of products, particularly the usage costs.

Tactics

- Integrate potential usage costs into the product costing calculations.
- Design products to be resource efficient during the usage stage.
- Train product designers in:
  - Design for Manufacture.
  - Design for Assembly & Disassembly.
  - Life Cycle Analysis and similar techniques.
- Implement cleaner design as formal part of design process.
- Reduce manufacturing impacts and costs through cleaner design and technology.

Results

- Improved focus on customer and consumer needs for reduced cost-in-use.
- Achievement of real cost savings from improved resource efficiency at the design stage.
- Adoption of clean technology to give real cost savings from reduced design and manufacturing environmental impacts.

More Information

- *Cleaner Technology - An essential guide for industry (GG288).*
- *Cleaner Product Design - An introduction for industry (GG294).*
- *Cleaner Product Design - Examples from industry (GG295).*
- *Cleaner Product Design - A practical approach (GG296).*

Available free from the Environment and Energy Helpline 0800 585 794

End-of-life - Minimising Outputs

The end-of-life cost hierarchy

Re-use

Remanufacture

Recycle

Disposal

Increasing cost

Destination shortages

•In the 5-10 year horizon the key task will be minimising the outputs at the end of the products life. Disposal is becoming increasingly expensive for waste created at any stage of manufacture and this is particularly true for the end-of-life stage. The current trend in legislation, e.g. WEEE (for electronic equipment) and EOLV (for cars) is to both increase the cost of disposal and to allocate a large part of it to the original producer. The trend for the future is to make the producer responsible for end-of-life costs.

The issue is not simply one of resource depletion, it is also due shortages of destinations for the outputs. The drive for reductions in CO_2 emissions is essentially a 'destination shortage' where the atmosphere cannot accept more CO_2 without being degraded. This lack of external destinations is being internalised to the producer companies through legislation and taxation, e.g. landfill taxes, CO_2 taxes and effluent taxes.

The key to sustaining profits and improving environmental performance at end-of-life is to appreciate why the product is no longer used and what happens to the product at this stage. It is then possible to make appropriate design changes to minimise both the costs and the environmental impacts. Part of the challenge with cleaner design is to improve the options at end-of-life.

The choices

At the end of its 'first' life, the product (or parts of it) can be re-used, remanufactured, recycled, disposed of in an incinerator (to recover energy) or disposed of to landfill. In the future, and perhaps even today, the further down the hierarchy the end-of-life option chosen is then the higher the cost.

In an environment where the 'producer pays' there is a need to improve control of the product during and after use to reduce costs, this can be achieved by:

•Labelling re-usable and recyclable parts.
•Using existing distribution channels to collect used products or components.
•Developing new distribution and more effective recovery channels to collect used products or components.
•Keeping up-to-date with developments in recovery and recycling to improve the options available.
•Discussing ways of recovering and recycling products with trade associations, waste management companies or companies offering similar products.

'Minimising the number of materials in a product will make it easier to recycle.'

BTexact Technologies

What happens now?

Designers need to find out what is happening to the products now to provide directions for the future. Examination of the current methods of disposal can reveal opportunities for increasing the product's recycling potential and decreasing the end-of-life costs. Typical questions are:

•Is the product typically disposed of to landfill? This can give rise to environmental impacts through the production of leachate and landfill gas and will be subject to increased costs in the future.
•Can 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 for reuse or remanufacture?
•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 to reduce costs?
•Can various modules or parts be stamped with labels indicating their recycling potential? This is particularly relevant for plastics where standard material designations and labels are available for common materials.
•Can the product and/or its modules be designed for service or maintenance to increase their life span?
•Can a product take-back service be developed to reduce 'producer pays' costs?

Answering these questions will help to identify the existing options for product re-use, recycling or recovery. In the future these will need to be improved to minimise the total cost of the product and avoid end-of-life costs that were not accounted for in the 'first' cost of the product.

Making re-use, remanufacture and recycling easier

Designers need to consider the costs of the end-of-life stage of products now - if this is ignored then the eventual costs will be unduly high if legislation changes. Designers must:

•Make re-use, remanufacturing and recycling easier for all products - re-using, remanufacturing or recycling all or part of the product will significantly reduce the eventual costs by reducing raw material use and diverting material away from limited landfill space.
•Design the product for re-use in its current form (i.e. without processing) - this can

extend the useful life of the product. Future product designs need to incorporate the requirements of subsequent uses, e.g. for packaging and containers, this may mean extra durability and the introduction of a re-use system suitable for the market.

- Design for product remanufacture or recycling - this needs increased focus on the physical organisation of the product, i.e. the structure and the way in which components and materials are put together. Reducing the number of fastenings and making fastenings easier to undo will help to make the product easier to disassemble and recycle.
- Design to enable recycling by reducing the number of materials used - single material products are much easier to recycle.
- Design to eliminate materials that can be hazardous during remanufacturing or make recycling difficult.

Cleaner design in the future will not be easy but the alternative high end-of-life costs are even less acceptable

Reducing the impact of disposal

The most common end-of-life option today (disposal) is destined to become the most costly option in the future. If there is no viable cost effective alternative to disposal then designers must attempt to reduce costs and the environmental impact of disposal.

Landfilling any product consumes limited landfill capacity and the cost of this is destined to rise. Depending on the material used, landfill can pose potential toxicity problems to land, watercourses and groundwater, e.g. through chlorinated solvents in landfill leachate. To reduce the cost of the landfill option, designers should:

- Design the product to allow the volume to be reduced before disposal to reduce landfill charges.
- Choose materials, where possible and appropriate, to build in biodegradability.
- Reduce or eliminate the use of hazardous materials in the product design to avoid additional 'special waste' charges.

Incineration with energy recovery provides an alternative 'disposal' option for some products and plastics are excellent for producing energy during incineration. They do, however, require good control systems to reduce harmful emissions.

Whatever options are chosen for the product end-of-life stage, it is certain that the costs will rise in the future and cleaner design offers a unique opportunity to minimise these costs at source.

Horizon	Keyword	Key Task
0 - 2 Years	Manufacture	Targeting efforts
2 - 5 Years	Use	Optimising Usage
5 - 10 Years	End-of-life	Minimising Outputs
10 - 15 Years	Raw materials	Minimising Inputs

The route map

Drivers

- Increases in regulations for disposal of products and emissions, e.g. WEEE, RoHS, Automotive End of Life (EOLV directive) and CFC regulations.
- Increase in cost of disposal of products and emissions.
- Market effects of product disposal costs impact on producers and increasingly on consumers, e.g. refrigerators and cars.
- Rising emissions charges, e.g. Climate Change Levy and Landfill taxes to reflect reductions in disposal sites.
- EMS will become an essential qualification for business continuity.

Strategies

- Improve resource efficiency and reduce resource usage to minimise effects of rising disposal costs.
- Plan to actively manage tradeable resource credits as they are introduced, e. g. carbon trading, PRNs.
- Formulate a 'take-back' strategy to deal with emerging product end-of-life requirements.

Tactics

- Monitor resource intensity and follow legislation as a tool for success, not as a minimum compliance requirement.
- Change or modify accounting systems and verify resource intensity to enable resource credit trading.
- Form customer and end user partnerships to enable 'take-back' strategy to be implemented when appropriate.

Results

- Minimising the inevitable effects of increasing disposal and end-of-life costs.
- Environmental design and control will become an essential cost control and marketing tools.

More Information

- *Cleaner Technology - An essential guide for industry (GG288).*
- *Cleaner Product Design - An introduction for industry (GG294).*
- *Cleaner Product Design - Examples from industry (GG295).*
- *Cleaner Product Design - A practical approach (GG296).*
- *Environmental Management Systems for the plastics industry (GG251).*

Available free from the Environment and Energy Helpline 0800 585 794

Raw Materials - Minimising Inputs

Planning for scarcity

The resources of the world are finite but the demands being placed on them are increasing rapidly. These demands will increase even more rapidly as the nations of the Far East aspire to and attain the living standards of the West. For example, it has been predicted that the amount of polymer processing machinery required in China over the next 10 years will equal that produced in the West since the plastics industry first started. These changes will inevitably require huge amounts of raw materials and both the resource depletion rate and prices increase. Polymer supply is a world market and a buoyant market in the Far East always translates into rising prices in the West.

The challenge in the long-term will be to control prices by planning for scarcity. This will mean reducing the usage of virgin materials and to increasing the usage of recycled materials. Cleaner design and resource efficiency will become the essential tools for continued success and survival.

'Use of recyclates can save material costs, but the company had to invest initially to stimulate post-consumer structures for material collection and processing.'

Ford Motor Company (Europe)

Current materials

Many materials currently used in products cannot be recycled and create significant environmental impacts during their production. A good starting point for assessing material suitability is to prepare a list of the materials used in the product. These can then be investigated to find alternatives with lower costs and environmental impacts. Suitable materials might:

- Be recycled or contain recycled materials.
- Be obtained from suppliers that are environmentally conscious.
- Be capable of recycling at the end-of-life stage.

Tip: Suggestions for suitable alternative materials or potential opportunities for recovery, re-use and recycling of materials should be sought from suppliers and customers.

'A focus on lightweighting and materials selection in packaging is essential to maintain profitability.'

Britvic Soft Drinks

Tip: 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 or to use one recyclable material for the entire product.

Examination of current materials must be ruthless in the search for reduced cost and environmental impact. In Germany products made from recycled materials can often attract a price premium, in the future this may become the norm rather than the exception. The markets are changing and plastics processing must change to meet the consumer demands.

Less material

The first target for improving costs and environmental impacts should always be to use less material. This reduces materials costs, resource use, transportation and the amount of waste for disposal when the product reaches end-of-life.

Reduce the materials used in the product by:

- Analysing how the main product function is delivered and whether it can be delivered with less material or even without the material at all. This can often be achieved, without compromising quality, through a detailed understanding the product function and improvements in manufacturing technology.
- Retaining the current form and reducing material use by thinner sections or reduced numbers of fixings.
- Reducing the part count by combining parts.
- Using the product design team to identify areas where material can be used more efficiently.

The process of lightweighting or dematerialisation not only brings environmental benefits, but also reduces manufacturing and transport costs and increases profits. A lightweighting project at Coca-Cola Enterprises Ltd produced a new can with a reduced end diameter. This saved over £1 per thousand cans and £2.3 million/year in the UK alone.

Less environmental impact

The second target is to reduce the environmental impact of the materials used in both the product and the production process. This will reduce the costs and environmental impacts associated with the product life cycle.

Reduce the environmental impact of the materials used in the product by:

- Using renewable materials and recyclates instead of virgin materials to reduce resource depletion and create opportunities and markets for using waste, thus diverting it from disposal.
- Using materials that have less environmental impact during their production, e.g. using less energy or causing less pollution, will reduce the product's environmental impact and can also reduce the need for expensive

controls during production.

- Eliminating or replacing hazardous substances from both the product and the production process. This will reduce the costs and environmental impacts associated with the product life cycle. Examples of reducing the impact are:
- The development team at IBM has successfully replaced virgin polymer in the design of an existing high volume product with 100% recycled content resin, without compromising production.
- The Volvo Car Corporation (VCC) has worked with its suppliers and contractors to eliminate hazardous materials in its vehicles or vehicle components. VCC has developed a 'black' list of substances whose use is banned and a 'grey' list of substances whose use should be limited.
- The Ericsson Corporation developed and used a materials declaration tool to help its suppliers document the material content of its products.

The future

In the future, the raw materials used will define the cost of the product even more than today. Incorrect materials choices will increase not only the initial cost but also the cost at all stages of the life cycle.

The correct materials choice will only be possible by knowing the impact and costs of the materials used over the complete product life cycle. This can be achieved by:

- Collecting information on possible material substitutes that are:
  - ♦ Less hazardous.
  - ♦ From renewable or recycled sources.
  - ♦ Produced with less environmental impact.
- Identifying materials databases that contain information on environmental impacts.
- Requiring suppliers of materials and components to provide detailed materials declarations as part of their supply contract.

Tip: Use a formal materials declaration list to collect the information.

Tip: Initially it will be difficult to obtain information about every part of every component but as the requirements become more common it will become easier.

Tip: Ask suppliers to provide proof of any assertions they make.

Planning for scarcity and reduced environmental impact involves transforming the marketplace. The winners will be companies who manage the transformation and the losers will be those taken by surprise by the changes.

Horizon	Keyword	Key Task
0 - 2 Years	Manufacture	Targeting efforts
2 - 5 Years	Use	Optimising Usage
5 - 10 Years	End-of-life	Minimising Outputs
10 - 15 Years	Raw materials	Minimising Inputs

The route map

Drivers

- Raw material shortages, caused by both resource depletion and growing demand, will increase prices of both products and utilities.
- Competition and price for recycled raw materials will increase as demand and usage increases.
- EMS will become mandatory for manufacturers.
- Compliance with environmental design standards (e.g. IPP and WEEE) will become legislative requirement.

Strategies

- Development and implementation of company strategy for purchase of recycled, renewable materials.
- Development and implementation of company strategy for use of renewable energy.
- Long term and sustainable corporate environmental plans.
- Full implementation of cleaner design principles.

Tactics

- Work with customers to define real product needs.
- Work with customers to reduce the amount and number of materials used.
- Work with customers to remove hazardous materials from the products.
- Work with customers to introduce recycled and renewable materials.
- Work with customers to gain acceptance of new life cycle of all products.
- Promote and sell environmental benefits to the marketplace.
- Introduction of cleaner technology.

Results

- Winners and losers.
- Transformation of the marketplace.

More Information

- *Cleaner Technology - An essential guide for industry (GG288).*
- *Cleaner Product Design - An introduction for industry (GG294).*
- *Cleaner Product Design - Examples from industry (GG295).*
- *Cleaner Product Design - A practical approach (GG296).*
- *Environmental Management Systems for the plastics industry (GG251).*
- *Finding and reducing waste in plastics processing (GG277).*

Available free from the Environment and Energy Helpline 0800 585 794

Distribution - The Essential Link

Transport is often hidden as a cost and environmental impact.

Focus on reducing transport costs to reduce overhead costs and reduce environmental impacts.

The signs are clear, the pressures are there - the only thing left is action.

Unsustainable patterns

Road traffic in the UK is increasing rapidly with almost 30 million vehicles using the road network. The resulting congestion is an increasing problem (particularly in urban areas) and the CBI has estimated that congestion costs British business £15 billion per year. The increasing congestion increases the time taken for travel or distribution and also increases the unpredictability of meeting crucial delivery slots and appointments.

Road traffic is also the source of about 24% of the UK's total CO_2 emissions - it is one of the fastest growing sources of CO_2 in the UK and is a major obstacle to meeting international commitments.

This growing volume of traffic and the increasing road congestion is making current distribution patterns in the UK unsustainable.

Managing Distribution

Efficient and well-managed distribution should firstly reduce the demand and then optimise the supply to minimise both the costs and the environmental impacts.

Fuel management and efficient distribution can improve both business effectiveness and profitability. Fuel cost is a major element of the total fleet operating costs (typically 25% of the total running cost of the vehicle) and fuel-efficient fleet management can produce typical savings of 10% - benefits that are likely to increase as fuel prices rise. Other possible cost reductions include minimising Vehicle Excise Duty and company car taxation by using more efficient vehicles, benefiting from government grants to support alternatively fuelled vehicles, and reducing accident and insurance costs from less driving and driving in safer, better maintained vehicles.

Reliable data on the cost of distribution is often not easily available and there is a need to be creative in setting targets and monitoring performance. Targets should be simple, independent of changes in the level of production and should aim to reduce demand before reducing the impact (e.g. reduce absolute distribution mileage before improving the cost efficiency of each mile).

Typical targets could be:

- Reduced vehicle mileage - set a target for % decrease in miles per employee/year or miles kg of product/year.
- Reduced fuel usage - set a target for % decrease in litres/employee/year.
- Distribution fuel efficiency for goods - set a target in % decrease in litres/tonne-km.

The typical information needed to set targets and monitor performance is:

- Fleet composition - Fuel efficiency information is available from official government sources, from manufacturers' own specifications and from trade and consumer organisations.
- Fuel use and mileage of the current fleet: Existing records on fuel consumption of the fleet should be available.
- Type of fuel: From purchase records, information should be available on the fuel used and the proportions of petrol and diesel, along with any alternative fuels used (e.g. LPG, compressed or liquid natural gas, electricity, or hybrid vehicles).
- Vehicles leased: Information on the types of vehicles leased, engine size, type of fuel, fuel efficiency and emissions. Records of mileage travelled can be converted to fuel consumption information.

Actions to reduce demand

- Reduce the need for distribution by minimising raw material inputs to both save money directly, and cut down on the need for deliveries. Minimising waste outputs will also reduce the need for disposal.
- Optimise the distribution of goods by ensuring that vehicles carry a maximum load when leaving the site, this can be encouraged by selling whole loads at a discount and also using at back-loading where return journeys are made with other loads. New information technology is being developed to maximise back-loading.
- Optimise delivery routes by using computer technology and use in-cab tracking and modern communications to enable diversions to optimise collection and delivery rounds.

Actions to optimise the supply

- Switch from energy intensive methods to cleaner methods such as rail. Freight quality partnerships bring together local authorities, local trading organisations, hauliers, train operating companies and conservation groups to agree standards for freight delivery that will minimise noise, disturbance and pollution.
- Keep existing vehicles efficient and well-maintained to give higher fuel efficiency and lower emissions.
- Monitor all vehicles to identify differences in fuel economy, tyre wear and maintenance costs.
- Identify and train drivers in fuel-efficient driving techniques and use an incentive scheme to 'reward' better performers.
- Purchase cleaner, more efficient vehicles.

Tip: There are differences of up to 45% in the fuel economy of different models using

the same fuel within the same size range. Choosing fuel-efficient vehicles can save large amounts of money.

Tip: The Government is encouraging the use of alternative fuels through the DTLR PowerShift programme which gives grants towards the additional cost of buying clean fuel vehicles e.g. natural gas; liquefied petroleum gas (LPG); battery electric vehicles (BEV); hybrid electric vehicles (HEV); fuel cell electric vehicles (FCV).

- Influence distribution suppliers by including environmental issues in contracts. Distribution creates significant costs to plastics processors and in too many cases it is treated as an uncontrollable overhead with little real effort to minimise the cost.

The shorter distribution lines for UK suppliers can provide a unique selling point only if it is used to the best advantage.

Using cleaner design to reduce costs and impacts

Cleaner design looks not only at the product; it is also concerned with reducing costs, energy use, waste and pollution during distribution and storage.

Product distribution, i.e. distribution, storage and packaging, can result in both significant costs and environmental impacts. Designers should investigate:

- The method and length of the distribution chain - Can the product be made closer to the point of use and can it be made in response to demand (i.e. minimum stock)?
- The type of packaging currently used - Can robust returnable and re-usable packaging be substituted for single trip disposable packaging?
- The amount of packaging currently used - Can using packaging of a more appropriate size reduce the weight and volume of packaging? Can packaging be redesigned to protect vulnerable components only? Can the product be labelled instead of the packaging to provide free advertising for life?
- The methods of storage during the distribution chain and if any require special storage conditions are needed. Is packaging needed to protect the product from poor storage or distribution conditions? If these were improved could the packaging be reduced or eliminated?

Tip: Ask the dispatch department, drivers and customers for areas and ideas to reduce packaging, implement re-usable packaging or packaging with a lower cost and environmental impact.

Horizon	Keyword	Key Task
0 - 2 Years	Manufacture	Targeting efforts
Distribution to user		
2 - 5 Years	Use	Optimising Usage
Distribution to disposal		
5 - 10 Years	End-of-life	Minimising Outputs
Distribution to raw materials recovery		
10 - 15 Years	Raw materials	Minimising Inputs
Distribution to manufacturing		

The route map - Concluding the series

The migration and loss of business to other areas in search of lower labour costs is not an inevitable process for the UK plastics industry. The cost of labour is not the dominant cost component today and as the markets and vital issues change it will be even less important in the future.

The markets and issues will change to reflect the demands for sustainable development from both consumers and governments.

The key issue in the future will be increasing the total resource efficiency of the business - not simply concentrating on one minor contributor and the major technique for improving resource efficiency in the future will be that of cleaner design. Cleaner design concentrates on the complete life cycle of the product and provides the basis for a route map to improved resource efficiency, increased profits, decreased environmental impacts. Implementing the route map will revitalise the way we do business and reduce the costs of resources at all stages of the product life for the UK plastics industry.

Resource efficiency and cleaner design are not temporary concerns but will become the defining aspects of the plastics processing sector over the next 15 years.

We believe that these changes will radically transform the UK plastics processing industry - companies that are pro-active in this area will benefit and prosper, reactive companies will see their competitive advantages and markets disappear.

More Information

- *Transport and Environmental Management Systems (GPG318).*
- *Fuel-efficient Fleet Management (GPG218).*
- *Fuel Management Guide (GPG307).*
- *Cleaner Product Design - An introduction for industry (GG294).*
- *Finding and reducing waste in plastics processing (GG277).*

Available free from the Environment and Energy Helpline 0800 585 794