



Product Innovation The Green Advantage

An Introduction to
Design for Environment
for Australian Business



April 2001



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Foreword

Australians are increasingly becoming aware of the importance of sustainable development to a healthy environment and robust economy. Producers, or manufacturers, are starting to minimise the environmental impact of their products by using more recycled materials and making them more efficient during use. More consumers are incorporating environmental considerations into their purchasing decisions and thinking more about how they dispose of a product when they no longer need it.

Building construction and motor vehicles are two high profile industry sectors where producers are utilising Design for Environment (DfE) to incorporate eco-efficiency principles into their product development processes, thereby strategically reducing the environmental impact of a product or service over its entire life cycle, from manufacture to disposal.

Companies that are incorporating DfE are at the forefront of innovative business management in Australia. As the link between business success and environmental protection becomes clearer, visionary companies have the opportunity to improve business practices to be more competitive in a global economy and increase their longevity.

With the release of *Product Innovation—The Green Advantage: An Introduction to Design for Environment for Australian Business*, and its sister publication *Shop Smart, Buy Green: A Consumer's Guide to Saving Money and Reducing Environmental Impacts*, Environment Australia continues to contribute nationally to the incorporation of DfE into Australian business practice. Such initiatives not only help to ensure the ongoing sustainability of Australian businesses, they also increase the availability of innovative and environmentally sustainable products. This allows all Australians to contribute towards a prosperous society and to achieve sustainable development without compromising our economic well being or quality of life.



A handwritten signature in blue ink that reads 'Robert Hill'.

SENATOR ROBERT HILL
Minister for the Environment and Heritage

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Preface

For a typical product, 70% of the cost of development, manufacture and use is determined in its design phase. By integrating environmental considerations into the upfront product design, a company can increase efficiency, reduce waste of materials and energy, and reduce costs.¹

This booklet explores Design for Environment (DfE) and how it can improve your organisation's financial, operational and marketing activities. It has been designed to help managers, designers, engineers, accountants and marketers in organisations of all sizes initiate a DfE program. Further, it links with a series of other booklets, including the Framework for Public Environment Reporting, which Environment Australia has produced to help Australian industry continue to improve its environmental performance.

DfE, sometimes called ecodesign, is an approach that encourages businesses to give greater thought to the design of products² so as to minimise their environmental impacts, while increasing market advantage and fostering innovation.

The principles of DfE are simple and implementing a DfE program is achievable for businesses of all sizes.

What we hope this booklet can do for you is:

- show you the economic and environmental benefits of DfE;
- show you how to introduce DfE into your business;
- give you some examples, through case studies, of Australian businesses that have successfully incorporated DfE into their business operations; and
- provide you with a useful list of additional resources and contacts.

For ease of use this booklet is presented in five sections. The first provides an overview of the concept of DfE and how it fits in with global and Australian manufacturing trends. The second outlines the benefits of implementing a DfE program, in terms of Australian business drivers. The third explains the steps involved in implementing DfE. The fourth contains five case studies and the final section provides useful contacts, websites and access to more detailed information.

For further information, contact:
Community Information Unit,
Environment Australia
1800 803 772

¹ Yarwood J.M. and Eagan P.D. 1998, *Design for the Environment Toolkit: A Competitive Edge for the Future*, Minnesota, USA.

² To date the focus of DfE has mainly been on products, particularly manufactured goods, therefore this booklet is targeted at manufacturers of goods, but the information presented can be applied equally well to many service companies. Therefore, where you see the work 'product' used you can usually also read 'services'.

The Design for Environment context

In manufacturing, transportation, forestry, construction, energy, and other industrial sectors, mounting empirical evidence suggests that radical improvements in resource productivity are both practical and cost-effective, even in the most modern industries. Companies and designers are developing ways to make natural resources—energy, metals, water, and forests—work five, ten, even one hundred times harder than they do today.³

Clear themes emerging from legislation in Europe, the United States and, increasingly, Australia suggest that:

- the polluter pays;
- the producer bears responsibility for waste disposal; and
- the public should have access to information about the environmental performance of companies.

In addition, shareholders, consumers and employees are increasingly seeking improved environmental and social performance from business.

This is consistent with global moves by business, governments and communities towards achieving sustainability. The World

Business Council for Sustainable Development coined the term 'eco-efficiency' to describe the efforts by businesses to take the environment into consideration in their operations.

Eco-efficiency is a combination of economic and ecological efficiency. It is basically about 'doing more with less'—producing more goods and services with less energy and fewer natural resources, resulting in less waste and pollution. Eco-efficiency directly links environmental performance to financial performance—as a process is made more efficient, financial as well as environmental benefits will be realised.

As every organisation's operations are different, so too are the strategies and tools that may be used to achieve greater eco-efficiency. A suite of suitable tools is available to increase a company's eco-efficiency and include: DfE, environmental management systems, product stewardship programs, public environmental reporting, environmental auditing, environmental accounting and supply chain management.

DfE is a critical tool for manufacturers wishing to become more eco-efficient.

Eco-efficiency Principles

The eco-efficiency paradigm recognises that the earth is finite, its capacity for recovery from damage because of resource use is limited, and that public and other pressures to modify business behaviour will inevitably increase.⁴

The World Business Council for Sustainable Development identified seven key principles every business should take into account when developing products, introducing process changes or taking other actions with environmental implications. They are:

- reduce the material intensity of goods and services;
- reduce the energy intensity of goods and services;
- reduce toxic dispersion;
- enhance material recyclability;
- maximise sustainable use of renewable resources;
- extend product durability; and
- increase the service intensity of goods and services.⁵

Energy Rating Labels

It is now compulsory for manufacturers to place energy rating labels on a range of electrical and gas products. This requirement covers the following electrical appliances: dishwashers, airconditioners, refrigerators, freezers, washing machines and clothes dryers; and these gas appliances: room heaters, ducted heating systems and water heaters.

These energy labels have a number (showing the approximate annual consumption of electricity or gas) and a star rating. The more stars (up to six), the more energy-efficient the appliance.

There is a similar, though voluntary, scheme for rating a product's water efficiency.

Through these schemes, products that have lower environmental impacts through improved energy and water efficiency are clearly differentiated. As a result, consumers are becoming aware of the savings they can make in running costs, greenhouse gas emissions and water use. This information is now in a form that can easily influence product choice.

³ Hawking, P., Lovins A. and Lovins L.H. 1999, *Natural Capitalism: Creating the Next Industrial Revolution*, Boston, USA.

⁴ DeSimone, L.D. and Popoff F. 1998, *Eco-efficiency—the Business Link to Sustainable Development*, MIT Press, London.

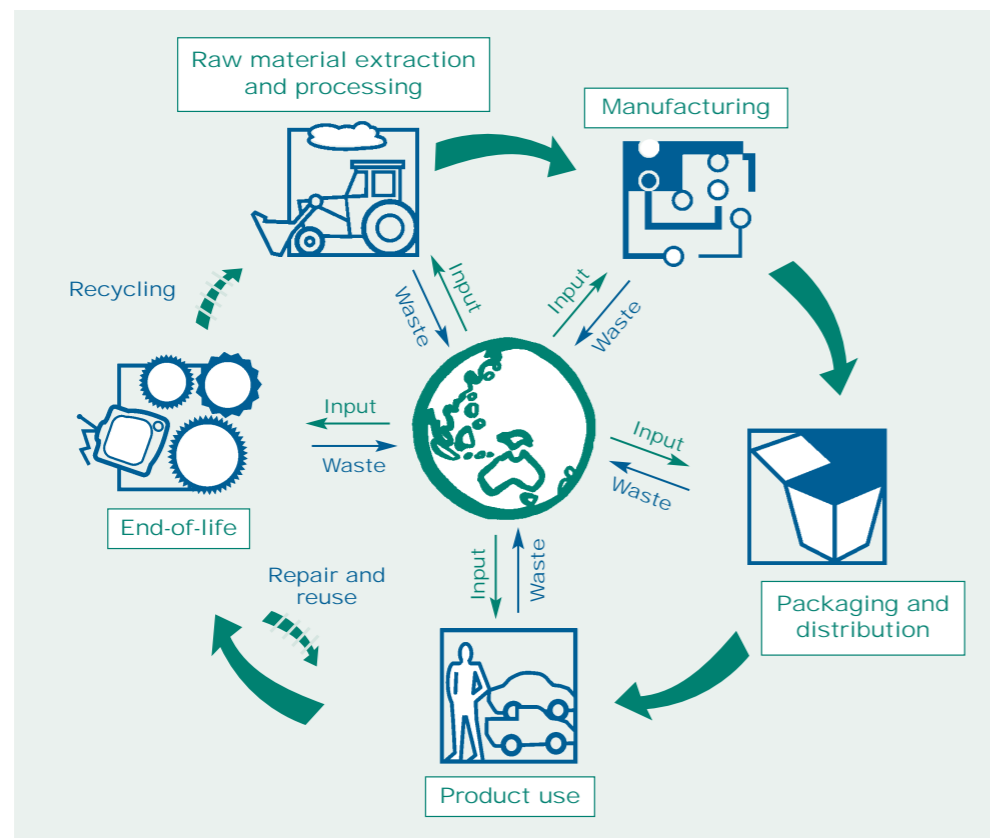
⁵ World Business Council for Sustainable Development, *Cleaner Production and Eco-efficiency*.

What is Design for Environment?

DfE is the systematic application of environmental and human health considerations at the product design stage. DfE aims to avoid or minimise significant environmental impacts and increase resource efficiency at all stages of a product's life cycle—raw material extraction and processing, manufacturing, packaging and distribution, product use, and end-of-life.

Figure 1 shows the relationship between the stages of the product life cycle, and the inputs (ie energy, water and raw materials) and waste (ie emissions to air and water, and toxic/non-toxic waste) that impact on the environment. A dashed arrow between two stages indicates that this link, whilst growing, remains relatively weak for most materials.

Figure 1: Life cycle stages of a typical product and associated environmental impacts



Design for Environment Strategies

The National Centre for Design at the Royal Melbourne Institute of Technology (RMIT) has identified a series of DfE strategies to reduce environmental impacts at each stage of the life cycle (see Figure 2). These strategies can be refined and developed to suit different products and organisations

and form the basis of a company's DfE program.

It is important to remember that a DfE approach is straightforward and companies can start with relatively simple DfE strategies, and if required gradually build up to innovative developments in product design and function.

Figure 2: DfE Strategies⁶

Raw material extraction and processing <ul style="list-style-type: none"> ■ Design for resource conservation ■ Design for low-impact materials ■ Design for biodiversity conservation 	
Manufacturing/packaging and distribution <ul style="list-style-type: none"> ■ Design for cleaner production ■ Design for low-impact packaging ■ Design for efficient distribution 	
Product Use <ul style="list-style-type: none"> ■ Design for energy efficiency ■ Design for water conservation ■ Design for minimal consumption ■ Design for low-impact use ■ Design for service and repair ■ Design for durability 	
End of life <ul style="list-style-type: none"> ■ Design for reuse ■ Design for re-manufacture ■ Design for disassembly ■ Design for recycling ■ Design for safe disposal 	

⁶ Adapted from The National Centre for Design 1997, *A Guide to EcoReDesign—Improving the Environmental Performance of Manufactured Products*, RMIT Melbourne, Australia.

Example— DfE Strategies⁷

Reducing impacts of raw materials

Strategies for reducing the environmental impacts of extracting and processing raw materials can be divided into those concerned with conserving resources using low-impact materials, and biodiversity conservation.

Design for **resource conservation** includes:

- using the minimum amount of material required for the function;
- using materials which are renewable;
- avoiding materials that deplete limited natural resources;
- using recycled and recyclable material; and
- using waste by-products.

Design for **low impact materials** includes:

- avoiding materials made from toxic or hazardous substances;
- avoiding ozone-depleting substances;
- minimising production of greenhouse gases;
- using materials with low embodied energy; and
- using materials that are easily re-used and recycled.

Design for **biodiversity conservation** include:

- avoiding materials which impact on biodiversity; and
- using materials that are sustainably produced

Reducing impacts of manufacturing and distribution

There are several ways in which companies can help maximise efficiency and minimise environmental impacts of the product life cycle during **manufacturing**. These include:

- minimising the variety of materials;
- avoiding waste of materials;
- reducing the number of components and assemblies;
- integrating functions;
- simplifying assemblies; and
- selecting low impact materials and processes.

The environmental impact of **distribution** can be reduced by:

- reducing the weight of the product and its packaging to save energy in transport;
- ensuring transport packaging is reusable and/or recyclable;
- maximising the efficiency of packaging; and
- choosing an efficient transport system.

The Benefits of Design for Environment

By reducing the environmental impacts of a product across its entire life cycle an organisation can strategically reduce environmental impacts and operational costs for both themselves and their customers, thereby creating significant marketing potential and customer loyalty.

Economic Benefits

Maintaining global competitiveness

Increasingly stringent environmental regulations in markets such as Europe, are resulting in products that have low environmental impacts throughout their entire life cycle. Australian-made products face tough competition from those produced overseas under stricter guidelines. DfE offers companies wishing to compete in the global market the means to meet these new standards for environmental quality.

Reducing production costs

Producing goods and services inefficiently costs more and reduces profitability. Disposal and control of pollution can be costly. Excessive waste during manufacturing indicates possible inefficiencies in production and poor use of raw materials. Implementing DfE can reduce pollution, improve manufacturing processes and minimise the use of toxic materials.

Improved strategic decision-making

An understanding of the product life cycle yields more information about product related inputs and outputs, allowing for more accurate planning and a more complete financial assessment of investment options.

Improving company value

DfE can improve a company's environmental performance and reduce exposure to liabilities for problems such as pollution and contamination, thereby increasing its financial strength and ability to attract investment.

Identifying new business opportunities

DfE encourages consideration of the function of a product or service. It can lead to new ideas for providing the same function with lower environmental impacts, possibly through a new product or service. The development of mechanisms to reduce environmental impacts can also lead to new products, services or markets.

Gaining advantage as a supplier

Large organisations and governments overseas and in Australia are beginning to require that their suppliers meet certain levels of environmental performance.

⁷ Adapted from The National Centre for Design 1997, *A Guide to EcoReDesign—Improving the Environmental Performance of Manufactured Products*, RMIT Melbourne, Australia.

Operational Benefits

Improving relationships with regulators

Taking the initiative on environmental management can improve a company's record with environmental regulators, financiers and insurers. Adopting DfE demonstrates a company's credibility and commitment to reducing environmental impacts.

Improving liability management

DfE can help identify potential environmental or health and safety problems. It can also minimise the risk of future liabilities relating to producing, using, servicing and eventually disposing of the product.

Building competencies

DfE increases coordination and communication between different sections of a company. It encourages communication within an organisation and with suppliers and enhances other competencies, such as integrative management.

Improved staff morale

Research shows that corporate responsibility and environmental commitment actually strengthen an organisation's bottom line, primarily by aiding in recruiting and retaining employees. Adopting DfE can help improve staff morale by improving occupational health and safety and giving staff the opportunity to contribute to environment protection initiatives.

Marketing Benefits

Addressing customer needs

International and Australian studies of consumer attitudes consistently show that consumers are concerned about the environment. They see it as an important issue for governments and businesses to act upon and are prepared to change their own behaviour to protect the environment. Companies adopting DfE can promote their environmental performance.

Improved products and product differentiation

DfE results in products that have less impact on the environment and are superior in quality and marketability. Consumers tend to prefer such products not only because they are 'green', but because they may be more durable, of higher quality and cheaper to run. A company can differentiate its products by using environmental quality as a distinguishing feature.

Improved public relations

Adoption of DfE demonstrates a proactive approach to environmental management. A company adopting DfE can actively demonstrate and promote its environmental credentials and good corporate citizenship. DfE gives companies a way of presenting clear, accurate and reliable environmental information to consumers.

Consumers Care for the Environment

Consumer attitudes translate into purchasing decisions. Businesses that ignore consumer attitudes to the environment risk losing their competitive edge and market share.

The Environmental Monitor 2000 report, *Global Public Opinion on the Environment*, is based on a survey of approximately 34,000 citizens in 34 countries. It found that:

- There are significant levels of environmental activism in industrialised countries and surprising levels of latent activism in developing countries. Avoiding environmentally damaging products is overwhelmingly the most popular way of expressing environmental concern. One in four respondents avoided a product or brand specifically for environmental reasons in the past year.
- Six in ten Australians have refused or considered refusing packaging for environmental concerns in the past year.

The NSW Environment Protection Authority 1997 survey, *Who Cares About the Environment*, found that:

- 89 per cent of people were concerned about the environment a fair amount or a great deal; and
- the most common area of greatest concern was for future generations.

DfE Stimulates Innovation

In addition to delivering economic, operational and marketing benefits for companies, DfE is acknowledged internationally as a source of and a catalyst for innovation, both in product design and in eventual changes in the way the function of a product is fulfilled.

Monsanto makes nylon fibre, much of which goes into carpeting. Each year, nearly two million tonnes of old carpeting go into landfills, where they constitute about 1 per cent of the entire US municipal solid waste load.

Nobody really wants to own carpet; they just want to walk on it. What would happen if Monsanto or the carpet manufacturer owned that carpet and promised to come in and remove it when it required replacing? What would the economics of that look like?

One of our customers is exploring that possibility today. It might be that if we got the carpet back, we could afford to put more cost into it in the first place in ways that would make it easier for us to recycle. Maybe then it wouldn't end up in a landfill.

We're starting to look at all our products and ask, what is it people really need to buy? Do they need the stuff or just its function? What would be the economic impact of our selling a carpet service instead of a carpet?⁸

8 Bob Shapiro, CEO, Monsanto.

Introducing Design for Environment to your Business

Starting a DfE program in your business can be simple. Even small changes in design can lead to significant benefits and sometimes you can identify benefits with no cost implications.

Starting with simple, easy-to-use DfE tools can win company support, ensure early successes and pave the way for more comprehensive applications of DfE principles. For example, you might begin by looking at one part of your product or manufacturing process and finding how you can easily reduce environmental impacts.

Another way to begin implementing DfE is to draw upon the skills and knowledge already in the company, such as by brainstorming ways of reducing the environmental impacts and improving efficiency of a certain product or process. Valuable ideas and suggestions might just be waiting to come out.

As you begin to explore the potential for DfE, it will become apparent that it is not just about designing products. An effective DfE program involves considering product development in the context of your company's core competencies and competitive advantages. The human and managerial aspects of product development also require consideration.

Success Factors for Implementing DfE⁹

Shelton and Shopley identified six factors for successfully implementing DfE. They are:

- design the DfE initiative to fit the product development process, not the other way around;
- keep in mind that the DfE goal is to create more competitive products;
- build collaboration among the product development and environment, health and safety (EH&S) staff, management and marketing;
- ensure that DfE belongs to the product development team, supported by the EH&S;
- simple, flexible, easy-to-use DfE tools and management systems are mandatory—especially at the beginning; and
- remember that DfE is not life-cycle assessment—develop and/or find simple, flexible tools that capture the life cycle approach.

Implementing Design for Environment

DfE programs around the world have identified common stages in the implementation of DfE programs. These stages cover typical organisational processes that occur during the introduction of a DfE program, they are not prescriptive, nor do they necessarily occur in the order presented.

Different professions within an organisation—managers, designers, engineers, accountants, and marketeers—all have a role to play in the successful implementation of a DfE program. Some are more involved than others, though all contribute to at least one of the stages.

Figure 3 provides a basic understanding of the professional roles and the processes necessary to implement a successful DfE program.

Analyse Opportunities

Review products and markets










Managers, designers, engineers, accountants and marketeers

Investigate the product development process within your company, the product market and incentives for adopting DfE by:

- identifying drivers behind product design (for example, are product specifications driven by engineering or by marketing?);

Figure 3: Stages in implementing a DfE program and who is involved

Stages in implementing a DfE program	Which profession should be involved
■ Analyse opportunities	 Managers, designers, engineers, accountants and marketeers
■ Promote DfE within the company	 Managers
■ Set goals and identify strategies	 Managers
■ Apply DfE tools	 Designers, engineers
■ Develop the product	 Managers, designers, engineers, accountants and marketeers
■ Market the product	 Marketeers
■ Evaluate	 Managers, designers, engineers

⁹ Klostermann, J.E.M. and Tukker, A. (eds) 1998, 'Product Innovation and Eco-Efficiency—Twenty-three industry efforts to reach the Factor 4', *Eco-Efficiency and Industry*, vol. 1, Kluwer Academic Publishers, Dordrecht.

- identifying the roles of individuals in the product development process;
- researching the product market and the competitive climate (information may already exist within the company); and
- identifying anticipated environmental regulations (for example, through your industry association or State/Territory environment protection authorities, or by looking at the regulations that affect your industry in other countries).

Analyse company capacity

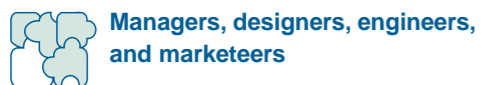


Managers

Investigate your company's resources and capabilities by:

- identifying skills and knowledge that already exist within your company that will help implement DfE; and
- identifying existing programs that can provide complimentary structures and resources for DfE (for example, environmental management and quality assurance systems, and environmental accounting).

Identify DfE opportunities



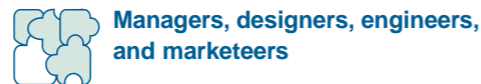
Managers, designers, engineers, and marketeers

You can choose to implement DfE in a simple manner to start with—perhaps with a single product, a part of a product, or a process—by:

- finding out which products may be ready for upgrading or redesign;

- identifying new products that are being designed but have not yet moved into the production phase; and
- identifying simple changes that can be made to existing products (for example, coding plastic for recycling).

Identify potential benefits

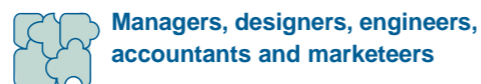


Managers, designers, engineers, and marketeers

The potential benefits to your company provide a powerful incentive for adopting DfE. You could:

- identify measures that cost little to implement but have the potential for significant cost savings;
- identify ways to comply with anticipated regulations now, to avoid future problems and allow products to compete in the global marketplace;
- analyse your market research to determine if there are potential benefits from environmental initiatives (for example, consider DfE as a way of differentiating your product); and
- identify moves by your major competitors to embrace environmental approaches—it may be easier to convince your organisation to adopt DfE if competitors are also taking new initiatives.

Identify a suitable product



Managers, designers, engineers, accountants and marketeers

Select a product for the DfE program and create a detailed picture of the product by:

- identifying a suitable product for redesign or a new product for DfE; and
- building a background dossier on the product, including the market and company information gathered earlier as well as the product details (design features, production processes, etc).

Promote DfE within the Company



Managers

Actively promoting DfE and communicating its benefits is a vital step in creating a corporate culture of eco-efficiency. Promotion should continue throughout all stages of DfE implementation by:

- gaining commitment from senior management (for example, by providing examples of success stories and identifying incentives);
- ensuring senior management officially launches the company's DfE program;
- providing DfE information and success stories in an accessible format (for example, on the company's internal communications network);
- talking with individuals who have an interest in DfE or an incentive to adopt it (for example, a marketing manager interested in green consumer preferences) about how you can work together to implement DfE;
- finding and supporting a DfE 'champion' in each business unit, including the product development teams, to promote DfE and ensure its consideration within their section; and

- providing training and education for those involved with DfE (see the resources section for a list of organisations that can help with training).

Set Goals and Identify Strategies



Managers

Having identified potential DfE opportunities and raised awareness within your company, you can develop goals and strategies for implementing DfE. You can set organisational goals and strategies first, before working at the level of specific products. These can help to gain commitment within your company and raise awareness of the scope, implementation and likely outcomes of a DfE project. It is essential that the DfE strategies and goals are closely aligned with your organisation's overall strategic direction. You could:

- hold a strategy formulation session for staff at various levels who have been informed about DfE;
- identify realistic goals and targets for DfE implementation, environmental improvements and economic performance based on DfE initiatives;
- identify the resources available for implementing DfE and seek additional resources if necessary;
- set goals for specific products, business units or divisions;
- ensure DfE strategies are aligned with overall company directions;
- develop strategies for achieving the targets; and
- identify time-oriented milestones and areas of responsibility.

Apply DfE Tools

Find suitable tools



There are many different tools that can be used in DfE, ranging from life cycle assessment programs through to simple checklists, guidelines and scoring matrices. At the end of this booklet there is a resource list you can use to find more information on specific DfE tools. You could:

- explore the available tools—consider the level of sophistication needed, the resources available to invest in tools, the complexity of the product and the amount of design time available;
- determine which DfE tools are suitable, both for the tasks and the people using them;
- evaluate tools and select the most appropriate ones;
- start with simple DfE tools (such as checklists) and work towards more complex ones; and
- bring in external assistance and/or training if needed.

Assess the life cycle of the product



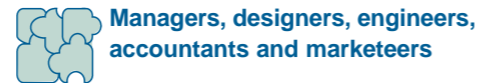
There are simple, flexible DfE tools that capture the essence of the life cycle approach. A preliminary analysis of the life cycle (rather than a detailed life cycle assessment) is simple and affordable,

and can reveal where the greatest environmental impacts occur and the opportunities for improvement. You could:

- identify the inputs, outputs and wastes of each stage of the product's life cycle;
- identify environmental impacts through an initial simple analysis (for example, by brainstorming with other staff);
- identify 'upstream' (before your company gets involved) and 'downstream' (following your involvement) impacts and which stages your company can influence; and
- assess environmental impacts at each stage.

Develop the Product

Having moved through all or some



of the previous stages (as appropriate for your company), you can begin designing, developing and prototyping the new product. You need to:

- gain company agreement on specific product strategies and development directions to be pursued;
- prepare a brief for detailed design, development and prototyping;
- provide the production team with DfE tools and information in a format consistent with other production specifications; and
- appoint someone to evaluate the design for compliance with environmental goals.

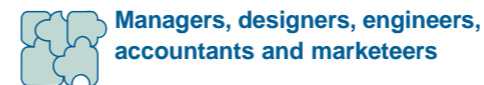
Market the Product



Much of the ability of the DfE process to add value to the product will eventually come down to marketing. You could:

- use the DfE process to develop credible, accurate and substantiated environmental information for the consumer;
- become involved in appropriate rating schemes (such as water efficiency ratings) that help to market environmentally preferred products;
- find ways to inform and educate consumers about the environmental benefits of your product; and
- consider forming partnerships with retailers, local governments, environment and consumer groups to help with marketing.

Evaluate



With any new process there are risks: you may find unanticipated environmental impacts or other reasons that an aspect of your DfE project may not be completely successful. However, implementing DfE is a continuous learning process and knowledge gained from the experience can improve the next product or process. At this stage you need to:

- adopt a formal feedback process to improve the learning ability of your company—any person involved in product development should be able to comment on successes and problems;
- evaluate progress against your initial goals and milestones;
- ensure feedback is incorporated into new designs or follow-on products; and
- regularly audit the level of implementation within each business unit and provide incentives for adoption.

DfE Time Horizons¹⁰

DfE typically involves an evolutionary approach to product development, including:

1. Incremental changes in existing products (time horizon 1–3 years). For example, the design of an office chair which minimises its use of materials, is recyclable and reduces the use of toxic materials.
2. More far-reaching changes in existing products (time horizon 3–15 years). Examples such as new distribution strategies that result in less and reusable transportation packaging would form part of this approach.
3. Radical changes in the function of products (time horizon 50 years). Such initiatives could include sustainable building methods, or the substitution of animal protein through biotechnological techniques.

¹⁰ Shelton, R.D., Shopley, J. 1996 'Improved Products Through Design-for-Environment Tools', *Prism*, First Quarter, Arthur D. Little, Cambridge MA.

Case Studies¹¹

Case study 1

Caroma—reducing Australia's water consumption

Culturally, Australians have a deep-rooted appreciation of the need to conserve water and have shown a willingness to accept the introduction into the marketplace of bathroom appliances that are environmentally and socially responsible.

Steve Cummings, Research and Development Manager, Caroma.



Caroma is a wholly-owned subsidiary of GWA International Limited, an Australian-owned company based in Brisbane, and is regarded as the leader of the Australasian sanitaryware industry. Caroma products, including the 6/3 litre dual flush system, are shipped to over 30 countries worldwide.

In the early 1980s, with the assistance of a Commonwealth industry grant, Caroma

developed the 6/3 litre dual flush toilet system. With an average flush volume of only 3.8 litres, the water usage of a family of four can reduce by up to 67 per cent compared with the traditional 11-litre single flush cistern.

Caroma utilised a number of DfE strategies to address the entire life cycle of the product. The product was designed for ease of assembly and longevity, with fewer components made of more durable materials. The valve mechanism contains recycled ABS plastics sourced from Caroma's manufacturing waste. Testing conducted on the valve indicates a life span of some 30 years. The toilets are produced from low impact materials, consisting of either inert plastics or vitreous china. The life span of the complete system is comparable to that of the house in which it is installed.

Studies conducted in 1993 modelled water savings in Australia with the introduction of the 6/3 litre dual flush system. The study found that water consumption dropped from 55 litres per person per day in 1982 to 18 litres in 1993 after the introduction of the new cisterns. The study predicted that the amount of water being used in Australia in the year 2020 would be less than the amount being used in 1991. This result would be achieved even with a projected population

Images courtesy of Caroma Australia



Case study 2

ReIn Pty Ltd—creating market share with recycled products

ReIn Plastics is an Australian company that designs and produces innovative quality plastic products such as waste, waste water and agricultural products for the Australian and international markets. The company has grown dramatically in the last eight years, from 11 employees in 1992 to 160 in 2000.

In 1990, ReIn decided to embark on a program to design and market waste minimisation products made from 100 per cent recycled post-consumer plastic. The company developed a line of organic waste recycling products including compost bins and worm farms (the Worm Factory™ and the Can-O-Worms™).

The products allow households to compost their organic waste, reducing their contribution to the waste stream, while producing hygienic, odourless solid and liquid fertiliser. The products themselves can be recycled at the end of their useful lives.

ReIn reduced packaging to a minimum. The Can-O-Worms™ packaging consists of a promotional cardboard disc, which is then used in the initial establishment of the worm farm and eaten by the worms, and a polypropylene strap, which ReIn asks purchasers to return to the company.

ReIn partnered with Australian local governments (which have direct responsibility for removing household waste and managing landfills) to distribute the Worm Factory™ directly to their ratepayers at minimal cost. The Worm Factory™ and other recycling products are now sold by over 400 local governments in Australia. In 1997, ReIn introduced the Can-O-Worms™ into the Australian retail market through national chain stores K-Mart and Mitre 10.



Environmental benefits

To date, manufacture of ReIn worm farms has accounted for over 1 000 tonnes of post-consumer plastic. In addition, ReIn estimates that their worm farms have turned an estimated 10 000 tonnes of organic waste destined for landfill into nutrient-rich, odourless worm castings and liquid. In total the company has used over 25 000 tonnes of recycled plastics in making various products.

Financial benefits

Development of both the Worm Factory™ and the Can-O-Worms™ cost more than \$1 million from the product concept to the finished product. Each product has a payback period of three to five years.

¹¹ You can find more information on this and all other case studies in this booklet at <http://www.environment.gov.au/eecp.html>

Over 230 000 worm factories were sold through councils during 1993-2000, reaching an estimated 3 per cent of Australian households. Over 26 000 Can-O-Worms™ were sold during the first three months of its release in 1997.

Reln now sells waste minimisation products in the United States, the United Kingdom, Germany, New Zealand, Canada and Japan. Reln was recently awarded the titles of *Innovator of the Year* and *Manufacturer of the Year* in the NSW Small Business Awards.

Images courtesy of Reln Pty Ltd



Case study 3

Fuji Xerox—operational efficiency through remanufacturing

What is good for the environment is good for business.

Graham Gavanagh-Jones, Director, Manufacturing and Supply, Fuji Xerox Australia.

Fuji Xerox Australia (FXA) is Xerox's global benchmark operation in the remanufacture of office machines and parts, and development of new remanufacturing technology and programs. Remanufacturing is the process of restoring used products to an 'as new' condition through refurbishment and/or partial rebuilding. A remanufactured product will serve the same function and be of the same quality as a new product. However, it takes far fewer resources to remanufacture a product than to produce a new one.

Remanufacturing has traditionally been based on cost efficiency rather than eco-efficiency, achieving reduced costs for materials, energy and waste disposal through the prolonged life of their products. These cost benefits also directly translate into environmental benefits through reduced demand for raw materials, reduced energy consumption and less waste being sent to landfill.

Benefits to FXA include:

- increased profitability—return, to date, of \$26 million on a \$2 million investment;
- increased design expertise; and
- new markets—FXA now services the Asia Pacific requirements of a worldwide network of remanufacturing facilities including the United States, Mexico, Brazil, Holland and Japan.



Benefits to FXAs customers include:

- significant savings on the price of a new machine or part; and
- upgraded machines with the same warranty as new machines (remanufacturing operations are certified to ISO 9001 and ISO 9002, which ensure performance and quality are maintained at a world-leading standard).

Broader benefits include:

- value-added export potential and reduced imports—remanufacturing activities now supply over 60 per cent of all Australian parts requirements;
- increased local employment and labour force skills; and
- reduced pollution and volume of waste to landfill—in 1997, more than 2 600 machines and 28 000 cartridges were remanufactured, reducing waste to landfill by 600 000 kilograms; and 90 per cent of all waste generated by the remanufacturing process is recycled.



Images courtesy of Fuji Xerox Australia

Case study 4

Wharington International—developing export opportunities

The 'Re-Define' furniture project involved developing a high-quality, low environmental impact three-seater sofa and a lounge chair for the commercial market. The furniture was designed and prototyped by a team comprising Wharington International, the National Centre for Design at RMIT University and MID Commercial Furniture, following a grant from EcoRecycle Victoria. The project aimed to reduce environmental impacts across the furniture life cycle, from materials selection and production through to distribution, use, reuse, recycling and ultimate disposal.

The National Centre for Design wrote the design brief for the project, specifying criteria for materials, manufacture, use, waste avoidance and resource recovery.

MID Commercial Furniture designed the sofa and lounge chair in accordance with the brief for use in foyers and lobbies.



Wharington International have developed the moulding technology to produce Tecopol™ recycled resin mouldings from engineering-grade resins, often used for casings of appliances such as vacuum cleaners, phones, computers, televisions, videos, washing machines and refrigerators. Most of these products currently end up in landfill, however, reusing the ABS resin converts this 'waste' into a quality product, and provides a viable, cleaner replacement for forest plywoods, hardwoods, plantation timbers and virgin plastic for internal framing in upholstered furniture.



Each 'Re-Define' sofa and lounge chair has the following environmental credentials:

- each shell contains the equivalent of approximately 45 post-consumer printer cases (approximately 39kg of waste material) that would otherwise be in landfill;
- the recycled resin shell results in 50 per cent less greenhouse gas emissions and 80 per cent less energy than a shell made with virgin ABS resin;
- no toxic or hazardous materials are used to manufacture the furniture or its individual components;
- the sofa has been designed to allow straightforward minor repairs with a durable fabric;
- the shell is fully recyclable;
- all stainless steel, steel and fabric used is 100 per cent recyclable; and
- Wharington International will take back used resin shells for remanufacture.



Producing the furniture to meet the design brief specifications has not been any more expensive than other products of a similar quality produced by Wharington and MID Commercial Furniture. The only additional expenses have been incurred in the design stage, which was financed by the EcoRecycle Victoria grant. The furniture's environmental standard allows its export to European and American markets, which increasingly demand green products and are legislating accordingly.



Images courtesy of MID Commercial Furniture, Wharington International and the Centre for Design at RMIT.

Case study 5

SC Johnston—Embracing Design for Environment

We believe in contributing to the wellbeing of the countries and communities where we conduct business. We commit ourselves to advancing the economic and social development of every country and community where we do business, and to actively promoting a sustainable natural environment.

SC Johnson Corporate Plan 1999.

SC Johnson operates in 60 countries manufacturing domestic products such as furniture polishes, air fresheners, glass and surface cleaners, insecticides, insect repellents and shaving gels. The company has an Australian manufacturing site making products such as Windex, Toilet Duck and Glade Air Fresheners.

The concept of DfE is actively pursued and rewarded within all aspects of SC Johnson operation.

Design for resource conservation and low impact materials

Where possible, SC Johnson uses recycled materials for packaging. Over five years the company reduced the use of virgin packaging components by 26.8 per cent from 1990 levels. Aerosol packages contain at least 25 per cent recycled steel and are themselves recyclable; shipping containers have a 95 per cent recycled content. The company also researches environmental data on raw materials, to select ingredients with lower environmental impacts.

Design for cleaner production, recycling and safe waste disposal

SC Johnson now makes only two types of bottles and spray triggers. This simplified production line reduces energy consumption, a significant cost benefit. Manufacturing processes are regularly assessed to reduce air emissions, waste emissions, waste water, energy and fuel usage; the company's goal is to reduce waste output by 50 per cent each year. Air, water and solid waste disposals in operations have been roughly halved over five years, and before conventional waste management practices are employed all recycling opportunities are explored.

Design for low impact packaging and efficient distribution

Packaging design focuses on maximum use of container capacity, recyclable and reusable packaging, reduced weight packaging and elimination of intermediate packaging through bulk shipment. Globally, the company is committed to efficient us^e

of road transport when shipping and distributing its products by reducing the size and weight of products, maximising the use of transportation volume, sharing transport with other businesses and using third party haulers.

Design for low impact use

SC Johnson evaluates product ingredients against current scientific research, identifying any ingredients for removal from products.

All company products and processes exceed legislative requirements for environmental performance. For example, the company will not use numerous chemicals permitted by Australian legislation.

SC Johnson uses independent audits, ongoing internal evaluations and management and employee training programs to achieve continuous environmental improvement. Employees attend regular environmental training sessions, and an induction program trains new staff on SC Johnson's environmental programs.

The company's global environmental management program and high level of environmental performance are improved by regular reviews of related scientific information and existing and nascent environmental legislation. Global environmental performance is tracked annually according to internal environmental targets.



Images courtesy of SC Johnson

Moving Forward

In the next century, as human population doubles and the resources available per person drop by one-half to three-fourths, a remarkable transformation of industry and commerce can occur. Through this transformation, society will be able to create a vital economy that uses radically less material and energy. This economy can free up resources, reduce taxes on personal income, increase per-capita spending on social ills (while simultaneously reducing those ills), and begin to restore the damaged environment of the earth. These necessary changes done properly can promote economic efficiency, ecological conservation and social equity.¹¹

Many companies, both international and Australian, recognise that industry has a critical role to play if society is to achieve sustainability. Incorporating DfE into the product development process plays a vital role in minimising the environmental impacts of a product over its entire life cycle. This process provides an organisation with the means to differentiate itself from its competitors, to meet the growing environmental demands from consumers, to increase its overall profitability and competitiveness, and to play its role in achieving a sustainable society.

By introducing the concepts behind DfE, outlining some of the economic, operational and marketing benefits, and covering the essential elements required to implement DfE, this booklet provides the basic information necessary to incorporate DfE into an organisation's operations.

The five case studies in the proceeding section demonstrate that implementing a DfE program can be straightforward, and that a wide variety of Australian organisations have positioned themselves to play an active role in achieving sustainability.

The Resources, Tools and Contacts section at the end of the booklet have been included to assist you to implement a DfE program by helping you to find more detailed information on all aspects of DfE, including useful tools, additional case studies, and organisations that can provide assistance.

¹¹ Hawking, P., Lovins, A. and Lovins L.H. 1999, *Natural Capitalism: Creating the Next Industrial Revolution*, Boston, USA

Resources, Tools and Contacts

The resources listed in this section will help you find more detailed information on all aspects of DfE, including technical tools, successful case studies and organisations that can help you.

Australian Organisations and Resources

Environment Australia (Commonwealth Department of the Environment and Heritage)

Environment Australia's Eco-efficiency and Cleaner Production homepage has information and case studies on the tools of eco-efficiency, including DfE, public environmental reporting, environmental management systems and life cycle assessment. It also has case studies of businesses and products.

Relevant publications

A Framework for Public Environmental Reporting—An Australian Approach, Environment Australia, 2000.

Profiting from Environmental Improvement in Business—an Eco-Efficiency Information Kit for Australian Industry, Environment Australia, 1999.

Shop Smart Buy Green—A Consumer's Guide to Saving Money and Reducing Environmental Impacts, Environment Australia, 2001.

Towards Sustainability—Achieving Cleaner Production in Australia, ANZECC, 1999.

Contact details

Community Information Unit
GPO Box 787, Canberra ACT 2601
Phone: **1800 803 772**
Eco-Efficiency and Cleaner Production home page: <http://www.environment.gov.au/eecp.html>
Environment Australia's home page: <http://www.environment.gov.au>

The National Centre for Design at RMIT University

A national research centre actively working on DfE, Life Cycle Assessment and Product Stewardship. Resources include case studies, handbooks, manuals, videos, websites, LCA software and short courses.

Relevant publications

Appliance Reuse and Recycling: A Product Stewardship Guide, 1999.

EcoSpecifier—A Guide to Sourcing Environmentally Preferable Materials, 1999.
(Also at <http://ecospecifier.rmit.edu.au/>)

Good Design, Better Business, Cleaner World. A Guide to EcoReDesign™—Improving the Environmental Performance of Manufactured Products, 1997.

Introduction to EcoReDesign™—Improving the Environmental Performance of Manufactured Products, 1997. Includes product-based supplements.

Return to Sender: An Introduction to Extended Producer Responsibility, 1998.

Short Circuiting Waste from Electrical and Electronic Products, 1996.

Contact details

National Centre for Design at RMIT University
GPO Box 2476V, Melbourne 3001 Vic
Phone: **03 9925 3485** Fax: **03 9639 3412**
Email: cfid@rmit.edu.au Web: <http://www.cfd.rmit.edu.au>

The EcoDesign Foundation

An independent incorporated non-profit educational organisation teaching and researching sustainability by design.

Relevant publications

Sustainments Information Ecology Service newsletter, available by email or hard copy.

Green Desire—Ecology, Design and Products, 1992.

Timber in Context, 1998.

Contact details

EcoDesign Foundation
PO Box 369, Rozelle NSW 2039
Phone: **02 9555 9412** Fax: **02 9555 9564**
Email: edf@edf.edu.au Web: <http://www.edf.edu.au>

Society for Responsible Design

A non-profit organisation working towards a sustainable future through environmentally and socially responsible design practices. Provides a newsletter, talks, a register of designers and a product database. Membership is available.

Relevant publications

Information pack available. Loose Leaves bi-monthly newsletter.

Contact details

Society for Responsible Design
PO Box 288, Leichhardt NSW 2040
Phone: **0500 589 500**
Email: srd@green.net.au Web: <http://www.green.net.au/srd/>

Environment Protection Authorities

The environmental agencies in all States and Territories (such as the NSW Environment Protection Authority) have information and publications on many aspects of Eco-efficiency and Cleaner Production.

Contact details

Select your State or Territory on the government directory website at <http://www.directory.gov.au/> and search for 'environment'.

EcoRecycle Victoria

Information on sustainability, recycling and waste management.

Contact details

Phone: **03 9639 3322** Fax: **03 9639 3077**
Email: mailbox@ecorecycle.vic.gov.au Web: <http://www.ecorecycle.vic.gov.au>

International Organisations and Resources

Centre for Sustainable Design, Surrey

The Centre for Sustainable Design facilitates education and research about eco-design and environmental, economic, ethical and social considerations in product and service development and design.

Relevant publications

Clark, T. and Charter, M. 1999, *Eco-Design Checklists—for Electronics Manufacturers, 'Systems Integrators' and Suppliers of Components and Sub Assemblies.*

Contact details

The Centre for Sustainable Design, Faculty of Design
The Surrey Institute of Art and Design, Falkner Road, Farnham, Surrey GU9 7DS, UK
Phone: **+44 1252 892772** Fax: **+44 1252 892747**
Email: cfsd@surrart.ac.uk Web: <http://www.cfsd.org.uk>

Massachusetts Institute of Technology

MIT's Technology, Business and Environment program was set up to help business achieve environmental excellence. Its website includes an excellent primer on implementing Design for Environment.

Contact details

Email: jnash@mit.edu Web: <http://tbe.mit.edu/>

United Nations Environment Programme

UNEP Cleaner Production Network includes information on worldwide moves towards cleaner production. Includes publications, case studies, Cleaner Production newsletter, databases.

Contact details

Email: unep.tie@unep.fr Web: <http://www.unepie.org/Cp2/home.html>

UNEP Working Group on Sustainable Product Development

Includes information on sustainable products and services. Includes a database of examples, contacts and *Way Beyond*, a downloadable magazine.

Contact details

Email: unep@unep.frw.uva.nl Web: <http://unep.frw.uva.nl>

US Environmental Protection Agency

The US EPA's DfE website has a wide variety of relevant information, including DfE assessment tools and industrial projects.

Contact details

Web: <http://www.epa.gov/opptintr/dfel/>

World Business Council for Sustainable Development

The WBCSD is a coalition of some 130 international companies committed to sustainable development. Members are drawn from 30 countries and more than 20 major industrial sectors. The WBCSD website includes Eco-Efficiency case studies, reports, definitions and speeches.

Relevant publications

Cleaner Production and Eco-efficiency, 1993.

Contact details

World Business Council for Sustainable Development
160, route de Florissant, CH-1231, Conches-Geneva, Switzerland
Phone: **41 22 839 3100** Fax: **41 22 839 3131**
Email: info@wbcسد.ch Web: <http://www.wbcسد.ch/>

Books and Publications

Burall, P. 1991, *Green Design*, The Design Council, London.

DeSimone, L.D. and Popoff F. 1998, *Eco-efficiency—the Business Link to Sustainable Development*, MIT Press, London.

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Hawking, P., Lovins A. and Lovins L.H. 1999, *Natural Capitalism: Creating the Next Industrial Revolution*, Boston, USA. (Available online from <http://www.naturalcapitalism.org/>)

Klostermann, J.E.M. and Tukker, A. (eds) 1998, *Product Innovation and Eco-Efficiency—Twenty Three Industry Efforts to Reach the Factor 4, Eco-Efficiency and Industry*, vol. 1, Kluwer Academic Publishers, Dordrecht.

Mackenzie, D. 1991, *Green Design—Design for the Environment*, Laurence King Publishing, London.

Martin, P. and Verbeck, M. 1998, *National Materials Accounting Strategy: A Path to Competitive Advantage for Australian Industry*, Profit Foundation Pty Ltd, Sutherland. (Available online from <http://www.profitfoundation.com.au/>)

National Centre for Design 1997, *A Guide to EcoReDesign—Improving the Environmental Performance of Manufactured Products*, RMIT Melbourne, Australia.

Shelton, R.D., Shopley, J. 1996, *Improved Products Through Design-for-Environment Tools*, Prism, First Quarter, Arthur D. Little, Cambridge MA.

Wenzel, H., Hauschild, M. and Alting, L. 1997, *Methodology, Tools and Case Studies in Product Development*, Chapman & Hall, London.

Yarwood J.M. and Eagan P.D. 1998, *Design for the Environment Toolkit: A Competitive Edge for the Future*, Minnesota, USA. (Available online from <http://www.moea.state.mn.us/berc/dfetoolkit.cfm>)

