Design for Sustainability Guide

by Abby Mellick

Introduction

The DfS Guide is a 10 stage introduction to Sustainment Design for all design disciplines. This guide will help you gain insights into the cultural agency of design: the ability of design to help shape the values, expectations, desires, habits and behaviours of people. Its main purpose is to develop your intuitive sense for sustainability and to encourage you to discover the potential of your design projects to contribute to more sustainable ways of living and working. The idea is to get you to think comprehensively about the entire life cycle of designed things—production and user side—as well as about your own design process.

While this guide will provide you with practical information, it is not a 'cookbook' for sustainable design. There is no ulitmate guide for sustainable design, nor are any true 'experts' in it. Sustainable design involves issues of material impacts, but it also involves value judgements, observation, self-reflection and collaboration. More than anything, design for sustainability requires a 'learning' disposition. We all have to learn to conduct design activity differently to how we have in the past. This means identifying problems that we have sometimes not even thought about before, creating new concepts in light of what we have learnt through research, re-negotiating design briefs with clients to introduce them to these concepts and finally, applying these concepts in the design delivery process.

Most of what needs to change about how we do design happens in what is usually called the 'pre-design' or research phase. This guide is therefore focussed on what you need to think about, do, ask and research before designing anything. It is a design planning tool that will help you to lay out the key issues and impacts associated with the life cycle of your product—whether it be a graphic icon, item of clothing, appliance or a building—in this first phase of designing. This will enable you to see problems and find opportunities to create sustainment through what you design at the 'front-end', where it counts.

Over the next year, you will be able to source examples of products developed using this guide at the Product Portfolio page on this website.

As this is the first version of the DfS Guide, we would welcome and value your questions, comments and feedback on this guide.

Use this guide to:
• *work out and source* design problems and opportunities
• *explore* ideas for new products
• *design* a 'return brief' to introduce sustainable options to your client.

Go straight to the Guide.

Find out How to Use the Guide.

Or, find out more about the theory behind the guide by choosing from the menu on the left.

Further Introduction

Making products that demand different kinds of industrial, social and cultural relations can be as powerful an instigator of change as lobbying industries and governments to adopt more stringent environmental policies. There is, however, a strong resistance to thinking about product design in this way, in particular the idea that products themselves have design agency—not as projections of the designer's intent (though this is part of the process), but *in themselves*, in direct response to the environments they are taken up in. Products are generally understood as the end point of the design process rather than its beginning. But products change culture (just think of the mobile phone) and we think this cultural aspect of design is the most creative and important part of the design process.

This guide seeks to elaborate on this aspect of designing by extending your sense of what design is both responsible for and what it can make possible. It goes further 'upstream' than most 'how-to's'—in fact right back before the 'drawing board', so to speak, to consider the pre-design stage of the design process. This stage focuses on cultural knowledge, habits and senses—those aspects of design we don't generally notice or that at best play a performative role in the 'game' of consumerism.

This guide also goes further 'downstream', which might at first seem unpragmatic. Instead of the design process ending when you deliver your design to the client, this guide assumes that your responsibility for your product will extend right through the product's life cycle. In line with this, you will notice that this guide asks you to assume you won't encounter obstructions such as stubborn clients or resistant manufacturers. You will be making 'as if' decisions that are usually 'outsourced' regarding materials, manufacture, marketing and end-of-life. You might be thinking that 'in the real world' this doesn't happen. But this too is strategically important.

Unless you give yourself the possibility of exploring the best-case scenario, make leaps of faith and imagine different, more environmentally responsible industrial worlds, you will be less likely to come up with ideas innovative, viable and exciting enough to sell to those stubborn, resistant clients. The point is that it is extremely important for you, as a designer, to map the territory of your design before the details get filled in by others, to understand the problems and claim your responsibility in line with your recognition of the generative agency of design.

Extended Designer Responsibility?
This idea of *extended responsibility* is drawn from an industrial environmental management strategy called Extended Producer Responsibility (EPR). EPR attributes the burden of responsibility for the environmental consequences of products to their producers. Rather than just managing the 'downstream' effects of products when they become 'waste', the idea is to encourage more sustainable 'upstream' design decisions in relation to appropriate design, material choices, product life-span, energy efficiency, improved reuse potential, labelling of components to aid reclaiming materials for remanufacture or reuse, and establishing appropriate infrastructure to support both distribution and take-back programs.

In most high polluting countries such as the US and Australia, EPR is a voluntary arrangement because mandated EPR schemes have been deemed 'too costly'. But in northern Europe and some parts of Asia, EPR and product 'take back' are becoming common, particularly in the packaging and electrical and electronic sectors. There is, however, an increasing urgency to the issue of compulsory producer responsibility. This is in part due to the relation between the increasing cost and frustrating ineffectuality of 'end of pipe' municipal strategies such as curbside recycling and drop-off programs, and the accelerating flood of materially complex but

short-life products (particularly packaging and electronic gadgets).

For further reading on EPR see:
The EPR section of UNEP's site.
Centre for Design at RMIT's Return to Sender Program (Go to Sustainable Products, then to Product Stewardship).
Environment Science and Technology Feature article.
SEEBA's EPR resource - this is particularly good on the electronics sector.

UNEP's *Ecodesign: A Promising Approach* elaborates eight ecodesign strategies that have been very significant in our thinking through the cultural context of how to design for sustainability. These strategies extend from the 'pre-design' phase right through the life-cycle of the product. We recommend that you read this publication. In terms of this particular guide, it is worth detailing their pre-design phase called *New Concept Development*. These strategies provide food for thought in exploring design ideas, but should not be blindly adhered to—such ideas depend for their success on appropriate application and how users will respond to them. UNEP's New concept strategies are:

a) *Dematerialisation*. This is the replacement of a material product with an 'immaterial' substitute which fulfils the same need (email replaces paper-based communications). The EcoDesign Foundation has been doing some research into Dematerialisation strategies;

b)*Shared use of the product*. Such as when several people make joint use of a product without actually owning it (such as with car pooling);

c) *Integration of functions*. The idea here is that materials and space are saved if several functions or products can be integrated into a single product;

d) *Functional optimization of product (components)*. 'Auxiliary' functions, such as the quality or status that the product expresses, may be realisable in an improved and less polluting way. For example the over-elaborate packaging of luxury goods.

We would add here the need to make products *appropriately adaptable* to changing circumstances in terms of their purpose, meanings, material composition, functionality and structure. Clues as to how to do this are provided throughout the design stages of the Guide.

Focus on Relational Design

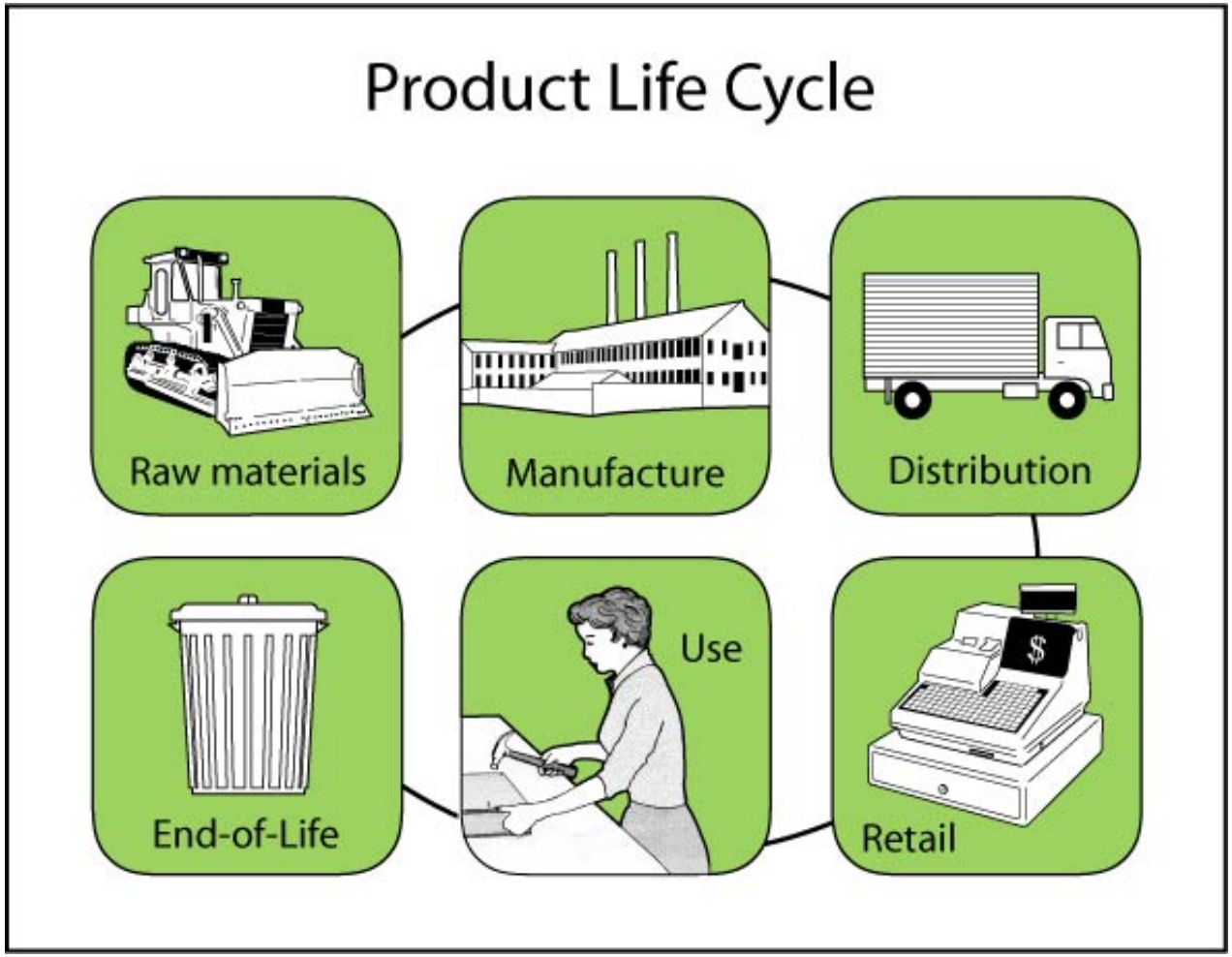
Sustainment design is about integrating the projection of what you are designing with *how* and *why* you are designing it. The assumption is that every product of design exists in a system of relations that exist 'before' and 'after' any specific product. This system includes the product, its users, the environments it depends upon and of course you, the designer. It is the interrelations of these aspects that are modified by design and cause far reaching cultural and environmental effects. The focus of this guide is therefore on working out and designing these relationships as much as it is on the product *per se*—in fact they are considered 'part' of the product. Considering a product as a system of relations is very useful in drawing attention to the cultural context as well as the material consequences of your designs.

The word design is translated in Latin-based languages with a word that is very similar to project, (for instance *progetto* in Italian). This word comes from the Latin *pro-jectum*, that means 'thrown towards'*. Think of your product-to-be as a pebble being thrown in a pond. As it hits the water, it creates a ‘ripple effect’ that moves outwards in all directions. Now run this image backwards. The ripples move inwards, toward the pebble. Sustainment design requires you to jump back and forth between these two dynamics: what your ‘pebble’ will generate and what generated your ‘pebble'. Designing in this relational way is not easy, as there are many variables that will have to be taken into account along the way; the ripple effect always depends for example on a range of other things, like the condition of the water. You are not however striving to make your product 'perfect'. This is impossible, as the stupidity of even the highest-end 'smart' machines when faced with the normal unpredictability of life, show. What you *are* trying to do is to understand what you are sending out into the world, and using this understanding to design more sustainably.

The additional knowledge you secure in the process of relational design can open up choices and opportunities that weren't previously available to you. You can, for example expend your effort in designing more short-life products, giving new ephemeral form to the old, unsustainable habits of our 'throw-away' culture, or you can explore the creation of new forms that embody and communicate sustainment like adaptable, modifiable and modular designs. The process can also sometimes have unexpected results. It is not assumed, for example, that some thing must be designed (though this goes against the grain of *product*ivist logic). It may be more appropriate in a given situation to design a different way of doing things that doesn’t actually require new material forms, such as designing a strategy for the co-operative use and maintenance of products. Arriving at such a design decision would only be possible as a result of understanding the designing relations a product exists within. More radically, this could lead to the 'un-designing' or elimination of a product. (On elimination design see Sustainments newsletter for April 2002).

Go to Examples for 'snapshots' of relational design scenarios.

* From editorial note in Ezio Manzini 'Prometheus of the Everyday' *Discovering Design: Explorations in Design Studies* Richard Buchanan and Victor Margolin eds. (Chicago and London: University of Chicago Press, 1997) 221.


Product Life Cycle
Raw materials
Manufacture
Distribution
End-of-Life
Use
Retail

The **Product Life-Cycle** maps the basic stages of a designed product's life from raw materials (recovery or extraction), through manufacturing, distribution, retail and promotion, use and end of life. This mapping is useful in learning that each designed thing has a past and a future as well as being inseparable from numerous processes. It also lays the groundwork for understanding how all of the material 'inputs' and 'outputs' associated with a product are part of the design of that product, and how understanding those inputs and outputs can contribute to more sustainable designing. The Product Life Cycle forms the basis of Life Cycle Assessment (LCA), a methodology that seeks to understand the main impacts associated with each stage of a product's life. LCA is generally used as a tool to compare the relative environmental merits of similar products or services. Some of the key benefits of LCA however, are in the learning potential of the process rather than the outcome, which invariably and necessarily provides a selective picture. For example, LCA entails communication and collaboration between stakeholders and informs the development of an intuitive sense for the dynamics of the product system ('life cycle thinking'). LCA is part of the International Standard Organisations suite of voluntary Environmental Management Systems called the 14000 standards. For further information on this system of environmental management, visit the International Standards Organisation.

Impact Assessment (IA), which makes up a stage of the LCA process (LCIA), is about evaluating life-cycle inputs and outputs in terms of the significance of their environmental impacts (measured in terms of 'impact categories' such as 'global warming potential' or 'human toxicity'). Like all standardised tools that have grown out of the Ecologically Sustainable Development (ESD) charter, there are many problems associated with accounting for situational differences. The attempt to standardise impact measurements along scientific criteria is also thwarted by the inevitable value-choices involved in the selection of impact categories as they apply to any one product system. Furthermore, the impacts associated with one output, say a particular chemical, will likely impact on air, water, land and animals differently and at different rates.

IA is perhaps more effective as a planning tool used to predict the impacts associated with an activity, say a major building development or even the planning of a city. Again, however, while impact assessment looks and sounds scientific, it is always to some degree a work of interpretation, and can (and has) been used to justify projects that are fundamentally unsustainable. Despite these problems, Impact Assessment is one of the most useful concepts we have encountered because it shows that each designed thing always has effects beyond itself and can be used to promote relational thinking. This guide draws on both the practices of LCA and IA.

For further reading on LCA and IA:
The Centre for Design at RMIT is the key locus for LCA activity in Australia.
The UNEP Production and Consumption Unit provides a comprehensive and useful set of resources on the history, processes and application of Environmental Impact Assessment.
For a look at ways the concept of 'impacts' has been employed as a planning tool to promote design for sustainability, visit the publications archive on the Team DES website.

The Relational Product System

The Product Life Cycle offers a very good way of reading products and mapping their impacts, but it does not

situate products within their functioning environments, which is where most of their impacts occur and where the greatest opportunities can be created for designing sustainments. By focussing too hard on the product and not enough on the product's environments of use or even cultural meanings, overarching problems, like the far too short lifetimes of products, are not addressed.

Industrial Ecology

Industrial ecology is a relatively new field of study and practice that focuses on the relations between industry and the environment and redressing the failures of industry to relate production processes to environmental consequences. It is therefore an important contributor to working toward more sustainable economies and cultures. Growing out of the sciences, industrial practice and policy design, Industrial Ecology focuses on DfE, materials selection, LCA, materials and energy flow analysis, industrial park and organisational design.

For general information on Industrial Ecology, visit International Society for Industrial Ecology at Yale University. It has an international quarterly journal published by MIT Press with IE news and information, a forum and peer reviewed papers.

IE Resources

international society for industrial ecology

governance | publications | membership | ISIE events | home

Welcome to the home page for the International Society of Industrial Ecology (ISIE). ISIE is a new society that promotes industrial ecology as a way of finding innovative solutions to complicated environmental problems and facilitates communication among scientists, engineers, policymakers, managers and advocates who are interested in how environmental concerns and economic activities can be better integrated.

>> ISIE INTERNATIONAL CONFERENCE EXPANDED

>> ISIE STUDENT CHAPTER

>> INDUSTRIAL ECOLOGY IN HIGHER EDUCATION

>> NEW JOBS POSTED

>> ISIE WEBSITE IN JAPANESE

>> MEMBERS-ONLY SECTION -- ISIE MEMBERS LOG IN HERE

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Publications

Each member of ISIE receives the society's newsletter as well as a subscription to the *Journal of Industrial Ecology*, an international, peer-reviewed, multi-disciplinary quarterly published by MIT Press for Yale University and headquartered at the Yale University School of Forestry & Environmental Studies.

- The *Journal of Industrial Ecology* is designed to foster both understanding and practice in the emerging field of industrial ecology. Since its premiere in spring 1997, the *Journal* has provided a forum for continuing exchange of information and opinions through contributions from scholars, environmental managers and policymakers, and advocates involved in environmental science, management, and policy.

- The *ISIE newsletter* is a members-only publication dedicated to providing insider news and information about the ISIE and the field of industrial ecology. If you are a member and would like to contribute news or a letter to the editor please send email to isienews@rci.rutgers.edu.

ISIE Newsletter, Volume 2

Issue 1 (February 2002)

Issue 2 (June 2002)

Issue 3 (October 2002)

Issue 4 (December 2002)

Volume 2, Issue 4

December 2002

ISIE News

Attention Industrial Ecologists

- Catch up on activities in Brazil and Russia
- Read conference reviews and new conference listings
- Attend ISIE II: ***Industrial Ecology for a Sustainable Future*** 29 June – 2 July 2003

Inside this issue:

ISIE II Planners Face an Embarrassment of Riches

Hundreds of Abstracts Have Been Submitted

More than 350 abstracts have been submitted to date for the Society's 2nd major conference. Planners had anticipated space for less than half that number of presentations during concurrent conference sessions. They are now organizing additional paper and poster session opportunities, given the large number of excellent submissions.

Organized by The International Society for Industrial Ecology and The Center for Sustainable Systems (CSS) at the University of Michigan's School of Natural Resources & Environment, the second International ISIE Conference will be held in Ann Arbor, Michigan from 29 June–2 July 2003.

Titled ***Industrial Ecology for a Sustainable Future***, the conference will highlight the contributions that industrial ecology can make towards attaining a sustainable future for the planet and its population. Short courses will provide an opportunity to learn about different IE techniques. Poster and platform presentations will introduce research. Exhibitors will showcase products and services. Ample opportunity will be provided to network and exchange ideas.

Conference co-chairs are Gregory Keoleian of the University of Michigan and Edgar Hertwich, of the Norwegian University of Science and Technology.

Register Early
for the 2nd ISIE Conference in
Ann Arbor, Michigan, USA
(29 June-2 July, 2003).
www.yale.edu/is4ie

Director's Message: Moving Forward

John Ehrenfeld, executive director

As I write this column, 2002 is rapidly drawing to a close. 2002 has been a very good and important year for the ISIE. A few words on what has happened seem appropriate for this issue. The major event for the Society this year was the appointment and election of the individuals and committees that will form the leadership of the ISIE as it continues its move from a fledgling, somewhat informal organization to a more established institution. And not a moment to soon. As Executive Director, I have watched the demands grow well beyond what Beverly Chevalier, the ISIE Program Coordinator, and I can handle.

The ISIE office at Yale can manage the everyday activities pretty well, but the development of policies and a long-range strategy to put the Society on an even keel for the long term needs strong governance. We now have a Council in place to act as the policy-setting leadership together with the President. They face a number of important issues including our relationships with other societies, and developing a strategy for fostering industrial ecology in academia and in its practical counterparts in industry and government. Sorting out the place of industrial ecology in an intellectual world with many overlapping ideas and practices is a daunting, but important task, and one that needs the best thinking our

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Editor's Corner

Closing the Loop **Clint Andrews, editor**

During the past few months I've had an opportunity to visit several universities whose faculty and students participate in the industrial ecology community. I've been particularly impressed with the Ph.D. students I've met.

Some, such as the Clarkson University program in upstate New York, USA, work within a discipline-plus tradition, where they are, say, chemical engineers first, and industrial ecologists second. Others, such as those at Yale University and the Norwegian University of Science and Technology, work in a more purely multidisciplinary environment centered on industrial ecology. Still others, such as those at the Helsinki University of Technology in Finland, study in related fields like environmental management and environmental sociology, but are fascinated by industrial ecological ideas.

These students share a common concern for their professional futures. Discipline-plus students will clearly be the best situated for traditional academic jobs. Multidisciplinary students can do well in industry, government, or the non-profit sectors. But I have a sense that our community is attracting more good students than good jobs. We need to redress this imbalance, preferably by identifying opportunities for bright new Ph.D.s to continue working in this field.

I will continue to visit European colleagues this Spring as my sabbatical continues, so let me know what's up. Email me, or find me in person at the Science Policy Research Unit, University of Sussex, England.

Send your letters to the editor and news about ISIE members to:

Clint Andrews at <isienews@rci.rutgers.edu>

ISIE Leadership Elected

The polls closed on 16 December 2002 for the election of the International Society for Industrial Ecology's first elected President and Councilors. The roster of candidates read like a Who's Who of industrial ecology.

Thomas Graedel will serve as the Society's first President for a two-year term. Braden Allenby will serve as President-elect and will assume the presidency when Graedel's term expires.

Elected Council members are:
3-years René Kleijn and Clinton Andrews
2-years David Allen and Helge Brattebø
1-year Stefan Bringezu and Barbara Karn

In addition to the officers elected, the governing body of the Society includes Kristan Cockerill, Secretary; Mak Dehejia, Treasurer; and a six-person nominating committee (Valerie Thomas, John Holmberg, Claudia Binder, Yuichi Moriguti, Ray Cote, and Anthony Chiu). The editor of the Journal of Industrial Ecology also serves as a Councilor, ex officio.

John Ehrenfeld will continue to serve as ISIE's Executive Director.

ISIE II

The International Society for Industrial Ecology invites you to join us at the 2nd International ISIE Conference:

Industrial Ecology for a Sustainable Future

29 June - 2 July, 2003

The University of Michigan

Ann Arbor, Michigan USA

Special issues to be highlighted are sustainable transportation and sustainable consumption. These will be addressed in special discussions and dedicated discussions.

Find more conference details at the ISIE website **www.yale.edu/isie.**

Click the link for 2nd ISIE INTERNATIONAL CONFERENCE .

New Members of ISIE

Julian Allwood, United Kingdom
Tony Baptista, USA
Sarah Boyd, USA
Tapas Das, USA
Angeline de Beaufort-Langeveld, Netherlands
Panagiotis Deriziotis, USA
Ann Dougherty, USA
Deborah Gallagher, USA
Charles Griffith, USA
Ling Han, China
Ermelinda Harper, USA
Paul Holle, Netherlands
Jennifer Howard-Grenville, USA
Danielle Kahn, USA
Gareth Kane, United Kingdom
Sang Yong Kim, South Korea
Cheryl Laskowski, USA
Kwiho Lee, South Korea
Jens Legarth, Denmark
Michael Lemon, USA
Kim Lenti, USA
Thomas McKone, USA
Daniel Müller, USA
Uyiosa Omoregie, Nigeria
Nigel Potter, Canada
Jean-Daniel Saphores, USA
Graham Street, United Kingdom
Tomhiro Tasaki, Japan
Eino Timola, Finland
Ronald Turco, USA
Melissa Vernon, USA
Joe Wong, Canada
Chunyou Wu, China

Submit Member News notes to ISIE@yale.edu

Conference Listings

Greentech 2002 Conference & Exhibition on Environment Management
January 31-February 1, 2003, Le Meridien, New Delhi, India

Internet Conference on Ecocity Development
February - June 2003, http://seagate.sunet.se/archives/et-frej.html

Fifth International Conference of the European Society for Ecological Economics: "Frontiers 2: European Applications in Ecological Economics"
February 12-15, 2003, Tenerife, Canary Islands, Spain

Final Conference of the Eco-Effizienz Project
February 13-14, 2003, Ausburg, Germany

Take it Back! 2003: Stewardship in the New Economy
February 24-26, 2003, Alexandria, VA

Ninth International Conference on Urban Transport and The Environment in the 21st Century
March 10-12, 2003, Crete, Greece

Eighteenth International Conference on Solid Waste Technology and Management
March 23-26, 2003, Pittsburgh, PA, USA

CERES 2003 Conference: Advancing Sustainable Governance
April 1-2, 2003, New York, NY, USA

Orbit 2003
April 30 - May 2, 2003, Perth, Australia

International Conference on Sustainable Energy, Planning & Technology in Relationship to the Environment
May 14-16, 2003, Halkidiki, Greece

Green Engineering: Defining the Principles
May 18-22, 2003, Sandestin, Florida, USA

2003 IEEE International Symposium on Electronics and the Environment
May 19-22, 2003, Boston, MA, USA

Fourth International Conference on Ecosystems and Sustainable Development
June 4-6, 2003, Siena, Italy

National Association of Environmental Professionals 28th Annual Conference
June 23-26, 2003, San Antonio, Texas, USA

SSGRR 2003 Summer Conference
July 28 - August 3, 2003, L'Aquila, Italy

Second International Society for Industrial Ecology Conference
June 29-July 2, 2003, Ann Arbor, Michigan, USA

Logistics Management 2003
September 24-26, 2003, Braunschweig, Germany

Eleventh International Conference on Modelling, Monitoring and Management of Air Pollution
September 17-19, 2003, Catania, Italy

2003 IEEE International Symposium on Technology and Society
September 24-26, 2003, Amsterdam, Netherlands

International Conference on Sustainable Planning & Development
October 1-3, 2003, Skiathos, Greece

GIN2003: The 11th International Conference of the Greening of Industry Network
October 12-15, 2003, San Francisco, California, USA

2003 Open Meeting of the Human Dimensions of Global Environmental Change Research Community
October 16-18, 2003, Montreal, Canada

Visit the ISIE Web Site for Details About Listed Conferences
www.yale.edu/is4ie

Regional Reports: Tropical and Arctic Industrial Ecology

New Environmental Initiatives in Brazil

Flávio de Miranda Ribeiro

In spite of living in a developing country, Brazilians are becoming very sensitive to environmental issues. Improvements in environmental legislation, increasing numbers of firms using certified environmental management systems, growing interest in cleaner technologies and increasing educational opportunities in the area show that the Brazilian government, production sectors and people in general are aware of the importance of being earnest, in environmental terms.

Nevertheless, in Brazil industrial ecology is still just a concept, taught at universities and present as a theme in academic research. There is growing curiosity within some industries, the most *pro-active* ones, on what it means and how they can take advantage of its new ideas.

Moreover there are several initiatives to use advanced environmental management concepts that move production (and consumption) towards more sustainable patterns. One of these are the establishment of ecoparks (called *Ecopolos*) in Rio de Janeiro State. Stimulated by tax reductions 14 firms joined their strengths to reduce waste and consumption of water and energy. Two of these ecoparks already have been inaugurated, and the expectation is to involve 110 firms in 6 different districts.

> **"[We]** need to develop industrial ecology further as a management science rather than a curiosity-driven enterprise"

Another important enterprise was the creation of the São Paulo Cleaner Production Roundtable, a multisectorial forum to discuss and disseminate related concepts, including industrial ecology. Headquartered at CETESB, the São Paulo State environmental agency (the only Brazilian institution to sign the International Declaration on Cleaner Production, in 1998), this roundtable comprises five working groups that come together periodically.

Yet another important initiative is the Brazilian Life Cycle Institute, a non-government organisation that congregates firms, universities, research institutes, NGOs and government to foster LCA use in the country. Indeed, a great number of research institutes and consultant companies are appearing, suggesting that a great market for advanced environmental practices is emerging.

My colleagues and I in the pollution prevention group at the Universidade de São Paulo believe that promoting pollution prevention techniques, LCA, cleaner production processes and industrial ecological systems are highly effective means to protect our environment and save natural resources. These measures are becoming even more important in countries like Brazil, where there is so much natural richness, or in other words, so much to lose.

Flávio de Miranda Ribeiro<flavio.miranda@poli.usp.br>

Ecological Modernization in the Barents Region of Russia

Clinton Andrews

This frigid northwestern corner of the former Soviet Union is a hinterland with a difference: not only is it a mining center, where towns have utilitarian names like *Nickel* and *Apatite*, but it was a closed military region throughout the Cold War. The recent tragic sinking of the submarine *Kursk*, off Murmansk, symbolizes the origins and nature of the region's current environmental problems.

The good news is that there are serious efforts underway to improve the environmental situation in the Barents region. Indigenously, the Kola Science Center of the Russian Academy of Sciences (which has had an Industrial Ecology Institute, so-named, since 1989) has completed a remarkably thorough baseline characterization of environmental conditions in the region, responding in part to allegations by Scandinavian countries of transboundary pollution. Radiological maps clearly identify a few military hotspots such as the nuclear submarine base in Murmansk, but they also identify mining enterprises as an important source. Air pollution maps show the devastating effect of nickel smelting on downwind landscapes (also familiar to North Americans who have visited Sudbury, Ontario). Yet counts of flora and fauna—and of hunting and fishing takes—seem to suggest that the environmental damage has a relatively small geographic range.

More problematic for today's Russians is the economic status of the Barents region, which has lost military significance and remains vulnerable to the boom-bust cycles associated with the mining industry. A multi-country research consortium has been created to strengthen regional economic ties and to invent new development strategies. The Barents Euro-Arctic Council includes Russia, Finland, Sweden, Norway, Denmark, Iceland, and the European Commission. Recent efforts have documented that there are relatively weak and unidirectional links, involving primarily Russian retailers distributing foreign products to Barents markets.

A workshop organized by Janne Hukkinen at the Helsinki univer-

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Membership Renewal

If you haven't already done so, be sure to renew your ISIE membership.

Renew online at www.yale.edu/is4ie/onlinemember.html

Conference Reports

Special Report from the Joint ISIE/SETAC Symposium

Ottar Michelsen

ISIE joined with the Society for Environmental Toxicology and Chemistry (SETAC) to organize a conference in Barcelona, Spain on 3-4 December 2002. This was the second time around for the two organizations.

In November last year, SETAC held the 9th LCA case symposium in connection with the first conference for ISIE in the Netherlands. The intention was, of course, to enable people to take part in both conferences and to generate closer connections between the two organisations.

This year a majority of participants took part in both conferences and it seemed like most appreciated the joint event.

SETAC held the 10th LCA case symposium with emphasises on recycling, close-loop economy and secondary resources. Reuse of construction materials turned out to be a hot topic at the moment and several studies were presented. An ever-returning question was how to include land-use changes and impact on biodiversity. There seem to be a striking need to work further on this topic.

In the ISIE meeting the scope broadened out, and it is obvious that most people working with IE regard LCA as only a part of the field. The topic of the meeting was "Industrial Ecology: From theory to practice" and included aspects such as chain management, closing loops, use of environmental indicators, mapping of material flows and organisational dilemmas in environmental work.

More information about the joint symposium is available at the SETAC web pages: http://www.setac.org/lca10.html

Ottar Michelsen <ottar.michelsen@iot.ntnu.no>

Lifecycle Approaches to Sustainable Consumption

Edgar Hertwich

Sustainable consumption is an issue that receives increasing attention of both the scientific and the policy community. It was a confluence of research and policy interests that brought together a diverse group of researchers for a successful workshop titled "Lifecycle approaches to sustainable consumption." The workshop, held on 22 Nov. 2002 at the *International Institute for Applied Systems Analysis* (IIASA, Laxenburg, Austria), was supported by the Japanese *National Institute for Advanced Industrial Science and Technology* (AIST) and endorsed by the *United Nations Environment Programme* (UNEP). The workshop was a first of a series of workshops to be organized by the research center for life-cycle assessment of AIST as part of a 3-year research project designed to help Japan meet its CO2 targets under the Kyoto protocol in part through efficiency increases and changes in consumption and use patterns on part of consumers.

The workshop was organized as a staccato of short presentations. The presenters came from a wide range of backgrounds, including energy analysis, life cycle assessment, consumer economics, and marketing. The first session focused on methods to assess the environmental burden from household consumption. The second session focused on economic and social aspects of consumption. Communication and consumer behavior was the focus of the next session. The last session focused on the life cycle of products and services.

Here are a few highlights. Mark Goedkoop and Durk Nijham presented an analysis of the environmental load of Dutch households. The work presented is, to my knowledge, the first analysis of this type to take into account the differences between the emissions intensity of products produced domestically and those imported. Harald Thorne-Host, using Norwegian cars to illustrate, questioned whether efficiency increases were sufficient to achieve sustainable consumption, given the rebound effect and

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Conference Reports

Industrial Ecology Shows Strong Presence at NATO Workshop on Sustainability

Kristan Cockerill

In October 2002 NATO sponsored a workshop in Maribor, Slovenia on Technological Choices for Sustainability. Explicitly and implicitly, industrial ecology was a prominent feature at the meeting. Although seeing NATO and sustainability in the same title seems a bit odd at first, it reflects the growing understanding that the idea of sustainability is far reaching and has relevance for all organizations and all issues.

The meeting prompted lively discussion about what questions we need to address and generated ideas for integrating sustainability in unique ways. While the meeting was intended to focus on how scientists and engineers can contribute to sustainability efforts, many of the speakers acknowledged that technological choices cannot be segregated from social and cultural issues.

"seeing NATO and sustainability in the same title seems a bit odd at first"

The workshop emphasized sustainability metrics and presentation topics ranged from thermodynamics to pedagogy to tapping new food supplies. The diversity was reminiscent of the 2001 ISIE meeting in the Netherlands (although on a much smaller scale!). Two talks included industrial ecology explicitly as the subject matter. Scott Butner from Pacific Northwest National Laboratory presented a paper suggesting that industrial ecology has become synonymous with industrial symbiosis and that there are gains to be had by extending the metaphor to other ecologic concepts such as biomimicry and temporal progression to address sustainability concerns. I presented the results from my research documenting that industrial ecology is being introduced in higher education largely in technical disciplines and the implications that this continued focus on technical aspects may have on IE's ability to advance ideas in sustainability.

While not explicitly using the moniker industrial ecology, numerous talks were clearly IE-relevant. David Shonnard at Michigan Technical University presented the Green Engineering textbook project that he has developed with David Allen at University of Texas and with the U.S. Environmental Protection Agency. Peter Salinger, representing multi-national corporation BASF, discussed their program to include eco-efficiency analysis in making decisions about products and processes. Alexander Komarov of the Russian Academy of Science presented a model for analyzing various silvicultural regimes to develop sustainable forest management practices. Roland Clift of the University of Surrey talked about the tendency for supply chains to "export unsustainability" and metrics for ensuring that social benefits are included in sustainability assessments. Other papers covered eco-efficiency reporting, cleaner production strategies, and environmetric strategies.

Meeting organizers, Subhas Sikdar at the US Environmental Protection Agency, Peter Glavic at the University of Maribor, and Ravi Jain at the University of the Pacific, did an excellent job in ensuring that attendees represented the diversity within NATO, including nations recently invited to join the alliance. Structured much like Gordon Conferences with everyone present for all sessions, the gathering provided tremendous opportunity for attendees to interact and to learn about research being conducted and applications being developed throughout Europe –east and west.

The intersections between industrial ecology and making technological choices seem obvious to researchers and practitioners who have positioned themselves within industrial ecology. Seeing industrial ecology as an integral part of a meeting focused on sustainability reflects IE's growing presence as a tool for achieving a sustainable future. The workshop's lively discussions about what it will take to make sound technological choices reflected clear links to the ongoing discussions about what industrial ecology is and what it should and can do to promote sustainability. Workshop products will be published.

Kristan Cockeril <kmcockerill@dowbiggin.com>

NATO Workshop on Environmental Risk Comparisons Inspires Collaborations

Clint Andrews

Comparative risk analysis was the focus of another NATO workshop in Anzio, Italy on 13-16 October 2002. With 22 participants representing 19 nations, there was a broad range of opinions and experience regarding risk assessment. Where other forums have pitted advocates of risk assessment against advocates of the precautionary principle, this group reframed the problem. Their recommendations focused on balancing the demands for both substantive and procedural rationality, or put differently, for recognizing that risk assessment and communication are interdependent.

Participants from the Mediterranean and Black Sea regions saw their cultural diversity and similar environmental problems as a research opportunity: Italian, Greek, Spanish, Turkish, Bulgarian, Russian, Jordanian, Israeli, and Egyptian scientists have inaugurated efforts to compare how their populations respond to similar water supply problems.

The systemic approach and long term perspective for which industrial ecology is known were present at this workshop, accompanied by a focus on what it takes to turn environmental knowledge into sound public and private decisions. For more, contact workshop organizer Igor Linkov <igor.linkov@icf.com>.

Clint Andrews <isienews@rci.rutgers.edu>

Conference Reports

Environmental CyberInfrastructure Planning

H. Scott Matthews

This workshop took place on 30 October-1 November 2002 in Boulder, Colorado, USA, and it was sponsored by the U.S. National Science Foundation and the National Center for Atmospheric Research. For those of you unfamiliar with the terminology, CyberInfrastructure (CI) is an NSF/research community buzzword for the development of a near-term hierarchy of support for everything from operating systems, through software and instrumentation, all the way up to complex computer modeling. In effect, CI will be a significant focus of future U.S. NSF funding as they try to ensure that the necessary 'basic needs' of the research community are being met. Nearly all of these activities will be relevant to those of us doing research in industrial ecology. Our work depends on understanding the links between identified environmental or ecological stressors and their impacts.

The environmental component of 'CI' is effectively everything from sampling up to climate change models (that's obviously quite a large range). NSF has already prepared white papers on the needs and requirements of CI, and the purpose of this workshop was partially to develop a white paper specific to environment.

There's the obvious concern within the community that the 'environmental' component will not get its fair share, and that Information Technology Research-type programs will result that tend to be dominated by purely technical and generic network and computational proposals - and that those are what will be funded. Thus the goals were to identify the low-hanging fruit as well as the longer-term issues and approaches to support them.

The invited audience of roughly 100 people - mostly environmental science/ecological types, I might add - really covered the spectrum. The workshop really depended on the work of 4 working groups: Collecting and Making Data Available, Generating and Using Data, Collaboration Tools and Strategies, and Creating a New Kind of Environmental Scientist.

I chose the fourth group, which was basically an educational panel (I.e. 'How to educate the next generation?'). Our working group really tackled the educational issues. You'll all be happy to hear that interdisciplinary efforts are one of the main impetus behind the push to realizing progress in ECI. However, there will remain a large fundamental computer/technology component of all work. Another major part of our discussions was the need to link the entire "K-16" educational system, in many cases by infiltrating the existing overloaded curriculum rather than creating new courses.

Highlighted needs from the other three other groups include: global support for data archiving and interconnection; citation rules for constantly-evolving datasets; hierarchical plans of funding responsibilities from all federal agencies; the need for structure, process, and protocol in data development and access; biodiversity data and analysis; funding support for digital libraries; computer model code sharing; and access to supercomputing power and processes for data analysis.

This was a very high-level workshop, and I was pleased to participate. The initial draft of the working paper should be coming out soon, but if you are interested in seeing the complete agenda of the meeting, or the ongoing progress, you can track that at the website:http://www.ncar.ucar.edu/cyber/index.htm

H. Scott Matthews <hsm@cmu.edu>

Barents Region Industrial Ecology

(continued from page 4)

sity of Technology on 9-10 December 2002 focused explicitly on industrial ecological approaches to the problems of the Barents region. A small, high-level group investigated descriptive issues (what's known, what's not) and prescriptive issues (what should be done). Workshop participants identified several potential technical projects to develop optimal multi-mineral extraction and processing schemes, find uses for mine tailings, and manage market volatility. They also recognized that the Barents region is a perfect natural experiment on how institutional context (Soviet communism vs Russian capitalism) affects industrial ecosystem structure.

Among the important findings for the broader research community were the need to develop industrial ecology further as a management science rather than a curiosity-driven enterprise, and to recognize that the industrial ecology field contains several distinct learning communities with equally valid research agendas on environmental, technological, and socioeconomic issues. For more go to http://www.hut.fi/Units/Civil/EM/BarentsWorkshop.html.

Clint Andrews <isienews@rci.rutgers.edu>

Conference Reports

Lifecycle Approaches to Sustainable Consumption

(continued from page 5)

rising affluence. Faye Duchin extended the metaphor of product-life cycle and applied it to social life cycles, showing the environmental importance of social transitions, such as going from being a student to starting a family. Pål Strandbakken and Eivind Stø introduced an investigation of the importance of eco-labels in five European countries. While most respondents in Germany and Norway would identify their national labels, the type I eco-label (the Blue Angel and White Swan, respectively), they did not know the EU flower eco-label. They actively consider eco-labels in decision making about consumer products such as toilet paper. In Italy and Spain, the most of the respondents
did not know the eco-labels, but were interested in the environmental impacts of hotels and vacations. Andreas Biel presented evidence that negative ecolabels were universally effective, while only environmentally concerned groups responded to positive ecolabels. Kirsten Gram-Hanssen showed that the energy use of identical row houses or flats in Denmark can vary up to a factor of 3, confirming the importance of user behaviour.

For more information go to http://www.iiasa.ac.at/~hertwich/. For information on future workshops and activities, try http://www.uneptie.org/sustain and http://unit.aist.go.jp/lca-center/english/top.htm.

Edgar Hertwich <Hertwich@iiasa.ac.at>

Job Postings

Endowed Professorship Holcim (US) Inc. Professorship of Sustainable Enterprise, and Faculty Director of the Corporate Environmental Management Program. University of Michigan Business School, Ann Arbor, MI, USA.

Faculty Position in Life Cycle Assessment. Iowa State University, Ames, Iowa, USA.

Fellowships in Science, Technology and Public Policy , Kennedy School of Government, Harvard University, Cambridge, MA, USA

Professor of Environmental Policy Sciences, Institute for Environmental Studies of the Faculty of Earth and Life Sciences. Vrije Universiteit Amsterdam, Amsterdam, The Netherlands.

Research Assistant (Ph.D. student) for agent-based modeling of industrial ecosystems, E.J. Bloustein School of Planning and Public Policy. Rutgers University, New Brunswick, New Jersey, USA.

Visit the ISIE Website for Details About Listed Job Positions
www.yale.edu/is4ie

ISIE Website Features

General Features

- Conference Listings & CFP Announcements
- Dissertation Listings
- *ISIE News* Back Issues
- Job Postings

Members Only Features

- Membership Directory
- Membership Statistics
- Special offers for ISIE members
- Announcements
- Latest issue of *ISIE News*

New Tools & Websites

Linking To (and From) Industrial Ecology

Reid Lifset

Lists of links to websites are so ubiquitous as to be annoying. Yet, well focused and annotated lists can be useful and stand out from the crowded world that is the Internet. Thus, it has always been a challenge for the *Journal of Industrial Ecology* (*JIE*) to identify appropriate links to carry on its website. Exacerbating this predicament has been a steady flow of requests to carry links to other websites. Given industrial ecology's vast topical interests, deciding which links belong and which do not, could be a full time job all by itself–and one that could make as many enemies as friends.

In addition to the central website maintained for the *JIE* by MIT Press at <http://mitpress.mit.edu/JIE>, the *JIE* maintains an ancillary website at <www.yale.edu/jie>. This latter website contains information that does not fit well into main website because of the constraints of the format used by MIT Press for its journals. It is on this ancillary site, for example, that the list of IE-related dissertations (that is now on the ISIE web site) was launched. This website contains–with a little trepidation– several sets
of links thought to be of interest to the industrial ecology community:

- Bibliographies of industrial ecology publications,
- Published research agendas related to the field,
- Special issues of other journals on topics related to industrial ecology,
- Manufacturing and environmental management information by industry sector,
- On-line environmental calculators, and
- Group and member lists of environmental experts

Given the porous boundaries of the field, no effort has been made to make the set of lists all-encompassing as this would be a quixotic task. Instead, categories of links that have well defined boundaries and appear to have specific value to the industrial ecology community, or not be duplicated elsewhere, have been chosen. Some of these categories of links are experimental. The *JIE* and the ISIE are looking at how to better coordinate their respective web resources as part of the overall evolution and integration of the two. Please contact the *JIE* if you have suggestions of links to add to the list.

Reid Lifset, Journal of Industrial Ecology
<indecol@yale.edu>

ISIE Student Chapter: Get to Know Us

Anahita Ahmadi

Industrial Ecology graduate students are enrolled in a real diversity of doctoral programs. Get to know a few of them by reading below. We will update the ISIE student chapter website soon after the holidays with all of our members' information, including their research interests. The Student Chapter wishes you all the best during the Holiday Season!

Amit Kapur is an advanced doctoral student at Center for Industrial Ecology, Yale University. His research focuses on building scenarios for copper use to estimate future developments on regional and global levels with respect to resource use, environmental burdens, and technical advances. The scenarios would serve as a benchmark tool to define indicators and formulate possible policy and technological interventions to address sustainable management of copper. Amit's dissertation builds on the extensive work done on the contemporary global copper cycle as part of the Stocks and Flows project at Yale.

Anup Bandivadekar is pursuing the Technology and Policy Program (TPP) at Massachusetts Institute of Technology (MIT). The mission of TPP is to provide an integrative education to scientists and engineers who wish to lead in the development and implementation of responsible strategies & policies for exploitation of technology for the benefit of their communities. Anup is working with Professor John Heywood in the Sloan Automotive Laboratory on assessment of technology alternatives and policy options, on both the demand and supply side of the automobile market, in order to reduce the fuel consumption of the U.S. light-duty vehicle fleet. He believes that the IE framework provides a great deal of insight in studying complex policy problems such as this.

Brendan Williamson is a Chemical Engineering Ph.D. candidate in the Environmental Manufacturing Management (EvMM) program at Clarkson University. EvMM promotes the development of a research topic by the student in conjunction with an industrial internship. Brendan's cohorts (including myself) went to Xerox in the summer of 2000. From this came a co-authored publication presenting a life-cycle inventory of black toner, which showed significant gains in the recycling of toner both within the manufacturing process and from consumer waste returns. Future research will focus on toner particle separation by density. Particle separation is a key to recycling toner from increasingly ubiquitous color copiers and printers.

Next time we will profile students in programs outside the USA.

Anahita Ahmadi <ahmadia@clarkson.edu>

ISIE

International Society for Industrial Ecology

Industrial ecology has been defined as "the study of the flows of materials and energy in industrial and consumer activities, of the effects of these flows on the environment, and of the influences of economic, political, regulatory, and social factors on the flow, use, and transformation of resources" (White 1994).

The International Society of Industrial Ecology (ISIE) promotes industrial ecology as a way of finding innovative solutions to complicated environmental problems and facilitates communication among scientists, engineers, policymakers, managers and others who are interested in how environmental concerns and economic activities can be better integrated.

International Society for Industrial Ecology
c/o Yale School of Forestry
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Director's Message: Moving Forward *(continued from page 1)*

community can provide.

We continue to grow by about 10 new members a month. Slow but steady. As we grow in numbers, we also grow in interests. There are now several smaller informal 'work groups' formed or forming around sub-topics of industrial ecology. We will need to develop a policy and mechanisms to support these groups beyond the ad hoc way we have addressed their needs so far. The unexpectedly large number of abstracts submitted (over 350) and requests for time for side meetings for the 2003 meeting raise questions about the need for extending the meeting or perhaps holding it annually. We are continually adding functions to the ISIE website. But now after a few years we need a more formal plan. Our 2002 experiments with joint meetings in Japan and Europe were quite successful, and we need to think about more formal arrangements.

Then there is the always present concern about financial stability. We have in place a Treasurer and Finance Committee to produce a financial strategy that will keep us healthy once the grants that were instrumental in getting us going run out in 2003. Their task is also daunting, as our present dues structure cannot support the activities of the Society including the bundling of the *Journal*.

Finally, many of you have asked me what the new governance structure means for my continuing involvement. I do not see much change and look forward to continuing for at least a couple more years. I accepted this job always expecting to work with an elected body and look forward to working with them. In any case, I have been working from the start under the guidance of our ad hoc Steering Committee which now dissolves. Let me finish this note by expressing my personal thanks and those for the membership at large to the members of the Steering Committee, which has provided the policy and strategic guidance in anticipation of the formal structure we now have. So as it is said, "Ca plus le change, ca plus le meme."

John Ehrenfeld <john.ehrenfeld@alum.mit.edu>

Recycling

Recycling has been criticised in recent years for being quite an energy intensive process (particularly when there is a demand to 'conceal' the first life of a product, as with pure white, recycled office paper), and for not having enough impact on the unsustainable expansion of material culture. In the case of the increase in 'recyclable' disposable products like cameras, it could be argued that it is even promoting this expansion. Recyclate should be treated as a scarce resource, certainly not as a justification for a new product.
If you are interested in the recycling debate, see Tim Cooper's *Beyond Recycling* paper.

Centre for Sustainable Consumption

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The Centre for Sustainable Consumption was established to respond to the need for greater understanding of sustainable consumption. Its research focuses on consumer behaviour and the environmental impact of household goods.

Product Life and the Throwaway Society Seminar, 21st May 2003, Sheffield Hallam University

What do we offer?

- **consultancy services** for industry on consumer attitudes and household behaviour, to assist in new **product development** and effective **waste management**
- **expert advice** for government and non-governmental organisations (NGOs) on strategy and policy relating to sustainable consumption, waste and the environmental impact of consumer products
- increased public understanding through high quality **research and teaching**, often in collaboration with other academic institutions

One of our primary areas of expertise is in the **life span of household goods**. Staff contributed to the 1994 New Economics Foundation report *Beyond Recycling*, the 1997 *Eternally Yours Congress* in the Netherlands, and the E-SCOPE report *Prospects for Household Appliances* (summary here, copies available on request). Staff will be speaking at the Eternally Yours conference *Time in Design* in October 2003.

We have a research programme on product-service systems, and in 2000 produced a report, *Products to Services*, for Friends of the Earth.

An interdisciplinary seminar exploring the relationship between consumption and Christianity in the context of sustainable development was held in 2002. The proceedings are available, price £10, from Danielle Green at the address at the foot of this webpage.

In recent years, we've worked for a wide range of private and public sector clients, including companies, local authorities and environmental organisations. Centre leader Dr Tim Cooper acted as Specialist Advisor to the House of Commons Environment Select

Committee for its enquiry *Reducing the Environment Impact of Consumer Products*.

Our current work includes:

- a European Commission project on consumer acceptance of product-service systems
- a project using quantitative and qualitative methods to investigate the impact of consumers on product life spans
- a series of case studies on the UK market for the repair of household goods
- a study of the potential for product life span labelling
- delivering postgraduate and undergraduate teaching programmes

The Centre is supported by the School of Sport and Leisure Management and partly funded by the Art and Design Research Centre (ADRC) of the School of Cultural Studies. Its output formed part of the ADRC's submission in the last Research Assessment Exercise, which was ranked 5.

Due to the multidisciplinary nature of our work, staff involved in projects include specialists in consumer behaviour, design, engineering, economics, food, energy and environmental management.

Further information is available from **Tim Cooper**

 0114 225 4838

 0114 225 2881

 t.h.cooper@shu.ac.uk

- Leisure Industries Research Centre
- Food staff biographies
- Back to Food home

School of Sport and Leisure Management, 1140 Owen Building, City Campus, Howard Street, Sheffield S1 1WB Telephone **0114 225 3506** Fax **0114 225 2881** E-mail slminfo@shu.ac.uk

1. Design Precedents

Because we need to understand more about how we have designed in the past in order to design more sustainably in the future, we need to start the design process with an understanding of what kinds of things have a determining influence on our designing. This might sound a bit nonsensical, but it really isn't. No design is 'original' in the sense that it has no heritage. Everything we design has some design precedent in the world and in our minds. For example, even if a piece of music sounds entirely new, with careful listening a mix of recognisable elements will emerge that nonetheless together in this new form might 'break new ground'. So before we begin designing anything, we have to carefully consider these precedents and what we can learn from them.

Exercises:

1 Create 3 headings across a page: Me; Product; Uses.

2 Under 'Me' write a short (20 word) statement about why you are designing this product. Then list all of the ideas you have or are starting to assemble related to this task: other designs you have seen and your impressions of them; elements you want to incorporate but you are not yet sure how to; influential images and other cultural forms. What is your overall impression of your product-to-be, what do you want it to communicate to the world?

3 Thinking about what needs your product must serve, what it must be able to do (function) and over what period of time, list under 'Product' as many specific products as you can that already do some or all of these things, even if not made specifically for the intended purpose. So for example, if you are designing a display for notes, messages, reminders (noticeboard) you might also list 'refrigerator' as a precedent.

4 Under 'Uses' list all the ways that you know people use the above products: how often and when are they used, are they used differently in different environments? What habits have they created: do people use them carefully and look after them or are they run fast and hard until they fall apart? You may need to interview users of these products to get a good picture of the range of these uses (See User Research on the left menu).

5 Select a 'proxy' product to work with. If possible, it should be nearing the end of its use-life. This product should be a 'benchmark' that is, what you consider to be the next best product around to what you are designing, perhaps a 'competitor'. By the time you finish this guide, you will know this product inside out and rather than replicating its successes, should be aiming to learn from its errors. The point here is to support front-end decisions by learning more about their consequences.

2. Secondary Products

One way of understanding the idea that design itself designs both in terms of and beyond its designated function (see Relational Design), is to think of these aspects as 'secondary products' that bear material implications. What we now need to do is use the information we gathered in the previous exercise for some future planning. What will your design in turn, design? This is how we start to discover impacts and what we need to find out about them. We can then use this information to reflect upon on our design plans.

Exercises:

1 Create three headings across the page: Materials; Meanings; Uses.

2 Using your proxy product, list under 'Materials' as many of the material relations this product depends upon as you can. Leaving aside for the moment what the product itself is made out of and the impacts associated with that, here we are concentrating on the use-phase of your product's life and the reference material flows it entails. What resources will your product itself need in order to operate (energy sources, water, cleaning products, labour) and at what rate over time; what other associated products will it need (for example notice-boards need pins or magnets; pens need paper, refills, pen holders, pencil cases, liquid paper etc.)?

3 The category of 'Meanings' is a little less straight forward. Meanings depend on the relationship between a product and its users: it refers to the perceptions your product will generate and depends upon over its life.

- How do you think the designer of your proxy product would have answered the following questions?

- What will your product be valued for?
- What kinds of feelings do you want it to create in its users?
- What do you want to be remembered about your product?
- How do you want the relationship between your product and its user/s to evolve?
- Now how would you answer them about your product?

As a starting point, go back to Step 1 where you listed impressions about what you want your product to communicate and why. In Stage 7 we will take the idea of designing meanings further, into the category of product styling.

4 The category of 'Uses' in this stage refers to the practical relations your product will create over its useful life. Who will use your product and how/why will they use it? Imagine a specific user, perhaps your 'ideal' user and describe them in as much detail as possible. As you discovered in Step 1, product users intervene in the intended design of products and create their own uses, which can radically alter the impacts of the product. You are now in a position to double guess some of the unintended interventions of users and increase the *usability* of your product, which has materials circumvention or 'Dematerialisation' potential. Looking carefully at your proxy product, Are there any uses that you think its designer failed to account for and what tells you this? What secondary uses do you think your product might invite?

3. Some Questions about *need*

This step is about justifying the existence of your product. This is probably the most difficult stage, because we are usually itching to get to the making of things. So why should you have to do this? Partly because, as strategic designer Professor Ezio Manzini has said, the world is full of too much making and not enough designing. In other words, we live in a world abundant with unsustainable products that are half thought through at best, mostly designed on 'autopilot'. Software encourages the full rendering of partly realised ideas and the time frame between concept and manufacturing has become shorter and shorter. In these conditions, we have to think much more carefully about needs.

The question about what we need is a very difficult one to answer in our consumer-driven culture because *wants* have become indistinguishable from *needs*. A successful product sets up new parameters of need, but with far too many products, the needfulness of these needs falls apart under the most cursory consideration (you would have noticed, for example, the almost hysterical ergonomics of recent toothbrush design, and perhaps asked yourself do we really need such multi-textured, multi-coloured, hyper-flexible toothbrushes? Not only do these toothbrushes have a bigger bill of materials, require more manufacturing, marketing and packaging, but suddenly, they make a plain handled toothbrush, even one with a replaceable 'head', look 'poor quality'!). We need to learn what it is we need—we can't just rely on our intuitive feelings about needfulness.

The ways in which we currently meet our need to 'create' or 'make' for example, also adds to the problem of over production. Our current ecological circumstances clearly indicate that we need to learn to design for less materially intensive ways of living and working. So you need to ask yourself: is your product needed, why is it needed, can this need be met in other ways that reduce the need for yet another product in the world? Design for sustainability means asking yourself these questions and finding new ways of answering them. This implies a process of reflection, discovery and change.

Exercises:

1. List the needs your proxy product meets.
2. Briefly indicating the implications of each of the following, consider how else these needs could be met, for example:
3. Could these needs be met by a *service* rather than a product?
4. Could these needs be met by *sharing* an existing product?
5. Could these needs be met by *modifying* an existing product?
6. In Step 1 you were asked what needs your product will serve and what products already meet these needs. Now go back to your response and think about these needs again. List them in priority.
7. Are all of these needs clearly needed? Why?
8. How will your product meet each of these needs more effectively and successfully than previous products?
9. What needs not being met by other products will your product meet?
10. What future 'needs' might your product *invent*?

4. Projected Use-Life

Many life cycle analyses demonstrate that the most materially and energy intensive part of the product's life is the use phase. (If you have not yet done so, look at Product Life Cycle for the methodology of LCA). In fact, the use phase of a product's life is crucial to consider for several key reasons.

Product lives are mostly determined by how long we use them for. But this is often more a measure of how they look than their usefulness. Our cultural habit of throwing things away before their material lives are over ripples back to the production side, encouraging the design of short-life, 'disposable' products. Short-life products are also the result of comparative functional obsolescence, particularly with technologies. So we are encouraged to buy 'the latest' technologies, even if we never take advantage of their suites of new 'whiz bang' functions. Carefully considering how products are used provides a designer with a lot of cultural information, which can lead to the emergence of new product concepts. How we use designed things determines how we value them, how long they will last and what kinds of products we will want to buy in the future. A careful consideration of these factors in the design process can even circumvent the need for environmental management strategies like recycling, by putting design for reuse first.

This stage is particularly concerned with what we can learn about designing for use-life from a *materials* perspective. In Stages 7 and 9 we incorporate other use-life considerations, like interface semantics and semiotics, though as you will see these aspects need to be considered in relation.

Exercises:

1 Following on from what you noted about your proxy in Stage 2, answer the following, as applicable:

2 What does the appearance of the product tell you about its handling, i.e. what parts look most worn out, what parts look unused?

3 Are the worn parts of the product integrated or are they able to be replaced?

4 Do you think this product has been shared or mainly used by a single user?

5 Do you think the product has been well cared for? Why?

6 Is the product hard to clean or care for?

7 Do you think the materials chosen for this product support or detract from its durability in use?

8 What amendments might you make from a materials perspective, to extend the product's life?

9 How long do you think your proxy product was designed to last for? What tells you this?

10 Is the product reusable, upgradable, disassemblable?

11 Does the product indicate to you how to manage its materials at the end of its life?

12 Now referring back to 'Uses' in Stage 1 and 2, map out the intended or 'ideal' first and subsequent use-lives of your product, for example it is a short-term product that can be reused several times for the same purpose (e.g. most baby products) or perhaps a long-life, adjustable product (e.g. some baby products: chairs and beds)? Considering what you have learnt above, write a general description of the material requirements needed to support this and subsequent use-lives of your product, for example, "my product needs to be made from durable, non-toxic materials that do not scratch easily, maintain their appearance and that are easy to clean. The least durable parts (for example, fabrics, foam backings) need to be easily and entirely removable, surface fabrics need to be dark and reinforced in certain areas. All materials need to be joined without adhesives so they can be easily pulled apart at end-of-life. Now consider the following:

13 How will you ensure your product is resource efficient during its use i.e., how will you design it to use less or no energy, water, chemicals for its operation and maintenance?

14 Can you design out the need for exterior sources of energy (e.g. utilise manual pumps or passive body heat?)

15 Will the product be at all hazardous to its users and in what circumstances? Will it give off fine particles or fibres, off-gas VOCs, emit endocrine disrupters? How can you modify any hazards this product may pose to users, or how can these be made obvious to users?

16 How will users learn how to best use, maintain, repair, reuse and prepare your product for end-of-life processing? What if any of these instructions will be embedded into the product materials; will you employ labels, embossing, manuals or ongoing support services?

5. Lean Design

One of the biggest problems we face is the inappropriate application of materials, i.e. high quality, highly environmentally impacting plastics making up mostly short-life, 'disposable' products. These materials are being wasted. Following on from the requirements you have established in projected use-life, this stage asks you to carefully consider the material commensurability of your product: how appropriate are the materials chosen for this product? Lean design is not, as the term might suggest, simply about production-side 'lightweighting'—which is often cited as a way to slash the energy bill of products (embodied and/or in use-life) as well as the overall costs of manufacture, transport and end-of-life materials 'output'. While important, this is only part of the picture if the overall volume of products continues to increase, if production and end-of-life management is more environmentally costly, or if these products afford more materials intensive uses. And there might in fact be good reasons to create a comparatively materials intensive product (for example replacing a lightweight, recyclable product package with a long-life, durable, multi-use product dispenser or container). This stage is about getting you to start to think more 'culturally' about materials: how certain materials tend to 'communicate' certain meanings. The choice of materials in a product can, for example, play a major role in whether users will bother to care for it and consequently how long it will 'live' for. This process can also be habit changing: it can circumvent the need for a user to purchase a range of similar products. A key ambition of the lean design principle is to modify the desire for the accumulation of lots of things as well as encourage a more careful, forward-thinking 'consumption'. The following questions should be answered intuitively. Make a note of what you can't answer as Step 6 is a more detailed materials research exercise.

Exercises:

1. Compile a materials audit of your proxy product including if possible packaging, noting any materials that you do not recognise or know about.
2. What is the nature of your knowledge about these materials—why do you think these materials have they been used in this particular product?
3. What kinds of inherent qualities do these materials possess?
4. What do they 'say' or mean to you, what do they bring to mind?
5. How does the product packaging relate to the actual product: are product and packaging materially and/or symbolically commensurable (e.g. a 'green' cleaning product packaged in durable, reusable cleaning gloves; a paper product that doubles as its own envelope or package)? If not, can you see how product and packaging might be integrated?
6. How else do you think the number and amount of materials used in this product be could be minimised?
7. Can the product be made to fold, nest or otherwise reduce in transport volume (related to Stage 8)?
8. Do you know whether the materials in this product include heavy metals, toxic substances, persistent organic compounds?
9. How do the materials in this product interface with each other—for example are components glued together, welded, snap-locked, and how do these interfaces impact on the end of life management of this product (this relates to Steps 7 and 10)?
10. Could the product be made more lightweight—does it need to be so big, heavy or materially complex? Why?
11. What will happen to the materials at the end of the use-life of the product, for example can they be recycled into another product or are they only able to be down-cycled to a lesser quality product, thus merely delaying landfilling?
12. What are some of the alternative materials that might have been considered for this product (e.g.bamboo for timber products)?
13. Are any of the materials to your knowledge derived from renewable sources (plantation products, soy-based inks and dyes, starch or sugar-based plastics)? Might they have been?

14 Could this product have been made out of reclaimed materials (what about reclaiming materials from products it replaces or has made obsolete)?

15 Given these considerations, summarise how the design of this product might be made leaner, i.e. more appropriate?

6. Manufacture Issues

The manufacture of the materials that go into making your product, the supply and transport of those materials (which we look at in Step 8), the assembly of your product—these are all 'outsourced' areas of design that the designer does not often consider or even know about (which you may have discovered in the previous Stage). However as a designer for sustainability you have a responsibility to find out about the Industrial Ecology of your product. This stage comprises a research exercise. The point is to answer as many of the questions listed below as you can, in order to see how and where your product may mitigate against and even reverse production side impacts. These questions may sometimes be difficult to research and answer, however the process of attempting to do so is a learning exercise in itself—you may be surprised at how little people know about the environmental impacts of what they are already caught up in doing. You could compile this information graphically in a process chart, but make sure you indicate 'known' and 'unknown' aspects, rather than erase what you do not know from the picture.

Exercises:

1 Returning to the materials audit list you made in the last stage, try to find out about the materials you do not recognise. In the case of a product that has only one or two materials, add to the list as many of the materials needed for the use of this product as you can (recall secondary products in Stage 2). Answer the following:

2 From what, where and how were these materials sourced?

3 Where and by whom were they manufactured?

4 What are the manufacturing processes for these materials?

5 Is there just one way to make these materials or are there many alternatives and how do they compare?

6 Are any of these materials recycled or otherwise drawn from prior product sources?

7 What kinds of energies are used in manufacture and product assembly (renewable or gas/coal based?) and what are the energy and water efficiency strategies employed, for example, do the manufacturers use cogeneration (the co-production of electricity and thermal energy using a single fuel) processes?

8 What are the machining requirements for the manufacture of this product, for example does it require the development of new tooling?

9 Where and if possible by whom was this product assembled?

10 Do the manufacturers/suppliers/assemblers have Environmental Management Systems in place to organise and monitor such strategies?

11 What do you know about the health risks for those involved in manufacturing these materials (for example particulates, emissions, noise)?

12 Are they sources of acid rain, ozone depleting chemicals, or do they contribute to local air pollution?

13 How does the supplier/manufacturer/assembler relate to their immediate environment, for example how do they manage pollution issues and what happens to material off-cuts?

14 How do they relate to other local ecologies, for example do they utilise local resources?

15 Do they/ are they planning to practice Extended Producer Responsibility? What are the legislative restrictions imposed on the manufacture of this product and what voluntary agreements does its production come under?

16 What kind of product recovery infrastructure do the supplier/manufacturer/assembler have in place (relates to Steps 8, 10)?

17 What kinds of measures would need to be implemented to manufacture this product more sustainably, for example, would it be possible to demand manage any aspect of the supply or manufacture of this product?

18 Can any aspect of this product be remanufactured (remanufacturing is the process of disassembly, component refurbishing and reassembly of products to meet first-use performance standards. It has a strong educational benefits, as manufacturers get to see exactly where and how products become worn in use)?

19 In summary, what do you think are the main environmental impacts associated with putting this product together?

20 How might these impacts have been reduced or reversed in the front-end design process?

7. Product Styling

Now you have made certain decision about the kind of product you are going to design and have done some research into manufacturing processes, you need to work out how you can style this product appropriately to promote sustainable use. Product meanings arise in the relationships between users and products. These relationships are both physical and symbolic—prompted by product 'affordances', tacit user know-how as well as by new meanings promoted by marketing strategies (which we look at in Stage 9).

As contemporary product buyers, we tend to expect products to aesthetically declare their functions and 'performance' (one of the most obvious examples is to be found perhaps in car detailing). As designers, we are often encouraged to style products 'gratuitously', that is, in a way that denies any need to create symbolically commensurate and integrated forms. The principle of commensurability discussed in 'lean design' is therefore also relevant here. Designers are often approached with bad design specs and more or less asked to 'spread some cool design' over the surface of the product*. But the world certainly doesn't need any more iMac-style telephones destined to join the 80% of new products that fail to be wanted, let alone needed. Often, the more 'specific' a product's styling gets, the more limited it will be in terms of usability and desirability. A piece of furniture with fixed shelving dedicated to the sizing of today's technology is an obvious example here, and will find itself unable to absorb the demands of technological innovation. Quite unapologetically, we wish to promote a different culture of styling—one that is about communicating and making desirable more sustainable ways of living and working. The spirit of invention is invited by sustainable design, but it needs to move in a different direction to the current aesthetically driven one. Products need to be styled more responsibly in relation to *what* they communicate (symbolic meanings) and *how* they communicate to users (interface semantics); in all, in ways that are more commensurate with their functional lives. This is not to advocate a 'modernist' representational approach, but rather to make the point that styling is, literally and symbolically, the key to a 'successful' product. It is about the ways in which products look, feel and even act toward users. The following questions are designed to help you reflect upon and apply direction to styling decisions you have perhaps already intuitively made.

* From Chris Heatherly, chief strategist at Frog Design, based in Sunnyvale, Calif. which appeared in "Cool Design Won't Save a Dud Product" by Bob Parks posted on ID Forum March 2001.

Considering the styling of your proxy product, ask the following questions:

1 What does this product 'know' about you, for example ergonomically (e.g. a rubber glove 'knows' I have 5 fingers); but also about what you need (e.g. it knows I need protection; assistance with grip); like and dislike (e.g. to keep my hands dry)?

2 What doesn't this product know about you (e.g. I don't need colour co-ordinated gloves; I don't know enough about the tolerance and performance of synthetic rubber, and tend to use the gloves inappropriately, like for handling some chemicals)?

3 What and how does this product communicate about its use-life to you, (for example, does it 'look' disposable)?

4 How does this product communicate about its materials to you, for example through labels, embossing, manuals? (related to Stages 4,6)

5 How does this product invite your understanding of how it works, for example through labels etc. (related to Stages 4 and 9).

6 If electrically dependent, how does the product encourage being turned off (research shows that turning a product off entirely rather than putting it on standby mode will not cause additional wear')?

7 How flexible is the product; can it be adapted to several uses or ways of use? If a technological product, is it designed for intergenerational compatibility?

8 Is the product assemblable and repairable or is it an ‘all-in-one’ that can only be put together and/ or taken

apart and repaired by an external source?

9 Following on from Stage 5, what and how will product packaging communicate to users? If surface signage is to be used, will this be adaptable, removable, reusable and generally low impacting?

8. Distribution Issues

We have learnt to sense that most things are deliverable or available at a cost. These costs however rarely include the environmental costs of supply and transport, not to mention the common scenario of ‘goods’ fast approaching obsolescence (or already obsolete), languishing in warehouses. Ask the following questions of your proxy—they may make a difference to how you see your own product taking shape.

Exercises:

1. How are materials distributed between materials supplier, manufacturer, assembler?
2. When assembled, is the product packed, how and with what? Where are these packing materials searched from and what happens to them at end-of-life?
3. How is the product distributed to ‘point of sale’ and where is it stored? How is it looked after?
4. How is the product distributed/delivered to users?
5. What packing requirements does this entail?
6. Is the product distributed in bulk or on demand? How are user expectations dealt with, for example if distributed in bulk, is a waiting period incurred?
7. How is the product repaired: does it need to be sent away requiring more transportation?
8. How is the product managed at the end of its life in relation to transportation issues?

9. Retail and Use-Life Management

This step concerns the ‘point of sale’ or equivalent and the support systems that will sustain the product's value over its use-life and encourage careful 'consumption'. This involves both material aspects, like repair and technical support, but also symbolic, 'declarative' aspects: the ways in which products are branded, promoted, represented and 'placed', as well as the ways in which these strategies are undertaken. Incidentally or intentionally, these aspects communicate certain meanings about products to users (this is again an issue of commensurability). The extents to which these meanings are supported by the design of products has a significant role in determining product use-life and influencing innovations in use.

The idea that things are 'disposable' for example is an idea that has been learnt and has become a cultural habit. Clearly, most things are not 'disposable', they are just 'hidden' in landfill. This has a variety of ongoing environmental effects, not least on the 'need' for newer versions of those same things. In order to change such cultural habits, we have to intervene at the promotional level and make other kinds of behaviours, such as product reuse, more visible and desirable. This means creating and promoting new kinds of associations and stories about products.

As the designer, you are best placed to think about how you could promote your product's specific sustain-abilities: durability, adaptability, *share*ability, reliability, mobility etc. Your first task then is to develop 'stories' about your product; its 'character profile', its 'lifestyle', 'career', appreciative users, putting it into future scenarios (where it has aged gracefully, for example). These could form the basis of promotional strategies for new but also remanufactured or used products, indicating that something is 'better than new 'cause it has a story' (to quote David Mamet). In doing this exercise it might be worth talking to other designers about their product 'stories' (how did this product come into being?). It is sometimes useful to unpack prevalent 'stories' about products to discover the unsustainable associations they have created, which you might be able to 'jam' or design against. A good place to start here is with a critical observation of advertising media. (Nb. the *Eternally Yours* book listed in the Resources section, which we are told may soon be available on the net, provides some great examples of such strategies).

Conversely, there might be ways to 'agree' your product into use, i.e. showing how it will save the user money. Though price is a powerful influencer of choice, it is not necessarily a behaviour changing mechanism. An important issue commonly raised in relation to price reduction strategies is what will 'consumers' spend the balance on? Another problem is the reduction in symbolic value 'cheap' products entail. Strategies to mitigate the 'cheapness' of plastic bags by 'pricing them up' at 'point of sale' are, for example, having great success in modifying how they are both seen and used (see Planet Ark's website). Another 'agreement' strategy is showing how a product will gain in value over time or improve quality of life (as distinct from elevating materialistic life styles).

The following questions relate to practical issues associated with this stage of the product's life. Some of them suggest research tasks—particularly in relation to the practices of retailers and their relation to manufacturers. It is worth noting that this stage of a product's life often falls off the agenda of LCA—therefore knowing about this stuff gives you a bit of a market edge!

Exercises:

1. What implications does sustaining the value of your product have on use-life management, for example what support services will be needed in relation to technical support, repair, customer service and how are these responsibilities distributed? What problems can you identify in relation to this?

2. How will the user be informed of these management responsibilities and of their own responsibilities in relation to the care of the product? How will this product be displayed and sold—will it require packaging and if so how can this be integrated into the product or otherwise reused?

3 What will be the material expenditure associated with the promotion and sale of this product, for example literature, lighting? How can this be reduced? (Problems associated with informational marketing strategies are discussed in Designing a Competition Logo.)

4 How can you reduce the material impacts of advertising, for example could the product have a website that could function as its site of sale, instruction, support? (related to Step 9)

5 Could this product be sold over the internet and if so how could you eliminate or reduce packaging and transport environmental costs?

6 How can you make the materials required to pack, distribute etc. present to the buyer, part of the product 'package'?

7 If sold in conventional shops, what Environmental Management Systems do the retailers employ?

8 Will they take back packaging and manage its return to manufacturers or what other kinds of strategies do they have in place?

10. Post-use Management

If you design your product as well as possible there should be nothing to waste at the end of its first entirely sustainable use-life. It should be fully consumed or inertly biodegradable, entirely disassemblable, reusable or recyclable in low impacting ways into other, needed products. Its material value will either be fully retained or transformable in a low or no impact manner into equally valued materials whose life purposes will more than make up for any environmental impacts. Your product will spend its life communicating sustainability sustainably with 'users' who will use, maintain, repair and care for it properly.

Additionally, by using your product, users will develop new sustainable habits and new insights into the other unsustainable products in their lives. The manufacturer will organise for the low impact collection of these materials to be fed into low impacting and exceptionally managed materials recovery and remanufacture programs...sounding a bit idealistic?

Even if all these things could be achieved, the perfect product does not exist because no matter how carefully you design something, environments are not and will never be entirely calculable (this, in a nutshell, is the main problem with scientifically derived environmental management systems). We can however, work toward creating sustainments even though the world is full of designers, products and processes 'sustaining the unsustainable'. The more sustainments that are designed—ethical products aware of the power of design—the more the possibility of a more generally sustainable culture will arrive.

This last set of questions is about consolidating what you have learnt by doing this guide. This is followed with a design process audit and a redesign task—tips for writing a 'return brief' incorporating some of what you have learnt.

Exercises

1. How many use-lives will your product potentially have, and drawing on your research summarise how its design will support this?(materials, material interfaces, instructions, infrastructure etc.)
2. Will the user be able to disassemble the product easily, for example are the components comprehensively labelled?
3. How will information about the management of post-use be included with product; where will prompts/instructions be located (for example on an internal computer chip; manuals, embedded into the materials)?
4. Will there be any kinds of incentives offered to users for the return of products or parts; will these incentives also be sustainments?
5. Will there be any kinds of feedback mechanisms in place, any way that users can document their experiences or otherwise participate in the design process so that the designer can learn from the culture of use the product has designed?
6. Your last task before rewriting the design brief is to summarise the audit of your design process. To do this, we suggest you use your log information to draw an 'ecomap': a visual schematic representation of your work process. Draw a simple diagram of your work space and try to locate the sites of intensity of energy or materials use. This is a quick way to identify key areas of unsustainability in your process, but should not replace a more thorough assessment of the main ecological impacts associated with the material and energy inputs and outputs you have logged. What changes or adjustments to your work process do you need to make, and how might the physical assembly of your space assist in this? For further information on this process see Eco- Mapping.

7 Finally, visit Seven Tips for a Return Brief . For help with research, check out User Research.

Please communicate with us about this guide - Comments and Questions Welcome.

Resources

This guide predominantly draws on the work the EcoDesign Foundation has done in sustainable design for the last 10 years. As far as other guides go, we have found J.C. Brezet and C.G. van Hemel *Ecodesign: A Promising Approach* (Paris: UNEP 1997) to be one of the most useful product design guides produced—see Further Introduction for their 'New Concept Development' strategies. Another more recent guide by Helen Lewis and John Gertsakis et.al.*Design and Environment: A Global Guide to Designing Greener Goods* (Sheffield: Greenleaf, 2001) was reviewed in the January 2002 issue of the Sustainments newsletter. Most guides and checklists however do not account substantially enough for the cultural contexts that are, as we hope to have suggested in this Guide, the key aspect of designing for sustainability.

A Few Recommended Books:

Beukers, Adriaan and Ed van Hinte. *Lightness:the inevitable renaissance of minimum energy structures*. Rotterdam: 010 publishers, 1998.
Beck, Ulrich. *Ecological Politics in an Age of Risk*. trans. Amos Weisz, Cambridge: Polity Press, 1995.
Buchanan, Richard and Victor Margolin (eds.). *The Idea of Design* . Cambridge: MIT Press, 1995.
Buchanan, Richard and Victor Margolin. (eds.) *Discovering Design: Explorations in Design Studies* . Chicago: The University of Chicago Press, 1995.
Frascara, Jorge. *User-Centred Graphic Design: Mass Communications and Social Change* . London: Taylor & Francis, 1997.
van Hinte, Ed (ed.) *Eternally Yours: Visions on Product Endurance* . Rotterdam:010 publishers, 1998.
Fry, Tony. *A New Design Philosophy: an introduction to defuturing.* Sydney: UNSW Press, 1999.
Fry, Tony. *Remakings: Ecology, Design, Philosophy.* Sydney: Envirobook, 1994.
Graedel, T.E and B.R Allenby. *Industrial Ecology*. New Jersey: AT & T /Prentice Hall, 1995.
Manzini, Ezio. *The Material of Invention: Materials and Design.* Cambridge: MIT Press, 1989.

McKenzie Mohr, Doug and William Smith. *Fostering Sustainable Behaviour: an introduction to Community-Based Social Marketing*. Gabriola Island: New Society Publishers, 1999.
Norman, Donald. *The Design of Everyday Things*. New York: Doubleday, 1990.
Papanek, Victor. *The Green Imperative: Ecology and Ethics in Design and Architecture*. London: Thames and Hudson, 1995.

Some Relevant Links For design issues:

This is an excellent design for sustainability resource site from Goldsmiths College, University of London Demi Design for Sustainability
Eternally Yours is an organisation with broad design affiliations that focuses on how the relationships between people and the products we buy and use designs the value, durability and quality of products.
SusHouse project is a European research project concerned with developing and evaluating scenarios for transitions to sustainable households.

For materials information:

http://www.ebuild.com
http://www.timbershop.wilderness.org.au
http://ecospecifier.rmit.edu.au/flash.htm

For energy information and issues:
CADDET (Centre for the Analysis and Dissemination of Demonstrated Energy Technologies) is an international agency for the exchange of information on renewable energy projects including biomass, geothermal, hydro, solar, wind, waste and PV. Extensive case studies with technical data and contact details.

For toxics and hazardous substances information:

Index of toxic or hazardous substances.

Links to important current and emerging legislative drivers for design for sustainability:
The EU's WEEE (Waste Electrical and Electronic Equipment)Directive
The EU's Directive on Packaging and Packaging Waste
Australia's voluntary National Packaging Covenant
The EU's End-of-life Vehicle Directive
The EU's EEE (Environmentally-friendly Electrical and Electronic) product proposal (whereas the WEEE legislation is concerned with the end-of-life processing of the product, the EEE initiative focusses on the full life-cycle of the product).
The EU's Energy Label and Energy Star Program

For other useful references, go to the links section of the EDF website.

demi guide to design for sustainability

SEARCH

GO

This website contains lots of information on design for sustainability. You can explore it by clicking on the map which shows this information clustered in six sectors. To get the best out of demi use the map in combination with the keyword weblinks and the free search.

demi has been written, unless otherwise stated, by researchers at Goldsmiths College, University of London as part of a UK Government-funded project

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Packaging and packaging waste

1) OBJECTIVE

To harmonise national measures concerning the management of packaging and packaging waste to provide a high level of environmental protection and to ensure the functioning of the internal market.

2) ACT

Council Directive 94/62/EC of 15 December 1994 on packaging and packaging waste [Official Journal L 365, 31.12.1994].

3) SUMMARY

1. The Directive covers all packaging placed on the market in the Community and all packaging waste, whether it is used or released at industrial, commercial, office, shop, service, household or any other level, regardless of the material used.

2. The Directive provides that the Member States shall take measures to prevent the formation of packaging waste, which may include national programmes and may encourage the reuse of packaging.

3. The Member States must introduce systems for the return and/or collection of used packaging to attain the following targets:

- recovery: 50% to 60%;
- recycling: 25% to 45%, with a minimum of 15% by weight for each packaging material.

4. The Directive lays down essential requirements as to the composition and the reuse, recovery and recycling of packaging; the Commission is to promote the preparation of European standards relating to the essential requirements.

Provisions concerning proof of conformity with national standards must be applied immediately.

5. The Council is to decide no later than two years after the entry into force of this Directive on the marking of packaging. The identification system for the materials used will be prepared on the basis of Annex I no later than 12 months after entry into force.

6. The Member States are to notify the drafts of the measures which they intend to adopt within the framework of the Directive, excluding tax measures, prior to adopting them.

7. To provide the necessary Community data on waste management, the Member States must ensure that databases on packaging and packaging waste are established on a harmonised basis so that the implementation of the objectives of the Directive can be monitored.

8. The Member States are to report regularly to the Commission on the application of the Directive.

9. Member States will ensure that users of packaging are given the necessary information about the management of packaging and packaging waste.

10. The identification system and the structure of the databases will be adapted to scientific and technical progress.

11. This Directive provides for a transition period during which packaging manufactured before its entry into force may be marketed.

Act	Date of entry into force	Final date for implementation in the Member States
Directive 94/62/EC	31.12.1994	30.06.1996

4) IMPLEMENTING MEASURES

Decision 97/129/EC - **Official Journal L 50, 20.02.1997**
Commission Decision of 28 January 1997 establishing the identification system for packaging materials pursuant to European Parliament and Council Directive 94/62/EC on packaging and packaging waste.
The Decision establishes the numbering and abbreviations on which the identification system is based, indicating the nature of the packaging material(s) used and specifying which materials are subject to the identification system.

Decision 97/138/EC - **Official Journal L 52, 22.02.1997**
Commission Decision of 3 February 1997 establishing the formats relating to the database system pursuant to European Parliament and Council Directive 94/62/EC on packaging and packaging waste.
The formats serve to harmonise the characteristics and presentation of data on packaging and packaging waste, making them compatible from one Member

State to another. The data will be used to monitor attainment of the objectives of Directive 94/62/EC. Provision of data is compulsory only in respect of the following packaging materials: glass, plastics, paper and fibreboard and metals.

Decision 97/622/EC - **Official Journal L 256, 19.09.1997**
Commission Decision of 27 May 1997 concerning questionnaires for Member States reports on the implementation of certain Directives in the waste sector (implementation of Council Directive 91/692/EEC).

Decision 1999/177/EC - **Official Journal L 56, 04.03.1999**
Commission Decision of 8 February 1999 establishing the conditions for a derogation for plastic crates and plastic pallets in relation to the heavy metal concentration levels established in Directive 94/62/EC on packaging and packaging waste.

Decision 1999/652/EC - **Official Journal L 257, 02.10.1999**
Commission Decision of 15 September 1999 confirming the measures notified by Belgium pursuant to Article 6(6) of Directive 94/62/EC of the European Parliament and the Council on packaging and packaging waste.

Decision 2001/171/EC - Official Journal L 62, 02.03.2001
Commission Decision of 19 February 2001 establishing the conditions for a derogation for glass packaging in relation to the heavy metal concentration levels established in Directive 94/62/EC on packaging and packaging waste.

Decision 2001/524/EC - Official Journal L 190, 12.07.2001
Commission Decision of 28 June 2001 relating to the publication of references for standards EN 13428:2000, EN 13429:2000, EN 13430:2000, EN 13431:2000 and EN 13432:2000 in the Official Journal of the European Communities in connection with Directive 94/62/EC on packaging and packaging waste.

Report [COM(1999) 596 final - **Not published in the Official Journal]**
Interim Report from the Commission to the Council and the European Parliament according to Article 6.3(a) of Directive 94/62/EC on packaging and packaging waste.
The interim report provides the Council and the European Parliament with the information they need in order to examine the practical experience gained in the Member States since 1998 and the findings of scientific research and evaluation techniques such as eco-balances. The report focuses primarily on "practical experience gained in the pursuance of the targets" (see point 3).
One third of the packaging for soft drinks, mineral water and wine in the European Union is reused. The packaging materials concerned by reuse are mainly glass and PET (polyethylene terephthalate). Some Member States have reuse systems in the milk products sector, though Directive 94/62/EC does not set targets in that area. It should be added that reuse systems are available to a much greater extent in the northern Member States than in the southern Member States.
Regarding recycling, the targets set by the Directive have proven realistic, with only slight geographical differences. The only material for which the recycling rate is still low is plastic.

5) FOLLOW-UP WORK

On 7 December 2001, the Commission presented a proposal for a directive of the European Parliament and of the Council, amending Directive 94/62/EC on packaging and packaging waste [COM (2001) 729 final - Official Journal C 103, 30.04.2002].
This proposal lays down new, more ambitious targets for recovery and recycling, to be met by 30 June 2006. The overall recovery and recycling targets must be between 60% and 75%, and 55% and 70% respectively. Specific recycling targets were also fixed according to materials: 60% for glass, 55% for paper and cardboard, 50% for metals and 20% for plastics (mechanical and chemical recycling only). Greece, Ireland and Portugal were given until 30 June 2009 to meet these targets.
The proposal signals the need for new definitions of "raw material" and chemical recycling. It includes an interpretation of the definition of packaging.

Codecision procedure (COD/2001/0291)
On 29 May 2002, the Economic and Social Committee delivered its opinion.
On 3 September 2002, Parliament approved the Commission proposal subject to certain amendments.

On 25 November 1996 the Commission put forward a proposal for a directive on marking of packaging and on the establishment of a conformity assessment procedure for packaging [COM(96) 191 final - Official Journal C 382, 18.12.1996].
The proposal harmonises the marking of re-usable and recyclable packaging practised on a voluntary basis by economic operators. It also establishes a conformity assessment procedure applicable to all the packaging covered by Directive 94/62/EC.

Co-decision procedure
First reading: On 25 February 1999 Parliament approved the Commission's proposal subject to 12 amendments [Official Journal C 153, 01.06.1999].
An amended proposal from the Commission incorporating the amendments it has accepted is awaited. The legal basis for this proposal has been renumbered following the entry into force of the Treaty of Amsterdam.

Last updated: 05.09.2002

THE NATIONAL PACKAGING COVENANT

The National Packaging Covenant was launched in August 1999.

The aim of the Covenant is to provide more effective management of used packaging based on the principles of shared responsibility and product stewardship.

The National Packaging Covenant has two tiers:

1. **The Covenant - The framework or umbrella document that establishes the policy approach and sets the broad parameters. It is the key document.**

2. **The National Environment Protection Measure (NEPM) or regulatory safety net - Focuses on brandowners and is designed to catch the "free loaders" and encourage companies to sign the National Packaging Covenant. The NEPM is secondary to the National Packaging Covenant.**

KEY DOCUMENTS

Following is a set of key documents relating to the National Packaging Covenant:

- **Overview of the National Packaging Covenant/NEPM**

- **The National Packaging Covenant**

- **The NEPM**

- **Independent Assessment of Kerbside Recycling in Australia, Revised Final Report - Volume I - January 2001**
and Appendix A - Environmental Assessment Methodology Details
If you are having trouble downloading these files, simply right click on the above link and choose "Save Target As..." (IE) or "Save Link As..." (NN)

ACTION PLANS - TRANSITIONAL FUND

Signatories to the National Packaging Covenant are required to produce Action Plans. Industry/company signatories are also required to contribute to the transitional fund. Following is advice/guidance on payments by companies to the Transitional Fund, together with advice on putting together an Action Plan and Guidelines for acceptance of that Action Plan:

Transitional Fund

Click here to view the Transitional Fund table showing contributions by turnover for company signatories. Please note that company signatories are required to make three annual contributions regardless of when they sign the Covenant.

For further information about the Transitional Fund, please contact:

Mr Gerard Van Rijswijk
Executive Director
Association of Liquidpaperboard Carton Manufacturers
P O Box 6250
North Sydney NSW 2606
Tel: +61 2 9954 4588
Fax: +61 2 9954 4546
Email: gvan@alc.asn.au

- **Action Plan Development Guidelines**

- **Action Plan Pre-Registration Assessment Guidelines**

- **Action Plans :**

Following are Action Plans - by category - submitted and approved by Covenant signatories:

- **For companies click here**
- **For governments click here**
- **For local governments click here**
- **For industry associations click here**

- **Signatories to the National Packaging Covenant**

- **Signing on to the National Packaging Covenant**

Following are contact details for signing on to the Covenant:

Ms Barbara Butt
Environmental Stewardship Team, Sustainable Industries Branch
Environment Australia
P O Box 787
CANBERRA ACT 2601
Tel: +612 6274 1679
Fax: +612 6274 1640
E-mail:barbara.butt@ea.gov.au
http:\\www.environment.gov.au/epg/covenant/

- **Presentations on the National Packaging Covenant by the PCA**

Management of end-of-life vehicles

---

1) OBJECTIVE

To prevent waste from end-of-life vehicles and promote the collection, re-use and recycling of their components to protect the environment.

2) ACT

Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on end-of-life vehicles [Official Journal L 269, 21.10.2000].

3) SUMMARY

1. Following the Council Resolution of 7 May 1990 on waste management policy, the Commission proposed various measures to combat certain categories of waste. Several waste streams have therefore already been the subject of Community regulation (waste oil , waste batteries and accumulators , waste packaging , sewage sludge).

2. The 5th Community action programme in the field of the environment and sustainable development stresses the need to modify both methods of production and development and consumer behaviour.

The Community approach to waste management is based on two complementary strategies:

- avoiding waste by improving product design;
- increasing the recycling and re-use of waste.

3. By Resolution of 14 November 1996, the European Parliament called on the Commission to legislate on waste streams, in particular end-of-life vehicles, on the basis of product liability. The Commission took the view that a specific directive was necessary given the importance of this type of waste. This position

is shared by the OECD Working Party on waste streams, whose 1995 report considers the treatment of end-of-life vehicles as a priority towards the overall objective of reducing waste.

4. The Directive defines an end-of-life vehicle as any type of vehicle which is waste within the meaning of Directive 75/442/EEC. The scope of the Directive therefore covers:

- any end-of-life vehicle designated as category M1 or N1 (as defined in section A of Annex II to Directive 70/156/EEC);
- two- or three-wheel motor vehicles and their components.

5. Waste prevention is the priority objective of the Directive. To this end, it stipulates that vehicle manufacturers and material and equipment manufacturers must:

- endeavour to reduce the use of hazardous substances when designing vehicles;
- design and produce vehicles which facilitate the dismantling, re-use, recovery and recycling of end-of-life vehicles;
- increase the use of recycled materials in vehicle manufacture;
- ensure that components of vehicles placed on the market after 1 July 2003 do not contain mercury, hexavalent chromium, cadmium or lead, except in the cases listed in Annex II. The Commission must amend the Annex in the light of scientific and technical progress.

6. The Directive also introduces provisions on the collection of all end-of-life vehicles (Article 5). Member States must set up collection systems for end-of-life vehicles and for waste used parts. They must also ensure that all vehicles are transferred to authorised treatment facilities, and must set up a system of deregistration upon presentation of a certificate of destruction. Such certificates are to be issued when the vehicle is transferred, free of charge, to a treatment facility.

7. The last holder of an end-of-life vehicle will be able to dispose it free of charge ("free take-back" principle). Producers must meet all, or a significant part of, the cost of applying this measure.

8. The storage and treatment of end-of-life vehicles is also subject to strict control, in accordance with the requirements of Directive 75/442/EEC and those of Annex I to the Directive. Establishments or undertakings carrying out treatment operations must strip end-of-life vehicles before treatment and recover all environmentally hazardous components. Priority must be given to the re-use and recycling of vehicle components (batteries, tyres, oil).

9. At the moment, 75% of end-of-life vehicles are recycled (metal content). The aim of this Directive is to increase the rate of re-use and recovery to 85% by average weight per vehicle and year by 2006, and to 95% by 2015, and to increase the rate of re-use and recycling over the same period to at least 80% and 85% respectively by average weight per vehicle and year. Less stringent objectives may be set for vehicles produced before 1980.

10. Member States must ensure that producers use material coding standards

which allow identification of the various materials during dismantling. The Commission must establish European standards on material coding and identification.

11. Economic operators must provide prospective purchasers of vehicles with information on the recovery and recycling of vehicle components, the treatment of end-of-life vehicles and progress with regard to re-use, recycling and recovery. On the basis of this information, Member States must report to the Commission every three years on the implementation of the Directive. The Commission must then publish a report on the implementation of the Directive.

12. Member States may transpose certain of the Directive's provisions by means of agreements with the economic sectors concerned.

Act	Date of entry into force	Final date for implementation in the Member States
Directive 2000/53/EC	21.10.2000	21.04.2002

4) IMPLEMENTING MEASURES

Decision 2002/525/EC - **Official Journal L 170, 29.06.2002**
Commission Decision of 27 June 2002 amending Annex II of Directive 2000/53/EC of the European Parliament and of the Council on end-of-life vehicles.

Decision 2002/151/EC - **Official Journal L 50, 21.02.2002**
Commission Decision of 19 February 2002 on minimum requirements for the certificate of destruction issued in accordance with Article 5(3) of Directive 2000/53/EC of the European Parliament and of the Council on end-of-life vehicles.

Decision 2001/753/EC- Official Journal L 282, 26.10.2001
Commission Decision of 17 October 2001, concerning a questionnaire for Member States' reports on the implementation of Directive 2000/53/EC of the European Parliament and of the Council on end-of-life vehicles.

5) FOLLOW-UP WORK

Last updated: 22.02.2002

Environmentally friendly end use equipment – proposal for an EuE Directive

The Commission is currently examining strategies as to how other policy areas can integrate environmental aspects. This proposal demonstrates how such integration can be achieved in practice.

The working paper contains an initial draft text for a directive which **harmonises requirements concerning the design of end use equipment to ensure the free movement of these products within the internal market, aiming to improve their overall impact on the environment**, and thus providing an efficient use of resources and a high level of environmental protection compatible with sustainable development.

The intention is to shape one framework directive by merging two initiatives - the EEE (impact on the environment of electrical and electronic equipment) and the EER (energy efficiency requirements) - on which previous consultations already took place.

A workshop on implementation issues of the EEE draft Directive took place on 21-22 February 2002.

An experts' meeting for life cycle data for eco-design of EEE took place on 9 October 2002.

A stakeholders' workshop on the EER draft Directive took place on 30 April 2002.

The working document aims at laying down one single framework for the setting of eco-design requirements and at providing the possibility for setting more detailed requirements.

This paper is intended to generate interest and feedback from stakeholders. Information concerning further developments relating to this proposal will be published on this website.

Working paper for a proposed DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL establishing a framework for Eco-design of End use Equipment

KEY ISSUES
WHAT'S NEW
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INDEX
INFORMATION
FEEDBACK

The European Commission would like to invite comments from all interested parties on the concepts which are described in this paper. Comments may be sent via e-mail to the following address:

Michail.Papadoyannakis@cec.eu.int OR Andre.Brisaer@cec.eu.int

Relevant comments will in principle be published here, unless the sender explicitly requests the comment not to be published. Anonymous comments will not be published. The Commission reserves the right not to publish comments which it receives.

The Commission analyses carefully the contributions to see whether and to what extent, the views expressed can be accomodated in the Commission proposal.

A stakeholders' meeting for discussing the initiative and the working paper took place on 18 November 2002. The issues presented and the comments discussed are available here.

Last update: 20/01/2003

Labelling household appliances

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1) OBJECTIVE

To harmonise national measures relating to the publication of information on the consumption of energy and of other essential resources by household appliances, thereby allowing consumers to choose appliances on the basis of their energy efficiency.

2) COMMUNITY MEASURES

Council Directive 92/75/EEC of 22 September 1992 on the indication by labelling and standard product information of the consumption of energy and other resources by household appliances.

3) CONTENTS

1. The Directive applies to the following types of household appliances, even where these are sold for non-household uses:

- refrigerators, freezers and their combinations;
- washing machines, dryers and their combinations;
- dishwashers;
- ovens;
- water heaters and hot-water storage appliances;
- lighting sources;
- air-conditioning appliances.

2. Household appliances offered for sale, hire or hire-purchase must be accompanied by a fiche and a label providing information relating to their consumption of energy (electrical or other) or of other essential resources.

3. The supplier must establish technical documentation sufficient to enable the accuracy of the information contained in the label and the fiche to be assessed. This documentation must include:

- a general description of the product;
- the results of design calculations, where necessary;
- test reports;
- where values are derived from those obtained for similar models, the same information for these models.

The supplier shall make this documentation available for inspection purposes for a period ending five years after the last product has been manufactured.

4. Suppliers must provide:

- a free label, to be attached to the appliance by the dealer in the appropriate position and in the appropriate language version;
- a product fiche, contained in all the brochures relating to the product or, where these are not provided, in all other literature provided with the appliance.

Suppliers are responsible for the accuracy of the information contained in the labels and fiches that they supply and are deemed to have given their consent to the publication of the information.

5. Where appliances are offered for sale, hire or hire-purchase by catalogue or by other means whereby the potential customer is unable to see the appliance displayed, the essential information contained in the label or fiche must be provided to the potential customer before purchase.

6. Information on airborne noise provided pursuant to Directive 86/594/EEC, and other public information relating to the appliance in question and provided pursuant to other Community legislation, must be included on the label or fiche.

7. Member States must take the necessary measures to:

- ensure that all suppliers and dealers established in their territory fulfil their obligations under this Directive;
- prohibit the display of labels, marks, symbols or inscriptions relating to energy consumption which do not comply with the requirements of this Directive and which are likely to cause confusion, with the exception of Community or national environmental labels;
- launch educational and promotional information campaigns aimed at encouraging more responsible use of energy by private consumers.

8. Where Member States have grounds for suspecting that the information contained in labels or fiches is incorrect, they may require suppliers to furnish evidence.

9. The Commission is assisted by an advisory committee.

10. The Directives adopted in implementation of the present Directive must specify:

- the exact definition of the type of appliances to be included;
- the measurement standards and methods to be used in obtaining the information relating to energy consumption;
- details of the technical documentation required;
- the design and content of the label;
- the location where the label shall be fixed to the appliance;
- the content and where appropriate the format of the fiche, on which must be included the information appearing on the label;
- the information details to be provided in the case of mail-order offers for sale.

11. This Directive cancels Directive 79/530/EEC. Directive 79/531/EEC is considered as implementing this Directive for electric ovens.

4) DEADLINE FOR IMPLEMENTATION OF THE LEGISLATION IN THE MEMBER STATES

01.07.1993

5) DATE OF ENTRY INTO FORCE (if different from above)6) REFERENCES

Official Journal L 297, 13.10.1992

7) FOLLOW-UP WORK8) COMMISSION IMPLEMENTING MEASURES

Directive 94/2/EC - **Official Journal L 45, 17.02.1994**
Commission Directive of 21 January 1994 implementing Council Directive 92/75/EEC with regard to energy labelling of household electric refrigerators, freezers and their combinations.

Directive 95/12/EC - **Official Journal L 136, 21.06.1995**
Commission Directive of 23 May 1995 implementing Council Directive 92/75/EEC with regard to energy labelling of household washing machines. Amended by Directive 96/89/EC - Official Journal L 388, 28.12.1996.

Directive 95/13/EC - **Official Journal L 136, 21.06.1995**
Commission Directive of 23 May 1995 implementing Council Directive 92/75/EEC with regard to energy labelling of household electric tumble dryers.

Directive 96/60/EC - **Official Journal L 266, 18.10.1996**
Commission Directive of 19 September 1996 implementing Council Directive 92/75/EEC with regard to energy labelling of household combined washer-dryers.

Directive 97/17/EC - **Official Journal L 118, 07.05.1997**

Commission Directive of 16 April 1997 implementing Council Directive 92/75/EEC with regard to energy labelling of household dishwashers.
Amended by the following measure:
Directive 1999/9/EC - **Official Journal L 56, 04.03.1999**

Directive 98/11/EC - **Official Journal L 71, 10.03.1998**
Commission Directive 98/11/EC of 27 January 1998 implementing Council Directive 92/75/EEC with regard to energy labelling of household lamps.

Energy efficiency: ENERGY STAR Programme

1) OBJECTIVE

To coordinate the labelling of energy-efficient office equipment using the "ENERGY STAR" logo.

2) ACT

Council Decision 2001/469/EC of 14 May 2001 concerning the conclusion on behalf of the European Community of the Agreement between the Government of the United States of America and the European Community on the coordination of energy-efficient labelling programs for office equipment [Official Journal L 172, 26.06.2001]

The detailed arrangements for implementing this Agreement at Community level have been put forward in:
Regulation (EC) No 2422/2001 of the European Parliament and of the Council of 6 November 2001 on a Community energy-efficient labelling programme for office equipment [Official Journal L 332, 15.12.2001]

3) SUMMARY

1. **Context**
Office equipment (personal computers, monitors, fax machines, scanners, copiers, printers, etc.) accounts for a large proportion of electricity consumption in the tertiary sector. In the context of the Community's international commitments, particularly in the area of climate change (notably the Kyoto Protocol), and given its objectives in such areas as sustainable development, the energy-efficiency initiatives take on special significance. The coordinated labelling programme (known as ENERGY STAR) will enable consumers to identify energy-efficient appliances and should therefore result in electricity

savings that will help not only to protect the environment but also to ensure the security of energy supply. The programme may also help to encourage the manufacture and sale of energy-efficient products.

EC-USA Agreement

2. **General provisions**
The Agreement, concluded for five years, sets up, between the United States and the Community, a common labelling programme for energy-efficient office equipment. ENERGY STAR is the name of the joint programme and logo and is a US-registered service mark owned by the United States Environmental Protection Agency (EPA).

3. **Participation in the programme**
Participation in the programme is voluntary, and the Agreement makes provision for manufacturers, vendors or resale agents of the products in question to register as participants in the programme and to be authorised to use the "ENERGY STAR" logo to identify their products, provided that these meet the requirements set out in Annex C to the Agreement (e.g. low-power "sleep" mode option for monitors). The Agreement basically covers the office equipment listed in the Annex thereto (monitors, computers and operating systems, but also fax machines, scanners, copiers and printers).

The products identified by the ENERGY STAR logo are tested at the participants' installations or by an independent testing laboratory. The management bodies designated by the two signatories may also test or examine products in order to verify whether they comply with the specifications set out in the Agreement.

4. **Management of the programme**
Each party designates a management body to be responsible for the management of the ENERGY STAR Programme: on the one hand, the United States Environmental Protection Agency (EPA) and, on the other, the Commission, which has assigned the task of setting and reviewing the technical specifications and of monitoring the application of the programme within the Community to an appropriate body, viz. the European Union Energy Star Board. This body, which is made up, in part, of national representatives, will advise and assist the Commission in the management of the programme.

The Agreement sets out guidelines on the proper use of the ENERGY STAR name. These guidelines cover not only the use of the logo as a label but also the use of the ENERGY STAR name in educational documents, advertisements, etc.

5. **Amendment and termination of the Agreement**
The parties are free to amend the Agreement (e.g. addition of a new item of equipment) by mutual agreement of the two management bodies. They may also terminate the Agreement at any time by giving three months' notice, in which case the European Community will no longer be able to use the ENERGY STAR mark, since it is the property of the EPA.

Community Regulation

6. **Objective**
The objective of the Regulation is to lay down the relevant rules for the

implementation of the above-mentioned Agreement in the European Community.

7. **Management at Community level**
The implementation of the ENERGY STAR Programme within the European Community is managed by the Commission, which has set up, for this purpose, a management body known as the European Union Energy Star Board (EUESB) (see point 4). The Regulation also provides for the participation of the various parties affected by the programme such as the manufacturers, retailers, environmental protection agencies, etc.

One year after the entry into force of this Regulation, and at twelve-monthly intervals thereafter, the EUESB will be required to submit a report on market penetration by products bearing the logo and on the technologies available for the reduction of energy consumption.

8. **Implementation**
Within six months of the entry into force of the Regulation, the Commission will adopt a Working Plan incorporating an implementation strategy for the subsequent three years. The Plan, which will be reviewed each year, will help in the elaboration of:

- energy efficiency improvements;
- a non-exhaustive list of office equipment products which should be considered as priorities for inclusion in the ENERGY STAR Programme;
- outline proposals concerning educational and promotional campaigns aimed at raising consumer awareness;
- proposals for coordination and cooperation between the Energy Star Programme and other voluntary energy labelling schemes (such as the Community eco-label).

One year after entry into force of the Regulation, the Member States must inform the Commission of the measures they have taken to comply with it.

9. **Assessment**
Before 15 January 2005 (date of renewal of the Agreement) the Commission will submit to the European Parliament and the Council a report assessing the energy efficiency of the office equipment market in the Community and the effectiveness of the ENERGY STAR Programme, and proposing, if necessary, complementary measures.

Act	Date of entry into force	Final date for implementation in the Member States
Regulation 2422/2001/EC	14.01.2001	-

4) IMPLEMENTING MEASURES

5) FOLLOW-UP WORK

Last updated: 11.01.2002

Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

on Waste Electrical and Electronic Equipment

and

on the restriction of the use of certain hazardous substances in electrical and electronic equipment

COM (2000)347

The European Commission has adopted a proposal for a Directive on Waste Electrical and Electronic Equipment (WEEE) and a proposal for a Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment. The proposed Directives are designed to tackle the fast increasing waste stream of electrical and electronic equipment and complements European Union measures on landfill and incineration of waste. Increased recycling of electrical and electronic equipment, in accordance with the requirements of the proposal for a WEEE Directive, will limit the total quantity of waste going to final disposal. Producers will be responsible for taking back and recycling electrical and electronic equipment. This will provide incentives to design electrical and electronic equipment in an environmentally more efficient way, which takes waste management aspects fully into account. Consumers will be able to return their equipment free of charge. In order to prevent the generation of hazardous waste, the proposal for a Directive on the restriction of the use of certain hazardous substances requires the substitution of various heavy metals and brominated flame retardants in new electrical and electronic equipment from 1 January 2008 onwards.

The press release and document are available by clicking the language icons below.

Press release

es da de el en fr it nl pt fi sv

Full text of the proposal

es da de el en fr it nl pt fi sv

(**pdf** ~340K)

Follow the progress of this proposal in the legislative process on the **Prelex database.**

last update: 04/03/2003

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ecospecifier

a guide to sourcing environmentally preferable materials

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project team

project details

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about ecospecifier

Welcome to EcoSpecifier. EcoSpecifier's aim is to help architects, designers, builders and specifiers shortcut the materials sourcing process. It's broader aim is to help create a more sustainable physical environment by increasing the use of environmentally preferable materials. EcoSpecifier is a joint initiative of the Centre for Design at RMIT, EcoRecycle Victoria and the Society for Responsible Design.

EcoMaterials- what and why?

life cycle context of materials

dealing with suppliers

trends among major suppliers

sponsors

ecospecifier fundamentals

The increased use of EcoMaterials is only one contribution towards developing sustainable outcomes. An over-emphasis on EcoMaterials can also be problematic when not considered as part of an overall suite of issues. It is vital to avoid evaluating any material in isolation of its life cycle impacts. Specifying most materials requires a judicious process of inquiry within the time, cost and knowledge constraints of practitioners.

information resources

publications

organisations

world wide web

salvaged/recovered materials suppliers

recycled plastic resins suppliers

sponsors

information resources

The following sources contain a variety of information related to EcoMaterials, ecodesign, sustainable architecture and building and Life Cycle Assessment. Contact us at ecospecifier@rmit.edu.au if you have suggestions for new inclusions, corrections or general feedback. We are particularly interested in sources of practical information that are readily accessible by designers, builders and specifiers in Australasia.

materials directory

This directory contains information about EcoMaterials that are commercially available in Australia. Its practical aim is to help architects, designers, builders and specifiers shortcut the materials sourcing process. Please ensure that you read the disclaimer. Contact us at ecospecifier@rmit.edu.au if you have suggestions for new inclusions, corrections or general feedback. We are particularly interested in hearing from suppliers about new materials.

composites

concrete/ masonry/plaster

finishes/ sealants/adhesives

glass

metals

plastics/rubber

reconstituted wood

textiles

miscellaneous

composites

composites

Boral Recycled Asphalt
Duroloid
Duroloid Bulletin Board
Marmoleum/Artoleum
Millennium

Boral Recycled Asphalt

Click here before Printing

Material / Product Description
A mixture of graded aggregates with a bitumin binder.

Applications
A variety of paving applications including roads, carparks and pedestrian walkways.

Claimed Environmental Improvements
Contingent upon the specific application, the product can contain up to 20% post-consumer recycled asphalt.

RECYCLED CONTENT, RECYCLABILITY & WASTE AVOIDANCE	
Contains post-consumer recycled content	✔
Contains industrial waste (that would otherwise be landfilled)	
Potential for extended material/product life	
Extended Producer Responsibility Scheme	
High potential for re-use	✔
Recyclable where collection scheme exists	
Packaging eliminated, reduced, reusable etc	
Potential for in-use low maintenance	
Uses materials in least processed state	
LOW TOXICS	
Substantially reduced off-gas/particulate emissions	
Low/non-toxic alternative treatments	
Non-toxic emissions from production process	
No listed carcinogens emitted during production	
Low impact disposal when discarded	
REDUCED GREENHOUSE RELATED IMPACTS	
Reduced Greenhouse or energy impacts	

Potential for reduced energy consumption during use	
Low energy use during processing/production	
SUSTAINABLE SOURCES, BY-PRODUCTS, BIODEGRADABILITY	
Contains agricultural by-products	
Uses abundantly available raw materials	
Uses materials from sustainable sources	
Advanced levels of biodegradability	
OTHER VITAL SIGNS	
Material safety data sheets	
Environment policy	
Environmental product information available	
Environmental claims independently verified	
Ecolabels, awards & other relevant accreditation	
ISO 14000/EMAS accredited	
Complies with relevant Australian Standards	✔

SUPPLIER

Boral Asphalt
15 Powers Road Seven Hills
NSW 2147
Telephone:(02) 8801 2000
Facsimile:(03) 8801 2011
Website: http://www.boral.com.au

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Duroloid

Click here before Printing

Material / Product Description
A linoleum finishing product. Available in 32 metre rolls, or cut to length.

Applications
Developed for use on desks, table tops, counters, bars, walls, partitions and doors.

Claimed Environmental Improvements
Manufactured from natural, renewable materials, and is biodegradable at the end of its life.

RECYCLED CONTENT, RECYCLABILITY & WASTE AVOIDANCE	
Contains post-consumer recycled content	
Contains industrial waste (that would otherwise be landfilled)	
Potential for extended material/product life	
Extended Producer Responsibility Scheme	
High potential for re-use	
Recyclable where collection scheme exists	
Packaging eliminated, reduced, reusable etc	
Potential for in-use low maintenance	✓
Uses materials in least processed state	
LOW TOXICS	
Substantially reduced off-gas/particulate emissions	✓
Low/non-toxic alternative treatments	
Non-toxic emissions from production process	
No listed carcinogens emitted during production	
Low impact disposal when discarded	✓
REDUCED GREENHOUSE RELATED IMPACTS	
Reduced Greenhouse or energy impacts	
Potential for reduced energy consumption during use	

Low energy use during processing/production	✓
SUSTAINABLE SOURCES, BY-PRODUCTS, BIODEGRADABILITY	
Contains agricultural by-products	
Uses abundantly available raw materials	✓
Uses materials from sustainable sources	✓
Advanced levels of biodegradability	✓
OTHER VITAL SIGNS	
Material safety data sheets	
Environment policy	✓
Environmental product information available	✓
Environmental claims independently verified	
Ecolabels, awards & other relevant accreditation	
ISO 14000/EMAS accredited	✓
Complies with relevant Australian Standards	

SUPPLIER

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VIC 3189
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Facsimile: (03) 9553 2131
E-mail: gryan@iaccess.com.au

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Duroloid Bulletin Board

Click here before Printing

Material / Product Description
A uni-coloured linoleum with very high cork content, both functional and decorative. Also provides thermal and noise insulation.

Applications
Suitable for offices, schools and residential spaces as bulletin boards. Can be integrated with office furniture. Not suitable for exterior use.

Claimed Environmental Improvements
The board is produced from 100% natural materials.

RECYCLED CONTENT, RECYCLABILITY & WASTE AVOIDANCE	
Contains post-consumer recycled content	✔
Contains industrial waste (that would otherwise be landfilled)	✔
Potential for extended material/product life	
Extended Producer Responsibility Scheme	✔
High potential for re-use	
Recyclable where collection scheme exists	✔
Packaging eliminated, reduced, reusable etc	
Potential for in-use low maintenance	✔
Uses materials in least processed state	
LOW TOXICS	
Substantially reduced off-gas/particulate emissions	✔
Low/non-toxic alternative treatments	
Non-toxic emissions from production process	
No listed carcinogens emitted during production	
Low impact disposal when discarded	
REDUCED GREENHOUSE RELATED IMPACTS	
Reduced Greenhouse or energy impacts	

Potential for reduced energy consumption during use	✓
Low energy use during processing/production	
SUSTAINABLE SOURCES, BY-PRODUCTS, BIODEGRADABILITY	
Contains agricultural by-products	
Uses abundantly available raw materials	
Uses materials from sustainable sources	
Advanced levels of biodegradability	
OTHER VITAL SIGNS	
Material safety data sheets	✓
Environment policy	✓
Environmental product information available	✓
Environmental claims independently verified	
Ecolabels, awards & other relevant accreditation	✓
ISO 14000/EMAS accredited	
Complies with relevant Australian Standards	✓

SUPPLIER

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Facsimile: 02 9674 8345
Toll Free: 1800 066 319
E-mail: molly@iaccess.com.au

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Marmoleum/Artoleum

Click here before Printing

Material / Product Description
Linoleum floor covering, available in both sheet and tiles, in a wide range of colours and patterns.

Applications
Its durability and long lifespan make it suitable for educational, health and commercial applications, as well as for residential use.

Claimed Environmental Improvements
Composed of abundant/sustainable natural materials, the product has been optimised for improved environmental performance throughout its entire lifecycle.

RECYCLED CONTENT, RECYCLABILITY & WASTE AVOIDANCE	
Contains post-consumer recycled content	
Contains industrial waste (that would otherwise be landfilled)	
Potential for extended material/product life	✔
Extended Producer Responsibility Scheme	
High potential for re-use	
Recyclable where collection scheme exists	
Packaging eliminated, reduced, reusable etc	
Potential for in-use low maintenance	
Uses materials in least processed state	
LOW TOXICS	
Substantially reduced off-gas/particulate emissions	✔
Low/non-toxic alternative treatments	
Non-toxic emissions from production process	
No listed carcinogens emitted during production	
Low impact disposal when discarded	✔
REDUCED GREENHOUSE RELATED IMPACTS	
Reduced Greenhouse or energy impacts	

Potential for reduced energy consumption during use	
Low energy use during processing/production	
SUSTAINABLE SOURCES, BY-PRODUCTS, BIODEGRADABILITY	
Contains agricultural by-products	
Uses abundantly available raw materials	✓
Uses materials from sustainable sources	✓
Advanced levels of biodegradability	✓
OTHER VITAL SIGNS	
Material safety data sheets	✓
Environment policy	✓
Environmental product information available	✓
Environmental claims independently verified	✓
Ecolabels, awards & other relevant accreditation	✓
ISO 14000/EMAS accredited	✓
Complies with relevant Australian Standards	

SUPPLIER

Forbo Floorcoverings
15 Ferndell Street Chester Hill
NSW 2162
Telephone:(02) 9738 4848
Facsimile:(02) 9645 4270
Website: http://www.forbo-krommenie.com

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Millennium

Click here before Printing

Material / Product Description
A linoleum sheet surface. Available in a range of colours, in rolls of approximately 14-17 lineal metres, or cut to length.

Applications
Suited for use on desks, counters, bar and table tops, walls, partitions and doors.

Claimed Environmental Improvements
Manufactured from natural, renewables materials, and is biodegradable at the end of its life.

RECYCLED CONTENT, RECYCLABILITY & WASTE AVOIDANCE	
Contains post-consumer recycled content	
Contains industrial waste (that would otherwise be landfilled)	
Potential for extended material/product life	
Extended Producer Responsibility Scheme	
High potential for re-use	
Recyclable where collection scheme exists	
Packaging eliminated, reduced, reusable etc	
Potential for in-use low maintenance	✓
Uses materials in least processed state	
LOW TOXICS	
Substantially reduced off-gas/particulate emissions	✓
Low/non-toxic alternative treatments	
Non-toxic emissions from production process	
No listed carcinogens emitted during production	
Low impact disposal when discarded	✓
REDUCED GREENHOUSE RELATED IMPACTS	
Reduced Greenhouse or energy impacts	

Potential for reduced energy consumption during use	
Low energy use during processing/production	✓
SUSTAINABLE SOURCES, BY-PRODUCTS, BIODEGRADABILITY	
Contains agricultural by-products	
Uses abundantly available raw materials	✓
Uses materials from sustainable sources	✓
Advanced levels of biodegradability	✓
OTHER VITAL SIGNS	
Material safety data sheets	
Environment policy	✓
Environmental product information available	✓
Environmental claims independently verified	
Ecolabels, awards & other relevant accreditation	
ISO 14000/EMAS accredited	✓
Complies with relevant Australian Standards	

SUPPLIER

Duroloid Pty Ltd
236 Wickham Road Moorabbin
VIC 3189
Telephone:(03) 9555 9921
Facsimile:(03) 9553 2131
E-mail: gryan@iaccess.com.au

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concrete masonry plaster

Australian Mud Bricks
Blast Furnace (BF) Slag Concrete Aggregate
Boral Plasterboard
Boral Envirocrete
Boral Recycled Roadbase
Boral Rollpave
Coal Ash Aggregate
CSR Hebel AAC Blocks,Panels & Lintels
Earthbricks
Georgica Earthbricks
Gyprock Fibre Cement
HardiPanel Compressed

finishes sealants, adhesives

Aquapro (Matt Finish)
BIO Ceramic Tile Adhesive
BIO Cork Adhesive
BIO Enamel Lacquer
BIO Natural Oils
BIO Paint Stripper
BIO Varnishes
BIO Wall Paint HD
Ceratech Radiation Control Coating
Citristrip
Colour Coat
Cork Flooring
Gripcore Sheets and Gripset Range
Keim Mineral Paints
Laminex - High Pressure Laminate
Living Proof Paint
Livos Dubron Natural Wall Paint
Livos Kunos Natural Oil Sealer
Murobond Aqua Glaze
Murobond Cement Paint
Murobond Pentimento Limewash
Murowash
Organoil Timber Finishes
Paint Odour Eliminator
Porter's Milk Paint
Porter's Original Distemper
Procor 75
Ready Floor
Solarfoil
Soyplex Form Release Oil
Taubmans Bristol
Tech-Dry Earth Bonding Emulstion
Xpex

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glass

Canterbury Windows
CertainTeed
PPG Azurlite
Smart Glass
Solarglass (using PPG Azurlite & Sungate 500)
Tyrol Windows
Velux Skylights

metals

metals

Aluminium Concertina Foil Batts
Aluminium Sunscreen Louvre Systems
Crane Enfield Metals Aluminium Extrusions
G James Recycled Aluminium Extrusions
JWI Sunshield Louvres
King Slide Product No. 8103-***2-ESA
Kleenflo Divertor Valve Filter
Ronstan Architectural Rigging Systems
Silver Batts
Smartflo Guttering System
Solar Mesh
Solartube
Termi-mesh
Western's Home Ventilators

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Atlantis Drainage Cells
Atlantis Ecological Tanks
Atlantis EcoPave
Atlantis GrassPave
Atlantis Strip Filter Drain
Atlantis Wall Drainage
Autex Insulation
Concrete Underlay
Dunlop Carpet Underlay
Ecoflex Wall Systems
Flexitec Bobble Pave
Flexitec Drainage Paver
Flexitec Fallsafe Pavers
Flexitec Playground Safety Edge
Flexitec Solid Paver
Flexitec Stable Mats
Freudenberg Ecoplan & Ecoment Rubber Floorcovering
Fusiontherm Pipe System
Gem Plastics Concrete Underlay
Gem Plastics Damp Course
Gem Plastics Handy Rolls
Horizontal Drainage Cell
Impactamat
IPS Polyethylene and Nylon Pipes and Fittings
Megaflow Panel Drain
PolyDrain
Polyester Insulation
Proflex Rubber Flooring
Recoplas
Regupol Equine Rubber Safety Surfaces
Regupol Everlast Recycled Rubber Flooring
Regupol Impact Sound Absorbing Underlay
Regupol Pavers
Reln Effluent Drain
Reln Plastic Septic Tank
Reln Stormwater Collection and Distribution Pits
Reln Surface Water Drainage Grate
Replas Products
Rib Loc Series 2000 Stormwater Drainage Pipe
Rib Loc Series 2000 Low Head Irrigation Pipe
Rib Loc Series 2000 Sub-Surface Drainage Pipe

Skylight Tiles
Specialised Rubber Services Flooring System
Sprinkle Edges
Stan-stat
Stormflex Pipe
Stratum Jeune
Stratum Path
Stratum Plus
Tred-Safe
Triangle Electrical Cabling
Tyrex™ Playcare
Tyrex™ WorkerCare
Tyrex™ CustomCare
Unimould
Visy Plastics
Water Divertor
Wharington RECOPOL™
Winter Windows

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recons wood tituted

- Bamboo Floors
- Bamboo Flooring & Lining Boards
- BT Bamboo
- Building Bitz
- Certified F.S.C Timber
- Crosstrack flooring
- Easiboard
- Enviroven
- Golden Cypress (Cypress Macrocarpa)
- Joinex
- Joinex Window Joinery
- 'Preserve with ACQ' treated timber
- Radially Sawn Timber
- Recycled Timber
- Rescued Timber
- Resource Tipshop
- Tanalith E Treated Timber
- Uniclic - laminate flooring
- Urban Salvage Recycled Tmbers
- Wonder Board
- Wunderlay Natural Timber Floor

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textiles

textiles

Bidim Geofabric
Carpet Tile
Carpet Underlay
Earth Plus Modular Carpet Tiles
Echo Screen
Eco BATTs
Envisions Carpet
Floorspace Coir
Floorspace Seagrass
Floorspace Sisal
Higgins Insulation
Homfrey Hycroft carpet
Macquarie Fabrics Collection
Natural Fibre Underfelt
Natural Floorcovering Centre Coir, Sisal and Seagrass
Play It Again Sam
Raw Cloth
Rebtex Sisal
Redux Collection
Smith Family Carpet Underlay
Swewi Leather
Thermowool
True-Blue Carpet Underlay
Volclay Voltex
William McDonough Collection
Woolmark or Fernmark Carpets

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miscellaneous

4 Seasons Cellulose Insulation
Battmans Natural Insulation
Celltherm
Eco Pebbles
Energymasta Cellulose Insulation
Envirospray 300
GranitgardTM
Solomit Strawboard Panels
Stratica
Thermospray 800
Woolcell Bulk Insulation

Process

Examples

Designing a Winter Coat

Designing a Competition Logo

Designing a *Smart* Interior

Process

It is important not to underestimate the value of questions. Questions beg responses—they expand the parameters of knowledge expectation which in sustainable design is critical. Each stage in this guide comprises of a set of design directives and/or questions that you should follow and answer as best as you can. You will need to do research in order to answer some of these questions, but you will also find that as you work through the stages assembling a detailed 'picture' of your product, you will be able to respond to previous questions more fully. You will find interesting links throughout the text on a variety of topics that will assist you with your research. You will encounter some repetition—this is to help you keep certain issues in mind, or to help you look at the same problem from another angle. There are also some terms used that you might not recognise—these are left undefined to encourage you to discover what they mean. The Resources section at the end will help you.

Each stage in this Guide is in sequential order, but as you move through the stages, you will be referring back to earlier stages, slowly building up a relational picture of your product: what it could or should be, what it could or should do, who it is for, its lifespan and subsequent lives, its environmental impacts across its life cycle, its contributions to sustainability.

Note: It is envisaged that all the following tasks be done in a (hardcopy or electronic) scrap book, that can be kept as a design archive for future reference. After completing each stage, it is worth reflecting on what you have learnt and how it might specifically modify your design. One way of doing this might be to create a running schematic of your product and notate modifications as you go. In Stage 10 you are also asked summarise an audit of your design process. This is a self-diagnostic exercise, designed to help you recognise the material and energy impacts associated with your work process. At this point, it simply entails keeping a log of the material and energy 'inputs' and 'outputs' your work process generates, ie in your use of room, computer, transport, paper, pens, over-head or task lighting and heating over a particular time frame (for example, the length of time it takes you to do a Stage of this guide). See Stage 10 for further on the process audit.

Go to the Guide to begin the design stages.

Look at the Examples on the left to get an idea of how the Guide can be applied to specific projects.

Designing a Winter Coat

Your task is to design a winter coat. Here are just some of the relations to think about as you are designing.

Firstly it's about you.
What you have worn, what you have seen, what you have liked and disliked. You think about why you are designing a coat, what kind of coat is needed. These first thoughts are important. You are recognising where your design comes from (as we have elsewhere noted, no idea drops without precedent from the sky). You are also recognising that your design(ing) is an extension of you and says something about you as a designer.

It's also about what you perceive is expected of you.
Your imagination is constrained by the material, cultural and symbolic conditions of your work. Are you an established designer with a given clientele, are you a design student who has been encouraged to experiment with the whole idea of 'coat', are you an experienced dressmaker wanting to make a coat as a gift for a friend? How do you negotiate these conditions?

Then it's about what you create...
Materially. The coming together of the inherent qualities, feel and look of a fabric with the shape of the coat, who the wearer is, what he or she does circle in your mind. What are the material requirements for this coat? Where are the materials you want to use to make the coat from, how are they made, what kinds of environmental impacts that will stem from their manufacture? Will they need to be dyed or bleached? What alternative, less environmentally impacting materials have you considered, and why have you rejected them? How are the materials you have chosen best looked after? How do they wear? Do they have water resistant qualities? Can your coat be worn in light rain, is it comfortable to work in, will it need to be sustained by special cleaning solvents or processes? Can these be avoided? Will it need zips, velcro, buttons, pop studs, care labels, waterproofing agents? Can your design be simpler?
Socially. Who will make your coat – will it be made in conditions of safety, security and appropriate pay? What ancillary products will be needed to make the coat, and will those involved in making the garment be harmed in any way indirectly by the inputs and outputs of the manufacturing processes your design has generated? Will the makers of your coat themselves have access to your coat?
Symbolically. By designing a winter coat, you are adding to that imaginary catalogue of winter coats carried around in people's minds. Future designers will learn from what you have designed and what your design means. Coat wearers will learn from it too. Is your coat made for instant impressions or is it also introspective, styled for long life and comfort? Will your coat, some years down the track, pleasantly surprise its wearer (who has grown used to poorly made coats) with its extraordinary quality and resilience?

For more to think about in relation to designing clothing:
Read Elaine Scarry's book *Body in Pain: Making and Unmaking of the World Oxford*: Oxford University Press 1985 (particularly the chapter 'Interior Structure of the Artifact').
Society for Responsible Design's 'sustainable apparel' checklist.
Interesting papers on clothing care are available at the SusHouse project, a European research project concerned with developing and evaluating scenarios for transitions to sustainable households.
Look at the events page of the O2 International Design Network.
For material on the social impacts of the fashion industry check out Naomi Klein's NoLogo.

"... promoting the value of design towards a sustainable future."

SRD - Society for Responsible Design

SRD - Sustainably Responsible Designers

PO Box 288 Leichhardt NSW 2040 Sydney - Australia
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International, Phone : +612 0500 589 500 .... Fax : +612 9385 4151

Combining efforts of society and industry through environmentally and socially responsible design practices to make products and services significantly better. There is much room for improvement that will ultimately provide major long term benefits for all. YOUR support and input is invited.

Designers today face the challenge of considering the lifelong impact of the products and processes they bring into being. Responsibility extends well beyond the time a product is used. Designers have to view the entire history of a product from materials extraction, through manufacture, transportation, sales, use, and post-use.
They need to consider the materials used, are they recycled, can they be recycled, will they decompose, be reused, are they toxic in manufacture, use or afterlife? Is the product useful, does it fulfil a real need, is it robust and durable, easy to repair, use the least amount of materials for the most performance? Does it generate pollution, is it energy efficient, is the least amount of packaging used to transport and display the product? Is the styling going to date too quickly, can the product be upgraded easily as technology improves, at the end of a useful life can components be salvaged for use in newer version?

Sustainable Responsible Design is a new direction that requires complete revision of thought and of action. The many questions raised however will only stimulate the number and sophistication of long term solutions through innovative design and problem solving processes.

Those not involved directly with design still have a huge opportunity for input. Starting with demanding better products and services to actually making a difference in and around their own home or office. Knowledge of the issues is the first step.

The Society for Responsible Design is a not-for-profit, volunteer run organisation who aims to provide some of the answers to those many questions. NB; this site is being redesigned. **SEND** website feedback and input for your design sector to: designoz@ihug.com.au

... CLICK the SRD Logos for a SITE TOUR

Email us at : **srd@green.net.au**

SRD Aims and Objectives

The aim of the SRD is to work towards a sustainable future through environmentally and socially responsible design practices

Our combined objectives are:

- To promote and disseminate **information** on responsible design among all designers, manufacturers and end users.
- To foster a **market** for environmentally responsible products and services.
- To work towards sustainability by assisting industry to **accept** and implement environmentally and socially responsible manufacturing and marketing practices.
- To establish an information **resource** and provide a forum for the exchange of information on responsible design.

- To promote the **evaluation** of the social, environmental and economic impact of design particularly in Australia.
- To **liaise** with and advise government agencies, professional associations, environmental groups, community groups and industry associations.
- To establish a skills bank which will make available to the larger community, the services and **expertise** of members for advice and practical assistance.

The SRD is active in all design disciplines including ;
Apparel, Architecture, Art, Building, Engineering, Exhibition, Furniture, Graphic,
Industrial, Interior, Landscape, Packaging, Permaculture, Pest Management, Product, Textile ...

SRD Initiatives

SRD Talks and Tours
An informative series of talks and excursions, where presenters discuss and display their real world experiences in bringing innovative sustainable and social design projects to market.
Topics have encompassed a wide range of design sectors from graphics, landscaping, textiles, commercial interiors and residential buildings to sites of re-manufacture facilities, alternative lifestyles in practice and the topics of water, child playgrounds, disabled and indigenous issues. See News & Events

EcoInfoBank
A database of all the information on green design products and services we have gathered over the past thirteen years.
Both computer and hardcopy based. This project has much scope for expansion and discussions are in progress to achieve this.

EcoSpecifier - http://ecospecifier.rmit.edu.au
A guide to sourcing environmentally preferable materials, complete in printed form and on the web (reduced info. version)
Produced in conjunction with RMIT. Principal sponsor: EcoRecycle Victoria.

Website
A resource that's also in development and expansion mode. Your participation, input and feedback is invited.
See item in News & Events "THE SRD SITE ...".

EcoDwell
A pictorial journal with tips for us all. A new webpage ecodwell.html describing the process of trying to incorporate sustainable concepts into a complete terrace renovation.

E-News
... on sustainable responsible design, local and international. Information and articles with the latest developments plus summaries of SRD public talks and Tours. Backcopies of our Loose Leaves newsletter are also available.

SkillsBank
A register of SRD members; designers and related businesses, in the many different fields of design that the SRD represents.
It lists their spheres of expertise and knowledge and is used for the many referrals received through the SRD office.

MADE Accountable Exhibition & Catalogue
Australia's largest public exhibition of Materials from Art and Design for the Environment, held at a recycled wharf building in September 1995. The catalogue of over 50 exhibitors at M.A.D.E. Descriptions of products, contact details and photographs and introductory design essays. Remains the first list of responsible Australian design.

Out and About
The SRD promotes responsible design through public events like Commonwealth Bank Home Show, World Environment Days and recycling days, amongst others.

Membership ... with the SRD has many benefits for you.

INDIVIDUAL

- **Supports** the continuation of a valuable organisation to promote the best design ideals and practices
- **E-News**. Contains transcripts of recent SRD Public Talks, articles on responsible environmental and social design, news on what is happening in green design from around NSW, Australia and the world. Delivery via this site and email.

- Notice of, and **discounts at SRD Talks and Events** which bring together challenging speakers on eco-design.
- Potential new customers via the **referral service** that SRD offers through our **SkillsBank**.
- **Information** on the growing range of green products/services in our **EcoInfoBank**.
- The valuable **networking** opportunities.

One year Concession membership ... $25
One year Individual membership $60
Two year Individual membership $100
Individual Life membership $500

. . . . . .

CORPORATE

Membership with the SRD has all the above benefits, with the addition of:

- **Recognition** in E-News **and** also on our **Website** Corporate Sponsors page. (see Sponsors)
- **Multiple** copies of our brochures / newsletters to distribute throughout your organisation.
- **Discounts** (for you & your staff) at SRD Talks.

One year Small business membership (1-10 persons) $150
One year Standard Corporate membership (10+ persons) ... $300
One year Sustaining Corporate membership ..... $500 (extra donation optional)

* All corporate, some individual membership and all donations over $2 are tax deductible.
* GST does not apply to our membership or donations and therefore is not included.

Click Here for our Membership Form

The EcoDesign Guidelines (Green Ink, Loose Threads, Inner Harmony) are by no means a definitive list, rather a discussion starter. Please contribute your own thoughts and suggestions via email.

- GREEN INK - GREEN VISION -
Responsible Graphic Designers :

SRD Home

Here are many ideas to consider that can reduce your environmental impact and achieve better practice.
We welcome input from all related Visual fields to increase the body and value of ideas for all to benefit:

- **Strive to create the greatest visual impact with the least environmental impact**
Achieving clients needs while limiting potential ecological damage
- **Encourage their clients to consider the environmental impact of their production**
Educated clients are more willing to undertake ecologically sound projects
- **Consider the use of tree free paper stock such as sugar cane waste, straw, seaweed, algae and hemp**
Alternative renewable paper sources can reduce need for wood pulp from old growth forests
- **Consider the use of Recycled paper stock with a high Post Consumer Recycled (PCR) content**
Clean mill waste has always been recycled so it is better to keep consumer paper out of landfill
- **Consider the use of recycled paper stock that has not been de-inked**
De-inking is a energy expensive process which still results in toxic waste ink
- **Consider the use of unbleached or non chlorine bleached paper stock**
Bleached paper requires the use of toxins which are harmful to marine and water based life
- **Consider the use of vegetable based printing inks such as soy inks**
Vegetable based inks are renewable and emit less toxic Volatile Organic Compounds (VOCs)

- **Avoid the use of ink colours which contain high levels of heavy metals such as copper, chrome, etc.**
  Many bright colours contain heavy metals which leach into ground water when landfilled

- **Avoid overuse of gloss paper stock, because more exists than can be de-inked and recycled**
  In some areas there is a glut of gloss paper because satin or matt paper is used less
- **Avoid overuse of plastic films, foil stampings, metallic colours and synthetic adhesives**
  Some synthetics have a life of 200-500 years after they have been disposed of in landfills
- **Avoid over use of perfect bound or spiral bound spines as they are difficult to recycle**
  The glues and metals in such binding impede cost effective recycling
- **Avoid 'bleeds' that are then trimmed and must be de-inked before recycling**
  Ink extended beyond trim marks requires more intensive recycling than ink within trim marks

- **Consider the smallest paper size suitable for each job, ie A5 instead of A4**
  Less paper used means less energy expended and should also be cheaper for client
- **Use paper sizes and number of pages that best fit standard sheet stocks without wasteful trimming**
  Printers can advise on best use of sheet stock for less paper wastage and more price savings
- **Use the least amount of ink colours for the job, ie 2 colour output instead of 4 colour**
  The greater the number of inks the more cleaning fluids required for the presses = greater cost
- **Avoid using too much ink in their designs**
  More ink means more difficult de-inking or greater toxic residue leaching into groundwater

- **Consider using filmless and plateless digital printing technology for small run jobs**
  Modern printing technology can reduce amount of plastics, metals and inks used for printing
- **Use computer equipment which has energy saver features**
  Energy saver equipment shuts down when not is use saving burden on non-renewable fossil fuels
- **Use the back side of other sheets to proof their work from inkjet printers**
  Increases by double the life span of office paper. Be careful with lasers as toner can adhere to the drum.
- **Avoid overpackaging, ie postcard for mailing instead of envelope and letter**
  Follows credo of REDUCE, avoids unnecessary paper waste and expense

- **Use the recycled logo or other devices to promote the recycled nature of their production>**
  Customers and Users need to have the opportunity to know they are purchasing recycled goods
- **Promote design responsibility by printing PCR content, ink and bleaching type on their work**
  Customers & Users educated by one product will look for the same credentials in other other products
- **Specify that the windows on business envelopes be of recyclable cellulosic content**
  Cellulose based windows can be recycled as paper or easily composted, plastic cannot
- **Keep informed of the latest environmental developments in inks, papers and printing processes**
  New technologies and rediscoveries of old techniques for green design are occurring constantly

(To implement all the above ideas may be impossible - yet every suggestion adopted will make a difference.)

http://www.earthdesign.com.au/enviro - Earth Graphic Design

- From one of SRD's Corporate Members comes this fast loading, easy-to-follow web site with plenty of substance. Has separate pages for ink, paper, chemicals, function, and recycling. Combined with links to other interesting and related sites, around the globe.

http://www.commarts.com/resource/res_eco.html - Communication Arts Journal

- This URL will take you to EcoOnline, dedicated to helping the design community, their clients and associates unravel the perplexing and often conflicting facts about our profession's impact on the environment . In ECO Columns read articles by our Eco experts to help designers make environmentally-responsible decisions. ECO Resources Has all the News, ideas, links and book reviews for the environmentally-aware designer. ECO Papers Is a US based guide to the best recycled and tree-free papers and a list of terms to help steer you through the maze of acronyms.

http://www.cfsd.org.uk - Environmental Issues in Visual Communications Design

- The Centre for Sustainable Design held this conference on 27 March, 1996. It is possible to download details on three of the

workshops that were held there: 1. Briefing Designers on the Corporate Environmental Report, 2. A Green Checklist for Designers and Printers, 3. Communicating Innovative Environmental Solutions.

- FASHIONED THREADS -
Responsible Apparel Designers :

SRD Home

Here are many ideas to consider that can reduce your environmental impact and achieve better practice.
We welcome input from all related Apparel fields to increase the body and value of ideas for all to benefit:

- **Aim to make long lasting clothing**
  - The more durable a garment the greater the timespan before replacement is needed, less resources are used
- **Strive to design clothing with classic lines**
  - Fashion styles are transient fads which require constant redundancy, classic styling equals a long life
- **Consider the use of recycled materials with a high Post Consumer Recycled (PCR) content**
  - PET drink bottles recycled into polyester yarns, charity shop discards shredded to make new yarn, rubber tyres into shoe soles
- **Consider the use of natural renewable materials**
  - Fibres like Cotton, Wool and Silk are renewable unlike virgin synthetics which are a by-product of non renewable fossil fuel extraction
- **Consider the use of unbleached materials**
  - Bleaching requires the use of toxins which are harmful to marine and water based life
- **Consider the use of chemical free natural materials**
  - Cotton, for example, is often processed using toxic formaldehyde to reduce shrinkage and wrinkling
- **Consider the use of undyed materials**
  - Many dyes leach heavy metals into groundwater and waterways during production, home washing and landfill disposal
- **Consider the use of naturally coloured materials**
  - Green and Brown cotton can grown without dyeing, Wool can be naturally black, grey, brown, fawn and ecru.
- **Consider wherever possible using organic materials**
  - Organic fibres are grown without the heavy use of potentially toxic synthetic insecticides, herbicides and fertiliser
- **Consider the use of natural renewable components**
  - Buttons and Jewellery can be made from Tagua nuts from the Amazon rainforest. Plantation wood buttons as well.
- **Consider the use of recycled and/or recyclable components**
  - Recycled PET cords, labels, webbings and 100% polyester recyclable zippers. Also recycled glass as buttons & toggles
- **Investigate alternative fibre sources**
  - Hemp can be grown organically and has the strength of polyester, Tencel is plantation pulp extruded through a recycled solvent process
- **Maximise fabric yields and minimise fabric wastage by carefully checking layplans & garment Design**
  - Extravagant pattern shapes can lead to a high amount of unwanted material which is then thrown away
- **Consider laying up with cardboard patterns instead of using computer generated layplan paper Computer Aid**
  - Manufacture needs new throwaway paper plans every time a new cut is done, cardboard can be used over & over
- **Design functional garments**
  - Pockets that can actually be used and are not for affect, ornamental components avoided , sized for comfort not vanity, etc.
- **Use synthetic dyes which are colourfast or completely biodegradable if natural based dyes**
  - Coloured dyes can leach out during fabric/garment dyeing and washing contaminating waterways
- **If using synthetic materials consider using homogeneous (all the same) materials**
  - For example some garments are 100% polyester, including labels, trims and thread so they can be recycled without contaminants
- **If using natural materials consider using all naturals**
  - It should be possible to compost 100% natural garments, especially unbleached, organic materials, after their long useful life
- **Ask their material suppliers to provide a comprehensive background on the fabrics and trim**

- Exhibiting interest in the technical and environmental history of a suppliers materials keeps them aware of their products shortcomings

- **Provide concise information on material content and care/laundering on permanent garment labelling**
  - Educated customers will value their garments and treat them with respect which will lead to longer useful garment life.

- **Avoid use of materials or construction detailing that requires special laundering**
  - Dry-cleaning, for example, is an expensive process which uses toxic solvents, such as hydrocarbons which are linked to ozone depletion
- **Educate both retail and end use customers on the environmental benefits of their designs**
  - Customers once educated will demand, or at least expect, the same high environmental standards from other garment designers
- **Investigate methods of reducing materials waste in the production process**
  - Short roll ends can be sold to staff, clean cutting scraps given to Reverse Garbage for school projects, natural fabric scraps composted
- **Keep informed of the latest environmental developments in materials, components and manufacture**
  - New technologies and rediscoveries of old techniques for green design are occurring constantly

(To implement all the above ideas may be impossible - yet every suggestion adopted will make a difference.)

http://www.conservation.org/ - Conservation Initiative

Enterprise promoting the commercial use of Amazonian rainforest products to keep indigenous tribes actively employed without destroying their forests. Promotes the use of ivory like Tagua nuts for jewellery and buttons and Treetap Vegetal, a natural latex rubber replacement from vinyl or leather.

http://www.maudnlil.com.au - Maud n Lil

Sydney based designers of clothing and toys from organic cotton. Easy to follow web site with organic facts and links to other organic cotton sites.

http://www.hemptech.com/ - Hemptech

A worldwide communication network on industrial hemp. Publishes books and reports, as well as providing consulting and other information services to the growing hemp industry. The Industrial Hemp Information Network

http://www.iatp.org - Institute for Agriculture and Trade Policy

Home page for the Institute for Agriculture and Trade Policy. It promotes resilient family farms, rural communities and ecosystems around the world through research and education, science and technology, and advocacy. A search feature provides many articles on cotton, etc.

ncbe@ncbe.co.uk -Textile Environment Network.

An international group of designers working in fibres, fabrics, finishes and products who are concerned about the environmental impact of the traditional textile industry

hemp.net@f701.n280.z2.fidonet.org - International Hemp Association

A nonprofit organisation established to promote the beneficial uses of hemp products worldwide. The IHA has sponsored programmes in Russia, China, Hungary and the Netherlands. The programmes centre around the themes of germplasm collection and conservation, hemp fibre identification, hemp product quality control.

http://www.patagonia.com - Patagonia

US based outdoor clothing company (with Australian stores) who have helped pioneer mainstream apparel from recycled PET drink bottles and from organic cotton. Great website with lots of information of environmental aspects of their products.

- INNER HARMONY -
Responsible Interior Designers

SRD Home

Here are many ideas to consider that can reduce your environmental impact and achieve better practice.
We welcome input from all related Design fields to increase the body and value of ideas for all to benefit:

- **Use all materials sparingly, particularly non-renewable resources**
  Old growth timbers, metals and precious stone are finite resources, for which better alternatives exist.
- **Select materials from renewable resources or recycled sources**
  Recycled materials are now more available, as are renewable materials like straw based particle boards.
- **Consider the offgassing properties of some materials**
  Formaldehydes in boards/textiles, benzene and toluene in paints can increase indoor air pollution.
- **Use products and furnishings which have considered their life cycle impact**
  Look at Picto and Aeon office chairs can be disassembled for recycling, keeping them out of landfill.

- **Strive for a 'look' which isn't only a fashion statement**
  Appropriate design will ensure that materials and products will have long years of use.
- **Use energy efficient appliances and fittings to save burning those fossil fuels**
  Compact fluoros and halogen lights use minimal energy while curtains and draft stoppers retain heat
- **Use materials which will aid in passive solar design**
  Floor tiles and concrete slabs, for example, in sunny winter rooms absorb and reradiate heat at night.
- **Use natural ventilation**
  Spaces can be cooled down in summer and rooms ventilated against indoor air pollution

- **Make sure the specification addresses all the eco qualities you are wanting in your design**
  For example specifying timbers certified by the Forest Stewardship Council clearly shows your intent
- **Design an eco deconstruction spec. when renovating or relocating so that materials are not wasted**
  Often no-one knows what to do with site materials, such a spec means they taken offsite responsibly
- **Start a library of eco-products and materials in your office library for others to use as well**
  Clients are often inspired after handling samples of eco-products. Help educate peers by example
- **Keep themselves up to date on eco-design issues**
  Use the accompanying resource list plus the SRD Talk and newsletters to keep up with latest issues

- **Select products and materials which create a healthy indoor environment**
  Avoid wall to wall carpets by using hard surfaces with floor rugs which can be easily cleaned and aired
- **Select water efficient products to save this precious commodity**
  Specify low flow or automatic cut-off taps and fittings, insulated tanks and pipes, quick boil urns, etc.
- **Promote the benefits of energy and water conservation to clients**
  While upfront costs may be higher, longer term use actually saves clients big money
- **Consider increasing the amount of natural light into spaces to reduce need for artificial lighting**
  Correct placement of windows, internal partitions and colours of walls/surfaces improve lighting

- **Specify timbers which they have ensured come from a long term renewable source**
  Timbers recognised by the Forestry Stewardship Council (FSC) are certified as sustainably harvested
- **Select 'pure blend' textiles, which are most suitable for the job they have to perform**
  100% blends make for ease of recycling, better still select a material which has already been recycled
- **Select fabrics which have come from a more sustainable source**
  For example, DesignTex have a line made from organic ramie/wool dyed with non toxic dyes
- **Avoid the use of chemically treated fabrics**
  Moth and stain proofing treatments can impact on both environmental and personal health

- **Consider installation of energy saving devices**
  Such as movement and light sensors for artificial lighting in offices and home to reduce energy use
- **Specify low Volatile Organic Compound emission paints**
  Plant or mineral based products emit less VOCs, which can contribute to Sick Building Syndrome
- **Use materials for presentation boards which can either be used again or recycled**
  Avoid styrene boards which can be difficult to recycle and conserve samples for further reuse
- **Prepare working drawings on A4 & A3 paper or digital CAD files on disks for easy copying**
  Not every consultant or contractor needs all the details on an large wasteful A1 sheet

(To implement all the above ideas may be impossible - yet every suggestion adopted will make a difference.)

http://www.iida.com/ - International Interior Designers Association

An obvious website for interior designers for all interests which also has information related to the environment and health issues. Check out the Fall issues 1997 of their Perspective newsletter titled - Technology/ ecology. This issue has articles from renowned eco designers such as Kirsten Childs from Croxton Collaborative Architects including lots of worthwhile reading. Well worth a look.

http://solstice.crest.org/sustainable/index.shtml - Solstice Sustainable Living

An excellent general website which has useful information for the interior designer including subjects such as indoor air quality and the environmental impact of buildings.

http://www.buildinggreen.com/ - Environmental Building News

A terrific regular newsletter also available by subscription for hard copies with full details of all articles. Includes some useful information for interior designers. Some articles from back copies available on website. A new searchable CD-ROM of all back issues also available. http://www.envirolink.org/aboutsite/ - Envirolink

A general environmental website with useful information on nearly anything you'd want to know about conserving the environment. See the Sustainable Business Network link for useful information and articles about products and materials.

http://data.oikos.com/products/ - Resources for Environmental Design Index (REDI).

A searchable database of over 1,400 products and resources for green buildings. Run by IRIS Communication. Ph: 0011 1 (541) 484 9353 Fax: 0011 1 (541) 484 1645 E-mail: iris@oikos.com

http://www.numenet.com/intconc - Interior Concerns Guide and Newsletter

Interior Concerns Environmental Resources, PO Box 2386, Mill Valley, 94942, USA pH: 0011 1 (415) 389 8049 Fax: 0011 1 (415) 388 8322 E-mail: intcon@nbn.com Interior Concerns Resource Guide, over 230 pages of tools, information, products, materials, case studies and listings for sustainable and healthy building and design. Interior Concerns Newsletter, bimonthly information on the same. (USD$35 plus postage.)

"Never believe that a few caring people can't change the world –
For indeed that's all who ever have." **Margaret Mead**

Email Us at srd@green.net.au

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Green Product Information

Product Directory

Last Update 4/29/2003

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Metals	Special Const.
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Perplexed? Read the help page.

Do you want to add your company or enhance your current listing? Please send comments or report problems to help@oikos.com.

To suggest a product, send your press release, product literature and photo to

Iris Communications, Inc.
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While you're at it, why not add us to your media list so we'll get all your new product announcements.

Gallery

American ALDES Ventilation Corp.

Engineered ventilation and indoor air quality products...

Quad-Lock Building Systems

Insulated concrete forms made from expanded polystyrene...

FOAM-TECH

Ozone-freindly foamed-in-place insulation...

ICE Block

Insulated concrete forms made from expanded polystyrene...

RCD Corp.

Water-based duct sealants...

Solid State Heating Div. SSHC, Inc.

Electric radiant heating panels...

Stirling Technology, Inc.

High-efficiency heat recovery ventilators...

The Energy Conservatory

Diagnostic tools, including the famous Minneapolis Blower Door...

WarmlyYours.com, Inc.

Electric radiant floor heat...

Designing an International Competition Logo

You are a graphic designer who has been asked to redesign the icons for an international interior design competition. You are given a pack of the promotional material from last year's competition: full colour, glossy A3 and banner posters, fold-up A5 brochures, letters, stickers, even drink coasters, in a glossy board folder, all printed with the obsolete icon. Leafing through this material, you suddenly get an impression of the sheer amount of paper and ink expended for such an ephemeral event. Paper for example is cheap and getting cheaper, but environmentally it is very expensive: the felling of unknown trees in unknown locations and transportation of logs in big-polluting trucks or ships; chipping, pulping and manufacture of paper involving huge amounts of energy and water and the exposure of workers, air and waterways to sulphuric acid, chlorine used in bleaching, dioxins and dust and other effluents such as heavy metals. There is also the manufacture of waxes, plastics, synthetic resins and formaldehyde for paper coatings and of course inks, as well as more transport, packaging, distribution and wastage.

You also remember what you have heard about the increases in paper consumption due to new, cheap technologies, such as colour printers (which devalue paper at the same time), and old habits such as printing out every design modification. You realise that every decision you make, from colours, to sizing, to fonts, to formatting will have similar material implications, and start to formulate a very different way of promoting the event: with a suite of electronic icons. How will this make a difference? You are extending the life of each icon by lending them to the electronic context - making them modifiable and inherently dynamic. The idea is that each icon can be altered while remaining recognisable. You decide you need to collaborate on this and get in touch with the competition’s web manager who herself has been toying with the idea of ‘dematerialising’ the competition’s promotional material.

She has also recently been involved in a project researching the possibility of re-directing marketing strategies for socially responsible ends. Through this project she has learnt that informational campaigns often fail because they lack effective 'placement' strategies. People do not generally retain 'information' until next they need it, but in fact have to be continually prompted. This situation is not resolved by materially excessive promotional campaigns. The information has to be targeted both in terms of content and timing and the content and form of the message has to be commensurable both for reasons of credibility and good design.

However, the competition organisers may take some time to come around—they specifically want posters and brochures. You discover that there are still boxes and boxes full of unused ephemera from last year's competition, so using the 'integration' principle, you decide to also work on a design that reuses this material. This will send a strong message about resource conservation to the competition community including entrants and sponsors. You decide to give the competition managers more than they bargained for in the 'return brief'— a five year promotional plan with a phase out of paper-based material over the next year. You also put forward the idea that designing a suite of long-life logos could become part of the competition brief in future years.

For more to think about in relation to designing graphic products:

EcoDesign Foundation ‘Understanding Paper’ in *Office Products: guide to sustainable purchasing and use* Inner Sydney Waste Board 2000.
Abigail J.Sellen and Richard H.R Harper *The Myth of the Paperless Office* MIT Press 2002.
McKenzie Mohr, Doug and William Smith Fostering Sustainable Behaviour: an introduction to Community-Based Social Marketing
Friends of the Earth 's fact sheet on the biophysical impacts of paper and pulp manufacture.

Society for Responsible Design have also produced a graphic design checklist.

Go to Adbusters site for their guide to creating Print Ads.

Designing a 'Smart' Interior

You are an interior architect who has been employed to redesign the interior of a large, old, centrally-located commercial building. The owners are planning to retrofit the building as a state-of-the-art 'smart' building in order to attract upwardly mobile, commercial tenants. The owners want the building to be both highly impressive and low impacting environmentally (by which they mean energy efficient) and want you to make recommendations for features that will highlight this.

One of the ‘smart’ features that they seem particularly excited about are infra-red and ultra-sonic occupancy light sensors, that detect when people enter and leave rooms, turning lights on and off. These sensors fit the ‘high tech’ image the building now wants to communicate, but are also ‘energy saving’ as they ensure that only rooms being used will have lights turned on, thus solving the problem of people forgetting to manually turn lights off.

A year ago you worked on a similar building with environmental consultants who revealed that there were big problems with ‘smart’ technologies being presented as energy saving devices, particularly when considered relationally and over time. Rather than being triggered to turn lights off, the tenants’ bad habit of forgetfulness gets reinforced by the new ‘smart’ system. Tenants become even more used to not having to think about manually turning lights on and off, and consequently are less aware over time of the direct relation between their activities, their environments, and energy consumption. They also tend to take this lack of awareness into other environments, forgetting to turn lights off in other places because they don't have to at work.

That such a design can change the culture of use was a bit of a revelation for you at the time, and since then you have been very cautious about leaping at technological responses to environmental problems particularly when they remove the agency of the user from operational systems (which is technology’s way of ‘solving’ problems). Particularly when you put the whole picture together of ‘always on’ office suites and security systems, air-conditioning etc (all of which tend to go with the culture of 'smart' buildings and increase energy consumption).

You decide to write a 'return brief' to the client. The return brief is a mechanism by which you are communicating back to a client what you understand the job to be, and how you will go about it. This is also an opportunity to introduce sustainable options to your client (which will also require some well placed strategic questions, backed up by persuasive and appropriate costing information: see our ReBriefing the Client tool). You want to communicate to them how 'smart' technologies tend to 'withdraw' from attention, defeating both their purpose of creating features that will make the building stand out, as well as potentially increasing energy costs. You propose instead an electronic billboard for the foyer that would indicate the building's overall energy consumption, and give users a variety of ways to engage with the operations of the building's technologies, including light-switches that are also designed as passive behavioural prompts. The idea is to achieve a more energy efficient building that is also valued by users for this quality.

For more to think about in relation to designing interiors:
Go to the Australian Energy Building Council's site for resources on improving the energy performance of buildings.
The SusHouse project for material on sustainable households. For tips on designing usable buildings go to Usable Buildings.
For a look at the kind of future lifestyle we don't need, go to the iHome site
And check out this 'smart'? design studio project.

Australian Building Energy Council

Improving the energy performance of buildings

ABEC's charter is to shape a National System of Best Practice which will ultimately lead to better environmental building performance and underpin changes in overall building practice. Energy efficient and environmentally designed buildings:

- Improve the productivity, health and comfort of their occupants
- Provide substantial operating cost savings over the life of the building
- Are more resource efficient, minimise impact on the environment and reduce greenhouse gas emissions

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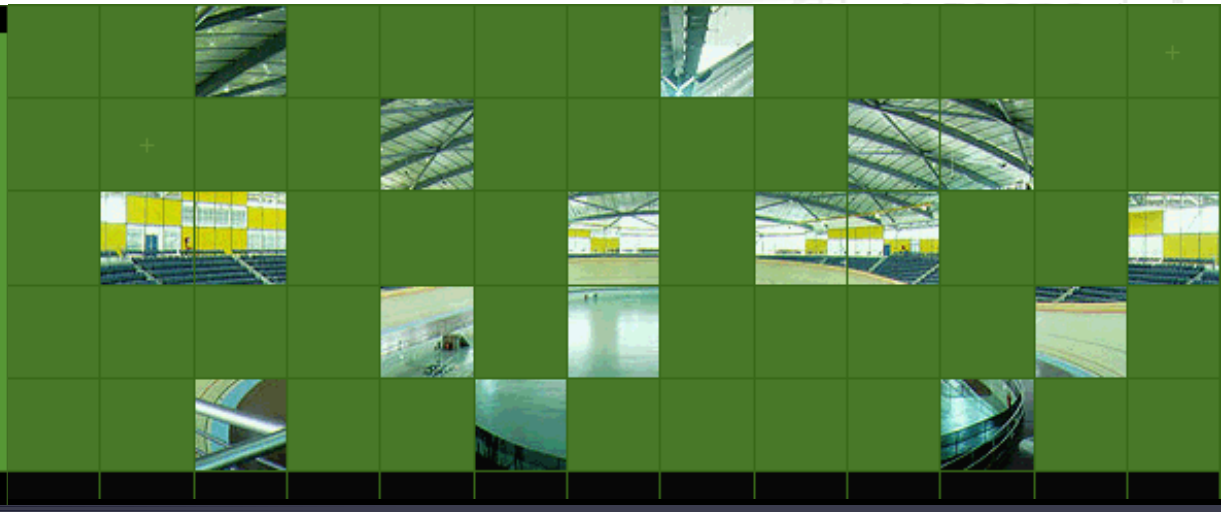


Search: Select Section

Process

It is important not to underestimate the value of questions. Questions beg responses—they expand the parameters of knowledge expectation which in sustainable design is critical. Each stage in this guide comprises of a set of design directives and/or questions that you should follow and answer as best as you can. You will need to do research in order to answer some of these questions, but you will also find that as you work through the stages assembling a detailed 'picture' of your product, you will be able to respond to previous questions more fully. You will find interesting links throughout the text on a variety of topics that will assist you with your research. You will encounter some repetition—this is to help you keep certain issues in mind, or to help you look at the same problem from another angle. There are also some terms used that you might not recognise—these are left undefined to encourage you to discover what they mean. The Resources section at the end will help you.

Each stage in this Guide is in sequential order, but as you move through the stages, you will be referring back to earlier stages, slowly building up a relational picture of your product: what it could or should be, what it could or should do, who it is for, its lifespan and subsequent lives, its environmental impacts across its life cycle, its contributions to sustainability.

Note: It is envisaged that all the following tasks be done in a (hardcopy or electronic) scrap book, that can be kept as a design archive for future reference. After completing each stage, it is worth reflecting on what you have learnt and how it might specifically modify your design. One way of doing this might be to create a running schematic of your product and notate modifications as you go. In Stage 10 you are also asked summarise an audit of your design process. This is a self-diagnostic exercise, designed to help you recognise the material and energy impacts associated with your work process. At this point, it simply entails keeping a log of the material and energy 'inputs' and 'outputs' your work process generates, ie in your use of room, computer, transport, paper, pens, over-head or task lighting and heating over a particular time frame (for example, the length of time it takes you to do a Stage of this guide). See Stage 10 for further on the process audit.

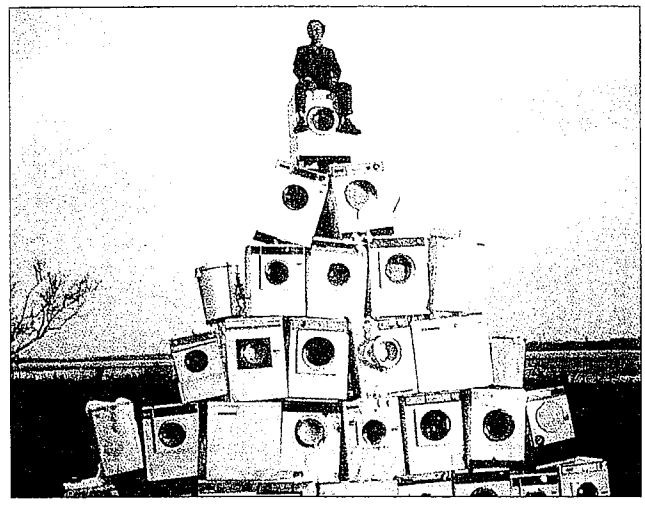
Go to the Guide to begin the design stages.

Look at the Examples on the left to get an idea of how the Guide can be applied to specific projects.

BEYOND RECYCLING

The longer life option

TIM COOPER



Recycling is widely considered to be positive for the environment. People instinctively believe that re-using materials from products which might otherwise end up in a landfill site must be environmentally beneficial. The idea that recycling is intrinsically 'green' is promoted widely – by politicians, local authorities, manufacturers, journalists and, indeed, most environmentalists. It has come to symbolise good environmental practice.

The fact that recycling allows raw materials to be used repeatedly might appear to suggest that no environmental damage need be caused by ever-increasing consumption in industrial countries. Yet the recycling process, like all physical activities, affects the environment. Energy is consumed as waste products are collected, sorted, cleaned and separated into their constituent materials. Pollution is caused, both as a by-product of this energy consumption and, more directly, by materials reclamation processes. The subsequent manufacture and distribution of products made from recycled materials also has an impact on the environment.

continued on page 1

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THE *new economics* FOUNDATION

Beyond Recycling

The longer life option

Tim Cooper

Contents

The Author

Tim Cooper is a Researcher for the New Economics Foundation. A former economic and environmental consultant, he began his career as an economic analyst in the construction industry. He has had papers and articles published in academic journals such as *Business Strategy and the Environment* and *Environmental Values*, as well as the *Financial Times* and *Guardian*. An influential figure in green politics and former parliamentary candidate, he was co-founder of Christian Ecology Link and is the author of *Green Christianity* (Hodder and Stoughton, 1990).

Energy and Materials Conservation Research

This report has been written as part of the New Economics Foundation's ongoing research work into Energy and Materials Conservation. This has included research into energy use carried out by Victor Anderson, the findings of which were published as a book, *Energy Efficiency Policies* (Routledge, 1993).

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Executive summary

The growing volume of waste in industrial countries, linked to high levels of consumption, is increasingly recognised as a key environmental issue. In Britain alone 6 million kitchen appliances, 3 million vacuum cleaners and 2 million vehicles are discarded each year. Many have lasted for less than a decade.

Until now, the focus of attention by government, industry and environmental campaigners alike has been on recycling. Yet recycling is coming under increasing scrutiny as awareness grows that it, too, has an impact on the environment.

Attention is now turning – notably in the Government's recent sustainable development strategy – to the possibility of reducing waste and pollution through the manufacture and sale of products with longer life spans.

This report argues that increased product durability should be the key element of a new environmental strategy to minimise waste: *the longer life option.* A new focus in the debate on consumption and waste is needed because the environmental benefits of longer lasting products have not been fully appreciated. The longer life option is not only environmentally beneficial but commercially realistic. For example, Swedish car manufacturers have thrived while increasing the average life span of cars from 9 years to over 17 years since the mid 1960s. By comparison their average life span in Britain is 11-12 years.

The report concludes that

- *there is a widespread awareness of the benefits of recycling over waste disposal in landfill, but there has been too little analysis of the environmental downside to recycling*
- *concern is mounting at the possible net commercial cost to manufacturers of recycling consumer durables and potential problems raised by contaminated secondary materials*
- *there is a need to distinguish 'technical life', 'service life' and 'replacement life', and the aim should be to optimise rather than maximise product life spans*
- *in addition to the environmental gains, increased product life offers potential benefits to consumers (who would gain better value for money) and manufacturers (who could improve their competitive edge)*
- *whilst action is needed by Government and industry to develop and promote longer lasting products, many consumers, too, need to change their attitudes.*

The influences upon product life are complex and deeply rooted in our contemporary industrial culture. Even so, there are many practical measures which would encourage the manufacture and sale of longer lasting products, including:

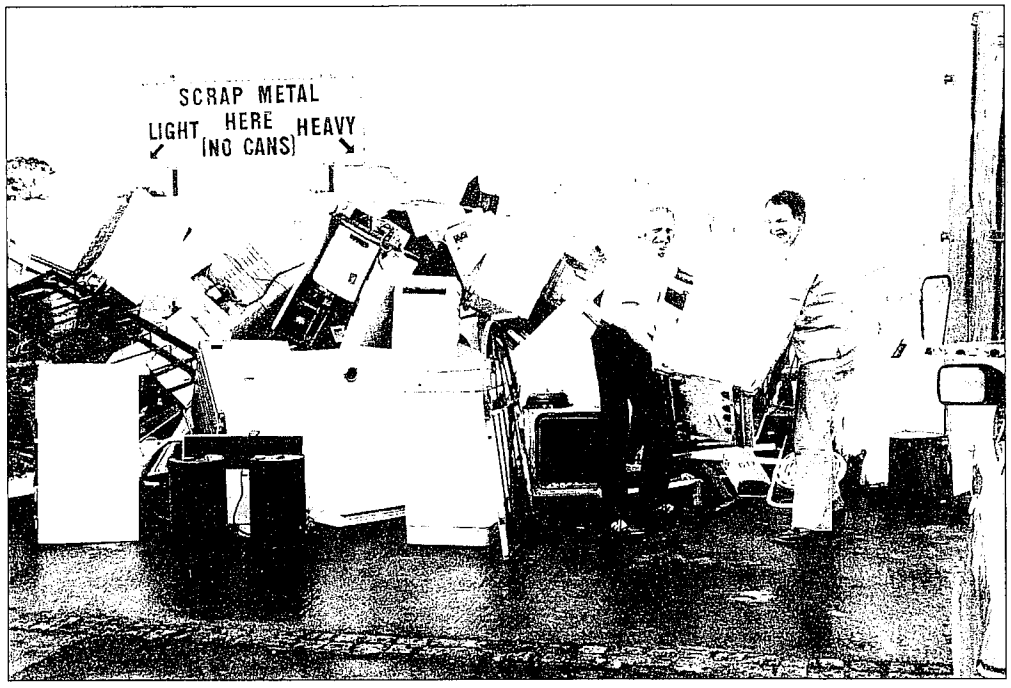
- *a shift in taxes from labour to energy and raw materials in order to encourage repair and reconditioning*
- *significantly longer guarantees, free at the point of sale, covering labour as well as parts, and lasting for at least ten years for most household products*
- *mandatory labelling of products with their normal expected life span, so that consumers can more readily assess their value by taking account of the anticipated length of service which they will provide*
- *action by central and local government to promote waste reduction and reuse, with clear policies and targets to complement those for recycling.*

It is increasingly evident that an environmental strategy is needed which goes *beyond* recycling, based on longer lasting products. Only such a strategy could achieve the reduction in the volume of energy and materials passing through industrial economies necessary if sustainable development is to be achieved.

continued from cover

The focus in the recycling debate has, so far, been on packaging rather than products. This new culture of recycling is now being extended, however, and a trend is emerging towards the promotion of products such as cars, washing machines and electronic goods as recyclable. There is a prospect that products which malfunction will increasingly be recycled rather than repaired.

This report takes a hard, critical look at recycling. Its focus is on consumer durables – defined here as vehicles, kitchen appliances, audio-visual equipment and other domestic electrical products, furniture and floor coverings, hardware and garden tools.[1] It questions whether recycling is the best environmental solution to the increasing volume of discarded consumer durables. Is it, perhaps, diverting attention from more radical responses? Rather than increasing society's capacity to absorb waste, should the priority instead be to reduce the flow of energy and materials through the economy (its 'throughput') by encouraging longer lasting products?



'White goods' delivered to a recycling centre

Such questions point to a need to consider an environmental strategy which goes *beyond* recycling. The relatively low position of recycling in the widely used 'hierarchy of waste management options', which prioritises different measures for dealing with waste according to environmental impact, is significant. As the reduction of waste by encouraging longer lasting products is at the top of this hierarchy, the current priority given to recycling needs to be questioned. The report thus analyses recyclability in relation to durability. Such a comparison is useful because choices have to be made in public policy, design and marketing. Public sector bodies have to decide where to concentrate their limited resources, while in the private sector designing products for recyclability and durability is likely to push up costs, forcing companies to decide what the market will bear. In addition, the use of particular materials or methods of construction to achieve durability may make recycling impossible or more difficult.

The aim of this report, therefore, is to:

- describe recycling and durability in the context of the debate on sustainable development and, specifically, the throughput of energy and raw materials in modern industrial economies
- consider the relative attention being given to recycling and increasing product life by government and industry
- identify and explain the position in the waste management hierarchy of reduction, reuse and recycling
- analyse the complementarities and conflicts between recyclability and durability in areas such as design, marketing strategy and public policy
- make practical recommendations for action to encourage the manufacture and sale of longer lasting products.

At the outset, it is necessary to state two caveats. First, this is not a treatise *against* recycling. Once products no longer function and cannot be repaired, any component parts that can be reused or reconditioned should be separated and those that cannot should (where appropriate) be recycled. In other words, there are benefits from operating at different levels of the waste hierarchy at different stages during a product's life cycle. Second, the report makes occasional generalisations, although it is recognised, of course, that environmental impacts vary according to the type of product and geographical location.

The issues raised in this report have a wide-ranging significance. Public sector decision makers, for example, are required to assess the relative environmental impact of various waste prevention, minimisation and management policies. They have to evaluate different responses to environmental problems caused by the substantial volume of waste generated in industrial societies. There is also a traditional macro-economic concern that resources be allocated efficiently: neither Treasury policy nor policies on waste should inadvertently encourage manufacturers, local authorities or consumers to squander finite reserves of energy and raw materials. Understanding the relationship between recycling and durability will help to inform decisions on waste-related policies such as recycling credits, a landfill levy, and other fiscal reforms and spending options.

Likewise, the issues are important to the private sector. Manufacturers are increasingly confronted with a need to make decisions based on the total environmental impact of their products, from 'cradle to grave' (i.e. from extraction of raw materials to final disposal). This need has arisen in part through pressure to substantiate promotional claims made in attempts to attract the 'green consumer', who increasingly demands firm evidence of a product's environmental performance. The main reason, however, is the prospect of legislation to make industry responsible for products at the end of their lives. Proposed 'take-back' legislation in Germany will soon require manufacturers of

vehicles and electronic goods to accept responsibility for them once discarded. Similar legislation is likely to be introduced throughout the European Union within two or three years.

Ultimately, the debate on recyclability and durability demands consideration of more fundamental issues relating to the shape and direction of our economy. The goal of sustainable development is accepted by politicians of all parties. Making a bold assumption that economic and environmental policy decisions will, *to some degree*, be integrated, two alternative future scenarios may be identified.

In one, economic output is maximised, but more and more of the ever-increasing output is devoted to clearing up environmental damage created in the process of achieving it. Recycling is encouraged on the basis that the repeated use of finite reserves of energy and raw materials will help to sustain a fast 'throughput' in the economy into the long term. Products are recycled rather than repaired. No ultimate limits to consumption are accepted.

In the other, the economy is managed on the basis that the aim is to maximise people's well-being and improve the environment while *reducing* this throughput, the flow of energy and raw materials. As products are designed for durability the level of manufacturing output is, relatively, low; it may even fall. On the other hand, repair and reconditioning work is far more common. Recycling takes place only after products, or their components, no longer function.

Such a dichotomy exposes the controversial territory which underlies this debate. This report thus starts by considering the broader economic and environmental context, before examining in detail the extent to which the second scenario is realistic.

1 Sustainable resource use

All economic activity depends upon and influences the physical environment. In seeking to explain the interaction between economic activity and environmental change, economists have sometimes utilised the basic laws governing the behaviour of matter and energy, the laws of thermodynamics.[2] Recently, for example, in *The Green Economy* Michael Jacobs highlighted the fact that the first law, which states that matter and energy cannot be destroyed or created, is a reminder that in production processes nothing fundamentally *new* is created; what happens is that materials and energy are transformed from one state to another (Jacobs, 1991, p.11). Thus each quantity of materials and energy which enters a productive process will eventually end up as the same quantity of waste; an initial part comprising residual waste and the remainder, the discarded product.[3]

This gradual process of transformation from resources into waste is dictated by the second law, which states that in the absence of external sources of energy the amount of available matter and energy is always in decline. Resources which were once concentrated and thus in a useful form become dissipated and unavailable for use – the measure of unavailability being termed 'entropy'. It follows that just as the sun enables natural cycles to take place in the living environment (where waste matter becomes food for other organisms), the use of solar technology in an industrial economy could slow down the rate at which entropy is increasing.

These physical laws shed light on the process of environmental change which results from economic activity. Research by the Wuppertal Institute in Germany has highlighted a strong inverse correlation between the environmental sustainability of an economy and the volume of energy and raw materials passing through it (Schmidt-Bleek, 1993a). Meanwhile, a related research development concerns the concept of 'industrial ecology', through which, as a means of developing a sustainable manufacturing strategy, a parallel is drawn between the processes in an industrial system and those in a biological ecosystem.[4]

A helpful model for differentiating the dynamics within contemporary industrial economies from those of an environmentally sustainable economy distinguishes a 'linear' economy from a 'circular' economy (Figure 1) (Jackson, 1993; Jacobs, 1991). The typical economy in industrial economies takes a linear form, in that it is assumed that at one end of the industrial system there is an unlimited supply of energy and raw materials, while at the other, the environment has an infinite capacity to absorb pollution and waste. The overriding policy goal is to expand the total amount of economy activity which, recorded as economic growth, is commonly regarded as a proxy for human wellbeing.

In a circular economy, by contrast, the aim is to minimise the throughput of energy and raw materials in the economy without sacrificing wellbeing. As throughput is determined both by the volume of energy and raw materials entering into the productive process and by the amount retained within the system (e.g. through waste reduction, reuse and recycling), both inputs and outputs are addressed: the production system is based on "minimum input, maximum retention and minimum output" (Kemball-Cook, Baker and Mattingley, 1991, p.2). In such an economy 'efficiency' is defined in terms of the effective use of physical resources rather than purely financial criteria. Of course, even in a circular economy finite resources are depleted and waste created, in keeping with the laws of thermodynamics, but, unlike a linear economy, the environmental impact is minimised.

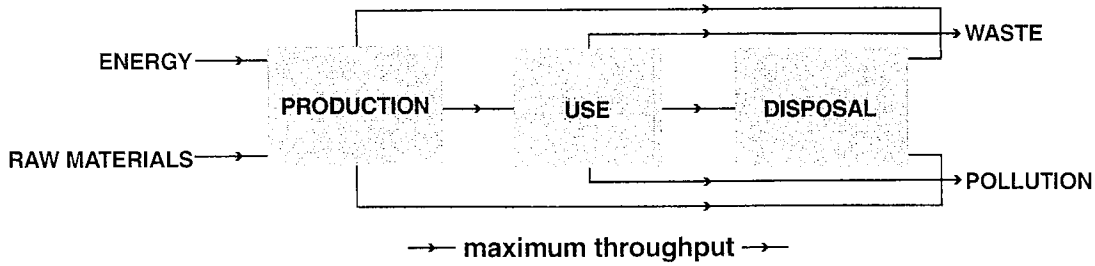
If the goal of sustainable development is to be reached, industrial countries must move towards developing circular economies, which will involve integrating economic and environmental policies. The strength of these policies will determine exactly how quickly this move towards circularity takes place and sustainability is achieved.

Excessive throughput?

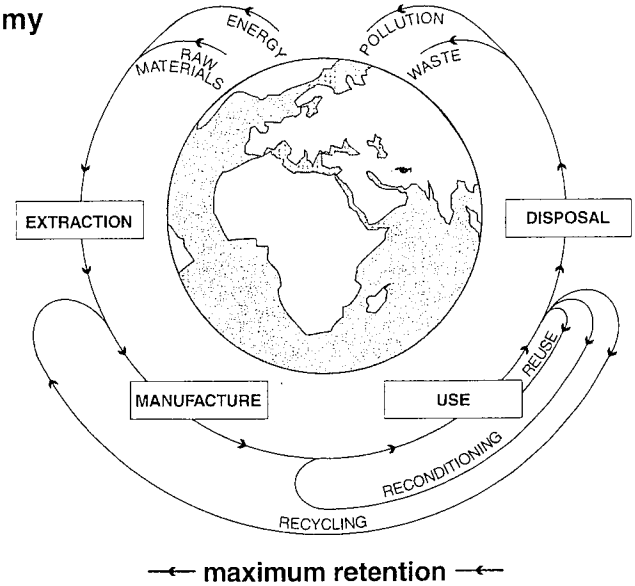
Recent environmental reports detailing the input of energy and raw materials and the output of pollution and waste in industrialised economies give an indication of the impact of current levels of throughput (e.g. World Resources Institute, 1994). As the case for recycling and lengthening

Figure 1: LINEAR AND CIRCULAR ECONOMIES

A. The Linear Economy



B. The Circular Economy



Source: NEF.

the life span of products is based on the premise that this level of throughput is excessive, this section sets out some of the evidence.

The report *World Resources 1994-95* pointed to human ingenuity and the prospect of materials substitution in arguing that "the world is not yet running out of most non-renewable resources and is not likely to, at least in the next few decades" (World Resources Institute, 1994, p.5). However, the fear of shortages of energy and certain raw materials expressed some twenty years ago in reports such as the Club of Rome's *The Limits to Growth* has not entirely disappeared (Meadows, Meadows, Randers and Behrens, 1972). A recent study in *Scientific American* warned that reserves of petroleum, copper, nickel and molybdenum are below 70 years and would fall "perilously low" if less developed countries were to match consumption levels in the industrialised world (Frosch and Gallopoulos, 1989, p.96). Energy raises the most concern, as at present most comes from non-renewable sources. Energy consumption worldwide has quadrupled since 1950 and is growing even faster in developing countries.

Even so, since *The Limits to Growth* was published it has become apparent that the greatest threat is not that energy and raw materials will run out, but that the natural environment will no longer satisfactorily act as repository for all the pollution and waste associated with their use (Pearce, Markandya and Barbier, 1989). The World Resources Institute has warned that "virtually all industrialised countries continue to release to the environment a massive quantity of toxic material – heavy metals, hazardous chemicals, and acidic gases" (World Resources Institute, 1994, p.4). Pollution crosses national boundaries and threatens people's health and livelihoods by causing climate change, destroying forests, lakes and other ecosystems, and damaging the ozone layer. Many problems arise even before raw materials are exported to manufacturing nations: dust from mining, acidic gases from smelting and refining, and emissions of fine particles of toxic trace metals which can enter animal and human food chains. Although serious pollution incidents and the dirtiest factories often attract the most attention, as the authors of *Beyond the Limits* (the follow-up report to *The Limits to*

Growth) have pointed out, "all use of materials, at each stage of the production process, leaves trails of pollution" (Meadows, Meadows and Randers, 1992, p.80).

In addition to environmental threats such as resource depletion and pollution, the amount of solid waste generated in industrialised countries is rising. In the member countries of the Organisation for Economic Co-operation and Development (OECD) municipal waste per head rose by 26% between the mid-1970s and late-1980s. In many countries, including Britain, the prospect of tighter development controls and more stringent licensing requirements for landfill sites is likely to create upward pressure on waste disposal costs. A vast number of consumer durables are discarded annually in Britain: around 2 million vehicles, 6 million large kitchen appliances, 3 million vacuum cleaners, a substantial quantity of audio-visual equipment, and millions of small appliances such as kettles, toasters and irons. In addition, a considerable amount of furniture, carpets and other bulky household waste is discarded. Estimates suggest that kitchen appliances account for 400,000 tonnes of waste each year and audio-visual and telecommunications equipment for a further 100,000 tonnes.[5]

Even so, it might appear as if, statistically, consumer durables constitute only a small fraction of the 20 million tonnes of household waste generated each year – perhaps no more than 5% – and an even smaller part of the total annual waste stream of 400 million tonnes. This would be a false impression, however, because the household waste stream and industrial and commercial waste streams interconnect. As consumer durables are discarded, a considerable amount of additional waste is generated through the production processes for replacement goods. Equally important, waste streams interconnect internationally, as many of the raw materials used are extracted overseas. A rule of thumb cited in *Beyond the Limits* is that every tonne of waste at the consumer end of the stream has also required the production of 5 tonnes at the manufacturing stage and 20 tonnes at the site of initial resource extraction (Meadows, et al., 1992, p.83). Thus, for example, in 1991 1,000 million tonnes of copper ore were extracted worldwide to obtain less than 10 million tonnes of metal (World Resources Institute, 1994, p.9).

Reducing throughput

How should environmental problems of such magnitude be addressed in industrial countries?

The environmental impact of production in a circular economy is reduced by increasing product life spans and by intervening at various points in the life cycle so that products (or their components) are reused, reconditioned or recycled. Recycling and increasing product life spans thus both represent means by which the throughput of resources can be slowed down. The value of recycling is not just the conservation of natural resources; indeed where the resources are renewable, such as the trees used in manufacturing paper, this may not be particularly significant. More important is the reduction in energy consumed. The most striking example is the typical 95% energy saving in the production of aluminium by recycling scrap compared with the process using the primary raw material, bauxite (Table 2).

An increase in the life span of consumer durables would likewise reduce the throughput of resources. This could be

RECYCLING

Recycling involves *the conversion of recovered scrap materials into a form suitable for use as a secondary material for the manufacture of marketable end-products.* The secondary (i.e. reclaimed) materials are mixed in various proportions with virgin materials. This may involve no loss of performance (as is normal with ferrous scrap), but a degree of downgrading may be necessary, resulting in products of lower specification (as with most plastics).

It is sometimes possible to use secondary materials in the manufacture of products similar or identical to those from which the scrap originated; this is known as 'closed loop' recycling and is intended to minimise the amount of residual waste.

Historically much scrap used to be collected door-to-door by 'rag and bone' merchants, but today most large discarded items are delivered by householders to civic amenity sites or 'traded-in' to retailers.

The term 'recycling' is sometimes confused with 'reuse', which more accurately describes the secondary use of *products* or *components.*

Table 1
AMOUNT OF POST-USE SCRAP RECYCLED AS A PROPORTION OF CONSUMPTION, 1992, UK

	Estimated home consumption *(Thousand tonnes)*	Scrap
Ferrous metal	13,420	45%
Aluminium	645	39%
Copper	391	45%
Lead	302	64%
Zinc	237	21%

Source: Department of the Environment, (1994). *Digest of Environmental Protection and Water Statistics*, London: H.M.S.O.

Table 2
ENERGY SAVED THROUGH RECYCLING

Ferrous metal	74%
Aluminium	95%
Copper	60-96%
Lead	77%
Zinc	61%

Source: NEF, based on Ogilvie (1992).

DURABILITY AND PRODUCT LIFE

Durability is *the ability of a product to perform its required function over a lengthy period under normal conditions of use without excessive expenditure on maintenance or repair.* This translates into several definitions of life span and, to complicate matters further, different measurement units may be used (e.g. years of existence, operational cycles, hours of use).

A product's 'technical life' is the maximum period during which it can physically function (i.e. irrespective of repair costs which might reasonably be considered prohibitive).

A more practical definition is its 'service life', the product's total life in use from the point of sale to the point of discard. Such a definition is of greater use to waste disposal authorities seeking to assess future waste streams. Retailers, however, are mainly interested in the 'replacement life' of a product, the period after which the initial purchaser returns to the shop for a replacement, irrespective of whether or not the original product still functions (it may have been sold as a second hand item, given away to friends or children, or kept as a spare).

Depending on the strength of the second hand market, there may be a considerable difference in product life according to which of these latter two definitions is used.[6]

Table 3
PRODUCT LIFE SPANS

	(average service life)	
Cars	11-12	years
Cookers	10-15	years
Washing machines	7-10	years
Refrigerators	10-12	years
Microwaves	8-10	years
Radio cassette players	10	years
Telephones	3	years
Televisions	10	years

Sources: Sarson, 1992; Poll, 1993; Nieuwenhuis and Wells, 1994.

achieved by designing products for greater durability and through activities which have been collectively termed 'product-life extension': the reuse of products (passed on as gifts or sold in second hand markets), repairs and reconditioning (the latter perhaps involving upgrading such as inserting a faster microprocessor into a computer) (OECD, 1982).

The precise *scale* of reduction in throughput required in industrial economies for environmental sustainability is difficult to quantify. An indication, however, is given by the minimum 60% reduction in greenhouse gas emissions suggested by leading scientists as required, immediately, to stabilise the current concentration of carbon dioxide in the atmosphere and prevent the threat of climate change increasing.[7]

Since the oil crises in the 1970s many countries have sought to improve the energy efficiency of their economies (i.e. the amount of energy consumed per unit of output, or Gross National Product). Germany's Wuppertal Institute prefers a broader measure. On the basis that "a drastic reduction in per capita resource consumption... is ecologically imperative" (von Weizsäcker and Jesinghaus, 1992, p.7) it is developing a conceptual tool called MIPS (Material Intensity Per unit of Service) to explore the possibility of radically 'dematerialising' industrial economies, i.e. reducing the consumption of resources generally for a given output. Schmidt-Bleek argues that to move onto a sustainable course industrial countries may need to dematerialise their goods and services by an average factor of ten (Schmidt-Bleek, 1993b, p.487). Such a transformation would clearly demand a smaller output of material goods, not merely less residual waste.

In order to achieve such change, some key economic influences upon resource use would need to be addressed. The fact that there is no *market* for 'environmental assets' such as unpolluted air, clean rivers and seas, unspoilt landscape and so forth means that no economic value is attached to them. The result is the linear economy, where such assets, being under-priced, are over-exploited and society as a whole bears the cost of remedying environmental degradation rather than the companies and individuals responsible for causing it.

Likewise, the market for waste is distorted. The fact that much waste is unmeasured and unpriced means that resources of potential value wrongly enter into the waste stream and a 'throwaway' culture is encouraged. One reason for this is that individual households do not directly bear the 'marginal cost' of increased domestic waste. Consequently a household has an inadequate incentive to minimise waste through, say, taking care to avoid over-packaged items or products with unduly short life spans.

In effect, when people buy consumer durables they are not paying the full cost, the sum which earlier this century the economist A.C.Pigou identified as the 'social cost' – the private cost of transactions plus indirect effects on society such as environmental damage (i.e. 'externalities'). As a result, although some consumers may be better off in the short term, the welfare of society in general is lower than if production and consumption decisions had incorporated the environmental impact.

One response would be to attempt to internalise all the wider effects into the product price so that from the customer's perspective there is no *economic* incentive for purchasing a product with sub-optimal environmental performance. This approach has limitations, however, in that economic instruments cannot correct all market failures: aesthetic and disturbance costs, for example, are difficult to quantify. It would be more realistic to influence the relative cost of the 'factors of production' which shape production processes and after-sales services (i.e. labour, energy and raw materials, and plant and equipment) through ecological tax reform: transferring tax from labour to energy and virgin raw material. Such reform would encourage environmentally sound practices through which, in general, the use of natural resources is reduced and employment increased: repairs, reconditioning and recycling tend to be labour-intensive rather than resource-intensive.

2 Current priorities

In the last few years industry and all levels of government – European, national and local – have shown increasing interest in recycling, whereas little attention has been paid to the life span of products. Thus manufacturers proudly pronounce that their products are 'recycled' or 'recyclable', but most are hesitant about stating how long they are likely to function. Likewise, the Government has introduced a national recycling target for domestic waste, but has yet to take practical steps to encourage the manufacture and sale of longer lasting products.

Industry

Many products with a high metal content, including vehicles and kitchen appliances such as washing machines and cookers, have traditionally been recycled. The suggestion that manufacturers are now making them with an unprecedented capacity for recycling therefore represents something of a myth. Indeed, far from there being any improvement in the recyclability of cars, for example, they are currently *less* recyclable than in the past because of a growing plastics content. This has increased to roughly 12%, compared with 2% in the early 1960s. Fears have even been expressed recently that it has become less economic to recycle cars because around 25% of each car (the plastic, plus rubber, foam, textiles and fluids) cannot now be recycled (Ogilvie, 1992, pp.50-1; Williams, 1991, p.4).

According to a report from the Warren Spring Laboratory, formerly the Government's environmental technology centre, around 75% of 'white goods' (i.e. kitchen appliances) are fragmentised in shredders to recover metals for recycling (Poll, 1993). In the 'brown goods' sector (i.e. audio-visual equipment and telecommunications equipment) only telephones have been extensively recycled. Most brown goods end up as landfill, as do most non-electrical consumer durables. Now that the manufacturers of vehicles and brown goods are faced with the prospect of 'take-back' legislation, however, which would make them responsible for their products after being discarded by consumers, many are exploring ways to increase the recyclability of products, such as using designs which make them easier to disassemble so that materials can be separated for recycling.[8]

Fear of 'take back' regulations has prompted the formation of two trade bodies which aim to create effective voluntary schemes in the hope of staving-off stricter legislation. The Automotive Consortium on Recycling and Disposal (ACORD) was set up in 1992 to improve vehicle recovery and aims to increase the average percentage of materials recycled in scrap cars from the present 77% to 82% by 2015.[9] Virtually all major car manufacturers in Europe have taken initiatives such as setting up vehicle disassembly plants where products can be dismantled and the separated parts either reused (perhaps after reconditioning), recycled, incinerated or landfilled. BMW, for example, has established a plant in Sussex and plans further plants sufficient to handle all BMWs scrapped in Britain. In the electronics sector the Industry Council for Electronic Equipment Recycling (ICER) has been set up to develop a national waste strategy for electronic goods. Companies such as IBM, DEC, Hewlett Packard, Rank Xerox and Grundig are already taking back used equipment, while Toshiba and Hitachi have research programmes to reduce dis-assembly times (Bashford, 1993; Clegg and Williams, n/d).

In contrast to the increasing commitment of manufacturers to recycling, for most types of consumer durable there has been no significant or sustained trend towards the development of products that last longer. Although no comprehensive historical data on product life span is available, the general trend appears to have been in a downward direction. Independent studies suggest that modern cookers, vacuum cleaners, kettles and irons are less durable than in the past.[10] The influences upon product life are discussed in detail later, but one important factor is that technological advances have made it possible to replace metal with plastic and to reduce the precious metals content in electronic equipment. Costs have been reduced but quality has often suffered. Such changes have sometimes been forced upon manufacturers by competitive pressures.

For a few products, however, there has been an upward trend in life span. Televisions, for example, appear more reliable than in the past due to improved tube technology, while corrosion prevention measures are likely to result in cars that will last longer.[11]

For some products customers have a reasonable degree of choice, with durability greater at the top end of the market. However, most volume manufacturers have given little attention to the possibility of increasing their products' life spans and tend to focus their marketing on price, cosmetic appearance and additional functions (some of which are rarely used). Moreover, the boundary between durable goods and disposable goods is becoming blurred. Items such as biros and razors have for many years been manufactured for a 'single use', but the area of overlap between durables and disposables has expanded through the development of single use cameras and the promotion of fashionably-designed spectacles, telephones and watches.

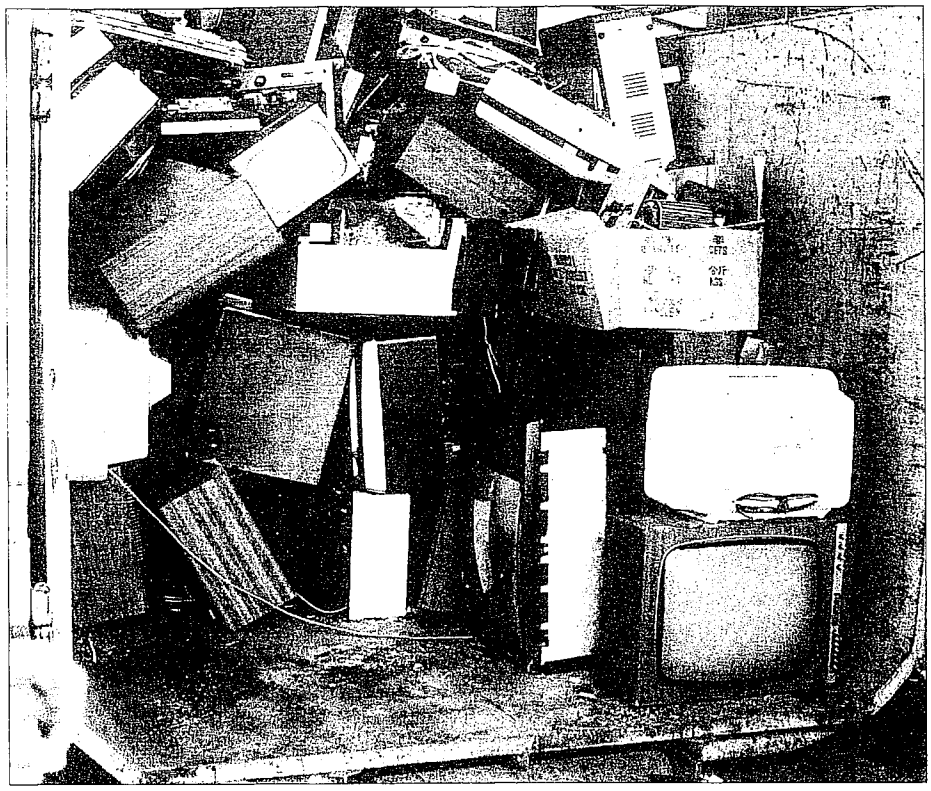
Apart from fear of legislation, why is industry choosing a strategy based on recycling rather increased life spans? In an article in *The Ecologist*, Simon Fairlie offered a provocative explanation: "Recycling offers business an environmental excuse for instant obsolescence" (Fairlie, 1992, p.280). Recycling, he argued, can be seen as part of a calculated strategy by industry to sustain sales in a world where markets for many consumer durables are reaching saturation. Though clearly controversial, his claim merits further investigation.

The public sector

Public sector bodies have, like manufacturers, shown more interest in recycling than durability. The most substantive piece of research on product life, an OECD report entitled *Product Durability and Product-Life Extension*, contained several recommendations for governments, but these were not taken up in Britain or most other member countries (OECD, 1982). Even the European Union's Ecolabelling Scheme, which is intended to promote products with a low environmental impact, does not include durability among the eco-label criteria. Inclusion was explicitly rejected when the terms for assessing washing machines were drawn up, although this decision is due to be reconsidered in any future review of the criteria (UK Ecolabelling Board, 1992, pp.44, 53).[12] A significant exception to the general lack of interest is the British Standards Institution's *Guide to durability of*

buildings and building components (BS7543), which contains some useful definitions and recommendations, but this is not generally concerned with movable consumer durable items.

It is only very recently, in its major environmental policy document *Sustainable Development: the UK Strategy*, that the Government appears to have started to pay closer attention to the benefits of longer lasting products (H.M. Government, 1994). This important breakthrogh is considered later. By contrast, prompted by an amended EU Directive[13] on waste which stipulated that member states must encourage recycling, the Government has set a target level for household waste recycling, published a Waste Management Paper specifically on recycling, provided various forms of financial assistance for recycling (including grants to industry and voluntary organisations), initiated a system of 'recycling credits', and entered discussions with key industrial sectors on increasing recycling and recovery (Department of the Environment, 1991; H.M. Government, 1994).



'Brown goods' arriving in a skip

In seeking to explain such priorities, the political expedience of recycling is perhaps significant. As the OECD report noted, recycling has an early effect on the waste stream and recycling volumes are readily quantified (OECD, 1982, pp.62-3). Any new recycling initiative has an identifiable impact within a normal electoral cycle. It is also a visible, photogenic activity which politicians can personally participate in. By comparison, the benefits of durability are far less transparent to the general public and take effect more gradually.

At the local authority level, household waste strategies have mainly focussed on newspapers and disposable packaging rather than consumer durables. They are very frequently based on the 'dust-bin' alone and not total household waste. Significantly, many recycling officers are employed by district councils rather than the county councils which oversee civic amenity sites (where the bulkier consumer durables end up).

Awareness is increasing, however, of the need for local authorities to pay attention to the destiny of consumer durables as well as packaging, and to promote reuse as well as recycling. Different solutions are required according to what has been discarded: compared with packaging, consumer durables tend to have a complex construction and more materials, are bulky, and sometimes have component parts which contain hazardous substances.

Finally, the priorities of businesses and the public sector may partly be explained by the fact that surprisingly little attention has been paid to durability by environmental or consumer organisations, despite much rhetoric about our 'throwaway society'.[14] Their focus has instead been on recycling. Consequently there has been little pressure on decision makers to move towards the longer life option.

Figure 2: ESTIMATED POTENTIAL FOR RECYCLING / INCREASED PRODUCT LIFE SPANS

	PRODUCT TYPE									
	White goods *large*	White goods *small*	Brown goods	Vehicles *cars*	Vehicles *bicycles*	Furniture	Floor coverings	Hardware *plastic*	Hardware *metal*	Garden tools
LEVEL OF RECYCLING	2	4	4[R]	1-2	2	4	4	4	2	2-3
POTENTIAL FOR INCREASE	3	2	2	2	3	4	3-4	3	3	3
SATISFACTION WITH LIFE SPAN	V	3-4	2-3	3[R]	1-2	V	V	3	V	2-3
POTENTIAL FOR INCREASE	2	1	2	1	3	2	2	3	2	3

Key: 1=VERY HIGH, 2=FAIRLY HIGH, 3=RATHER LOW, 4=VERY LOW/NIL, V=VARIABLE, [R]=RISING

Note: The 'potential for increase' rows are for illustrative purposes only, being dependent on technical and economic factors. Recycling, as defined in the report, excludes reuse.

Source: NEF.

3 The limits to recycling

There are many benefits to recycling compared with the disposal of products in landfill. Obviously the waste stream is reduced and thus waste disposal costs are lowered. In addition, there are the energy savings noted earlier, while from industry's perspective recycling scrap metal is profitable because secondary materials can be produced at a competitive price. However, concerns relating to environmental impact, commercial potential and technical limits need to be taken into account in assessing the future of recycling.

Environmental uncertainties

The overall environmental impact of recycling is inadequately documented, especially in relation to the transportation of materials, but it will by no means invariably be positive.

Steven Ogilvie's appraisal of the environmental effects of recycling for the Warren Spring Laboratory, though in general sympathetic towards recycling, concluded that "it is quite possible that the burdens created as a result of the collection of materials for recycling could outweigh any environmental benefits accruing from the recycling process itself" (Ogilvie, 1992, p.14). No other significant research has been carried out to quantify the environmental hazards which are involved, but there is sufficient anecdotal evidence to suggest that recycling is by no means environmentally benign.[15] For example, the break-up of products into their constituent materials, which is the basic process involved in recycling, means that hazardous materials are no longer 'locked up'. Consequently various forms of pollution are possible during recycling: dust and noise from shredders, emissions from the processes used in reclaiming metals, a toxic final residue.[16] For example, old appliances may still have capacitors and transformers with toxic PCBs (polychlorinated biphenyls) and may contain heavy metals such as cadmium, which is used as a colouring medium and as a stabiliser in plastics.

According to available research, pollution from recycling processes appears not to be a particularly serious concern, although many companies have hitherto not monitored their emissions and are only beginning to do so because of the introduction of integrated pollution control regulations in 1995. It is, however, known that in copper recycling the control of lead emissions can be difficult and air emissions from secondary aluminium smelters, caused by the combustion of contaminants (i.e. oil, paint, polymers), can be a problem. Emissions when ferrous scrap is used in making steel are thought to be below the level when only primary metal is used (although here, too, exact figures are unavailable), while emissions from plastics recycling processes are considered insignificant (Henstock, 1988; Ogilvie, 1992).

The residual waste which remains after recyclable materials have been recovered can cause problems because it may contain a high concentration of hazardous matter. Around a quarter of shredder feedstock is currently non-recyclable and discarded as landfill. Shredder waste from white goods is less hazardous than in the past, especially as fewer capacitors with PCBs are present, but shredder waste from vehicles (which accounts for 70-80% of feedstock in shredders) is more problematic due to the possible release of various acids and mineral oils, heavy metals and hydrocarbons. In addition, one of Ogilvie's main concerns related to the use of salt fluxes in aluminium recycling to prevent oxidation, as some 450-600kg of slag is produced for every 1,000kg of aluminium and its disposal is becoming unacceptable as landfill due to high levels of soluble fluoride (Ogilvie, 1992, p.85).

Above all, however, it is the net consumption of energy in recycling which raises most concern regarding its overall environmental impact. As noted above, less energy is used in obtaining raw material inputs by processing scrap than extracting metal from primary sources. However, as Jacobs points out: "Wastes can't turn back into resources unless there is some external source of energy. 'Recycling' doesn't just happen on its own... it has to be powered by an energy source" (Jacobs, 1991, p.112). At each stage in the recycling process – processing scrap materials, manufacturing, transporting discarded products, secondary materials and replacement products – energy is used. This in turn results in pollution and waste (e.g. carbon dioxide from burning fossil fuels or radioactive waste from electricity generated by nuclear reactors). In other words, recycling waste reduces one environmental problem only at the cost of increasing others. Moreover, if the amount of recycling is increased, the energy required will rise as more dispersed and intractable wastes are handled.

Figure 3: POTENTIAL CONTAMINANTS IN RECYCLED MATERIALS

Recycled Material	Residual contaminants	Non-residual contaminants
Iron and Steel	Copper, tin, nickel	Zinc
Aluminium	Iron,silicon	Lithium, glass, siliceous dirt, magnesium, zinc, tin, lead
Paper	Flexographic inks (>10%), water-resistant coatings	Adhesive wire staples, plastics
Glass	Iron and chromium colourants	Metals, ceramics
Plastics	Fillers, colourants	Other polymers, bacteria, inks labels, adhesives

Note: *Residual contaminants* are not removed during pre-treatment and processing operations and impair the quality of the recycled material or product.
Non-residual contaminants can be removed by processing but removal reduces the yield of the reclaimed product, extends processing times to allow contaminants to be reduced to acceptable limits, or leads to the discharge of toxic fumes, effluents or solid waste.

Source: Department of the Environment (1991).

Commercial obstacles

As consumers and taxpayers may increasingly be required to pay for recycling, perhaps at the expense of other environmental measures, it is important to consider the economic implications of recycling consumer durables.

The fact that vehicles and large appliances such as washing machines and cookers have traditionally been recycled is evidence that recycling *can* offer a commercial return. The recovery of most types of discarded products which have not previously been recycled appears to be uneconomic, however, and manufacturers have been charging a levy. In Germany, where manufacturers are preparing for 'take back' legislation, Grundig have charged DM37 (around £15) to dispose of a television and DM15 (£6) for a video.[17] In addition to these extra costs for consumers, taxation to fund public expenditure on the promotion of recycling is, in effect, a subsidy on the waste generated by a 'throwaway' production system. This expenditure may well increase: there is pressure from industry for more public investment to support the attainment of recycling targets. The car recovery and recycling organisation, ACORD, for example, has stressed that its targets could only be met if the Government invests in incinerators to burn the shredder waste.

Whether a significant increase in the recycling of consumer durables is a realistic commercial proposition is uncertain. A major expansion might bring the commercial benefit of economies of scale, but on the other hand, the marginal cost of recycling is liable to rise sharply as waste becomes more dispersed and intractable.

The main influences on the profitability of recycling are the volume and quality of recyclable materials, the extent to which discarded products are geographically dispersed, and the available market for recyclate (i.e. secondary materials recovered from scrap). The cost of producing this recyclate is, in turn, determined by factors such as disassembly times and the degree of contamination.

Cars, for example, are worth recycling because they contain a large amount and relatively high proportion of recyclable scrap metal, for which there is a ready market. Plastic housewares represent the opposite extreme; they are widely dispersed, each contains little material and the market for that material is very weak. The variety of materials in products is important. Recycling is most cost effective when there is a large volume of homogenous material. Thus scrap steel from demolished buildings or shipbuilding is even more desirable than that from cars and large appliances, while the scrap value of most small appliances, which contain a large number of different materials in relation to their volume, is insignificant.

Perhaps the most fundamental problem affecting profitability is that recycling preserves only the value of materials in products, which represents a relatively small proportion of the total 'value added' in the production process. A major report on end-of-life electronic equipment concluded that for nearly all items the cost of recovering materials would exceed the scrap value (Roy, 1991). Another report suggested that in a hypothetical piece of electrical equipment weighing 10kg, not too dissimilar in composition from a television, the value of scrap materials would be only £1.71 (Bashford, 1993, p.68). According to Wim Bruens, Environmental Manager at Philips, recycling a television set will always be unprofitable and the best that can be hoped for is to reduce the loss by redesigning sets.[18] The company has estimated that, in contrast to the DM38 (around £15) typically charged for collecting televisions, the actual cost is DM100 (£41). The main problem, Bruens argues, is that raw materials are too cheap.[19] Another company, Noell, which has operated a pilot scheme in Germany for recycling telephones, claims that a scrap telephone is worth 30 pfennigs (around 12p) but costs DM3 (£1.20) to recycle.[20] In the vehicle sector Horst-Henning Wolf, the head of BMW's recycling programme, has described the programme's costs as 'frightening' (Nieuwenhuis and Wells, 1994, p.156). The amount of time involved in the manual disassembly of cars results in labour costs which may (at least for plastic) exceed the value of materials recovered. In other words, the problem is not simply that raw materials are too cheap, but that they are too cheap relative to labour. One solution might be automation in order to reduce the labour costs involved in disassembly, but this involves major investment expenditure and the benefit of increased employment is lost.

Although products are increasingly being designed to improve their recyclability by, for example, making disassembly more easy, other trends in design are not so positive. Like many economic activities, the profitability of recycling improves as volumes increase, but lightweighting and miniaturisation reduce the flow of materials and make them more dispersed. Materials substitution is another factor which makes recycling less promising. The substitution of gold in electronic equipment with nickel-on-palladium or silver reduces the value of discarded products.

The trend towards substituting plastics for metal is even more significant. Reference has already been made to cars. Whereas once vacuum cleaners were mostly metal they are now typically over 70% plastic. The trend is similar for other products, from washing machines to personal stereos. Given the absence of a healthy market for polymer recyclate, this trend presents an obstacle to sustaining – let alone increasing – present levels of recycling. At present less than 1% of post-consumer plastic waste is recycled. A key problem is the need to separate the many different types of plastic. Consequently secondary material generally costs more than virgin material of the same quality.[21] For some products the different plastics could be standardised to facilitate recycling, but this would involve over-specifying, which increases the cost to the consumer.[22] Only when there is a very high volume waste stream of a standardised product does recycling plastic become commercially realistic. However, even recycling telephones, of which over 2.5 million are recovered annually, is apparently not profitable (Roy, 1991, p.33).

One final factor affecting the commercial equation which ought to be noted is that scrap markets tend to be volatile. Without a strong and growing demand for new recycled *products*, matching the supply of secondary materials arising from increased recycling, the price of scrap material is liable to fall and make the whole exercise uneconomic.

Technical limits

No comprehensive study has yet been carried out of the potential implications of an industrial system in which recycling is the norm for most products, but one concern would be the contamination of materials and the possibility that there might be absolute technical limits to recycling.

The performance of materials depends on a certain minimum level of purity, which can obviously be affected by the use of scrap (Figure 3). The effects of contamination are complex, but excessive residual elements can render material unusable, or at least reduce its value. For example, copper in ferrous scrap in excess of 0.2% can cause steel to be brittle. Residual elements of tin and nickel can also be harmful. Zinc from galvanised steel oxidises in steel-making, creating voluminous dust that causes problems in furnaces and increases the residual waste.

The implications for the quality of products of a gradual and sustained increase in impurity levels are largely unknown. In *Design for Recyclability*, Michael Henstock has at least addressed the threat: "Scrap is a recirculating load; each time that it is recycled it can introduce fresh contamination, cumulatively raising the impurity level of the basic steel scrap. Such stock, when eventually it forms scrap, is of ever-diminishing acceptability" (Henstock, 1988, p.27). He points out that the purity of steel fell after the first world war, because of copper and tin impurities resulting from recycling scrap during the war, and notes that it has never returned to pre-war levels. One report has suggested that the average copper content of fragmentised scrap steel has risen from 0.2% to about 0.3% since cars and white goods began to be processed in shredders (Poll, 1993, p.29).

The current technical obstacles to recycling plastics have been well documented (e.g. Ogilvie, 1992; Roy, 1991; Sarson, 1992; Williams, 1991). There are a large number of different types of plastic and many cannot be recycled together. Either separation or over-specification (both of which add to costs) is required. Fillers and additives, used to colour plastic, make it electrically conductive or change its density, may inhibit or prevent recycling. There are, in any case, limits to the number of times which plastic can be recycled because its properties degrade after a few cycles.

More generally, the current state of technology is such that a substantial number of materials cannot be recycled, including thermosetting plastics, ceramics, composites and coated materials. Thermosetting plastics include polyesters (used in furniture and, for heat resistance, in items such as toasters and circuit boards) and formaldehyde (used in saucepan handles), and account for around 40% of plastic used in cars. Nor can important components such as CRTs (cathode ray tubes) in televisions, which contain heavy metals, or, indeed, the LCD (liquid crystal display) components which are superseding them.

In summary, it is likely that large consumer durables made primarily of metal will remain recyclable but it is unlikely that recycling will be profitable for many other items of electronic equipment and most small electrical appliances without a significant change in raw material prices. Henstock issued a stark warning: "A general trend is observable towards the use of smaller quantities of metals in consumer goods, and their replacement by polymers and other non-metallics (and) the use of complex materials or mixtures of materials...Taken to its logical conclusion, this trend could lead towards the virtual cessation of the recovery of secondary materials from post-consumer scrap and a corresponding increase in the amount of materials discarded in irrecoverable form" (Henstock, 1988, p.5).

Most non-electrical consumer durables – such as sofas and carpets (which represent a considerable proportion of bulky domestic waste) and any products made predominantly of plastics, wood or natural fibres – are unlikely to be commercially recyclable in the near future. The ultimate fate of a discarded carpet, for example, will probably still be use in cellars, garages or keeping rain off compost heaps – in other words, some form of product-life extension – rather than a recycling bin.

4 The longer life option

The previous section suggested that recycling does not represent the 'ultimate' green solution to our throwaway culture. In assessing the means by which to cut the amount of waste generated in modern industrial economies, the standard model used is the 'hierarchy of waste management options', which prioritises different measures for dealing with waste (Figure 4).[23] The order in this hierarchy suggests that increasing the durability of products and improving after-sales services, in order to extend their use, ought to take precedence over recycling, which is rated third.

Recycling reduces waste but does not *minimise* it – an important distinction. It is essentially an 'end-of-pipe' response (although recyclability may require modifications in design at the start of a product's life cycle). As such, it barely affects the inherent flaws in a production system which make manufacturers dependent upon ever-increasing throughput for their profitability. By contrast, increased durability requires more radical change at the point of production. It represents a 'front end' response.

In its major report *Sustainable Development: the UK Strategy*, the Government suggests that the hierarchy of waste management options mirrors the requirements of sustainable development. Acknowledging past flaws, the report then states: "It is salutary, therefore, to consider the extent to which current waste management practice in the UK operates towards the bottom of this hierarchy." (H.M. Government, 1994, pp.150-1)

Most significantly, having identified waste minimisation as at the top of the hierarchy, the report continues: "***Effective waste minimisation is not just a question of reducing unwanted outputs from the manufacturing process. It also involves producing... longer lasting products***" (ibid). This recognition is welcome, but it now needs a Government led initiative to encourage appropriate action.

This section thus explores the potential environmental impact of a strategy to encourage longer lasting products, the benefits to consumers, and the implications for industry and government. It should be stressed that any such strategy should be to *optimise* rather than *maximise* life span. Durability should not be treated as an end in itself. There must be allowance for the fact that the gradual replacement of outmoded models may bring environmental gains,

Figure 4: THE WASTE HIERARCHY FOR CONSUMER DURABLES

REDUCTION IN ENERGY AND MATERIALS USE

less material in products

less waste in manufacture

lower energy consumption in production and use

longer lasting products

↑

REUSE OF PRODUCTS

extending product-life through secondary transactions

reusing components once original product is discarded

repair and reconditioning of malfunctioning, underperforming or broken products (perhaps upgrading)

↑

MATERIALS RECYCLING

converting scrap products or components into usable secondary materials

↑

ENERGY RECOVERY

producing energy by burning waste or using landfill gas

↑

LANDFILL

landfill without energy recovery

Source: NEF.

especially if the environmental performance of products is improved through technological advance. For example, Porsche established a research programme on the potential for a 'long-life car' and studied cars designed to last 25-30 years but concluded that the optimal life span would be 18-25 years (Nieuwenhuis and Wells, 1994, pp.160-1). Before considering the implications of increasing the life span of consumer durables, it will be helpful to highlight some of the main influences upon it.

Influences

Three of the key influences upon the life span of consumer durables may be summarised as fitness, functions and fashion.

The failure of a product to work effectively, a loss of *fitness*, is the most obvious explanation for the discarding of products. Whereas a century ago products were manufactured to last as long as possible, most now have a predetermined 'design-life'. The ease with which a product can be repaired is an important factor. The increased complexity of products sometimes makes them more difficult to repair, especially with electronic devices such as printed circuit boards. A product's life span is also affected by the quality of care given to it by the owner and the owner's expectations of future reliability and service life (Figure 5).

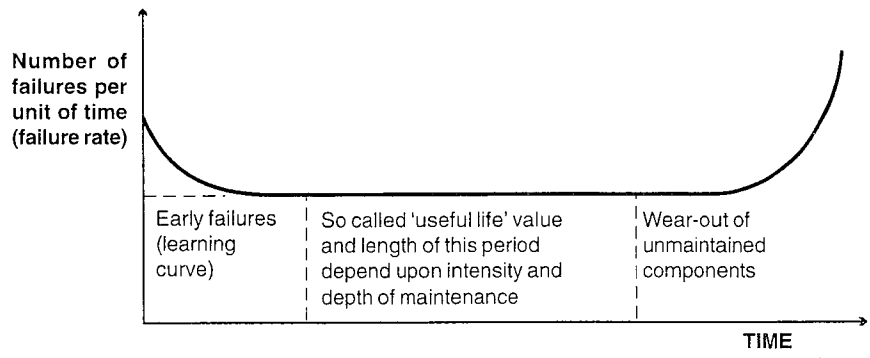
People's ability to get products repaired may well depend on the availability of spare parts. Although trade associations have codes of practice, recommended periods for stocking parts are sometimes below the average life span of products. For example, AMDEA (the Association of Manufacturers of Domestic Electrical Appliances) recommends to its members that parts for refrigerators and freezers are stocked for eight years even though such appliances typically last for ten to twelve years. Some companies vary from the industry norm: the Consumers Association found that appliance manufacturer Miele keeps functional parts for 15 years, whereas Haden stocks parts for only 2-4 years.[24]

Another important influence is technological change, which leads people to replace ageing products with new models which may appear of higher quality or offer more extensive *functions*. For example, computers have become more powerful with each generation of microprocessor, washing machines have faster spin speeds, telephones contain new features such as last number redial, and televisions have remote control and stereo sound. Occasionally genuine environmental improvements are offered, such as increased energy efficiency.

Some products are upgradable and consequently there is less pressure to replace them. Personal computers can be upgraded with faster microprocessors, for example, and in Germany well over a million cars have been retrofitted with catalytic converters (Nieuwenhuis and Wells, 1994, p.167). Currently, however, few consumer products are designed to be readily upgraded.

Thirdly, replacement sales are stimulated through the influence of periodic changes in design which are essentially concerned with *fashion*. Superficial changes are made to the appearance of, say, electrical goods for no purpose other than to make past models appear out of date and encourage people to replace them as quickly as possible, even if they still function effectively. Annual or seasonal 'face lifts' are also applied in order to inspire sales staff to appear eager and excited about products to customers, in the hope that this might increase sales.

Figure 5: BATH TUB CURVE SHOWING THE RELATIONSHIP OF NUMBER OF FAILURES AGAINST TIME



Note: More frequent maintenance lowers the bottom of the curve subject to diminishing returns. Taking more components into maintenance prolongs the flat portion. Scheduled preventive maintenance correctly carried out acts on *components* to reduce average failure rate of the *system*.
Source: BS5760: Part 0: 1986.

The cultural context

The main obstacles to increased product life are not technological. As the OECD report concluded, citing a leading scholar, R.T. Lund: "From a technical point of view there is no question that longer-lived appliances could be made. This is freely agreed upon by manufacturers of these products" (OECD, 1982, p.15). More important are the cultural and economic pressures which generate the throwaway mentality which has become so prevalent in society. In short, society has become more acquisitive, individualistic and profligate, each of which has an impact on product life.

As society has become increasingly acquisitive, people have come to *expect* that certain consumer durables will need to be regularly replaced, whereas once they were regarded as long term investments and lasted for several decades. Sofas, which are replaced on average every 8 years, are an example. Demand for innovative products such as microwaves and portable telephones tends to grow rapidly. In addition, people have a strong preference for products which are new and for these there is an extra 'virginity value'. This is reflected in the heavy depreciation in the price of second hand goods: the sales value of a car, for example, drops by 50% after the first three years – barely 25% of its expected life span.

This trend is long established – R.H.Tawney's *The Acquisitive Society* was published in 1921 – and is reinforced by a shift in our political culture towards individualism. Market pressures have been used to steer people towards private ownership. The relaxation of credit controls a decade ago, for example, enabled the purchase of consumer durables without a deposit. In contrast, shared or communal facilities, such as launderettes, tend to be held in low esteem. Moreover, it often costs little more to purchase than to rent items such as televisions.

At the same time, despite this individualism, people do not live or act in total isolation. Each individual's behaviour in buying products and services is influenced by that of others, which is in turn affected by societal aspirations. In other words, the overall level of consumption is not simply the sum of isolated choices, but may partly be explained by social psychology.

In economic debate there is acceptance across all political boundaries of 'consumer sovereignty', the idea that social welfare is maximised when the demands of individual consumers are treated by Government and industry as of paramount importance. This can be criticised on at least two grounds. Firstly, it depends on a false assumption that consumers are autonomous, able to be viewed and understood outside of a social or environmental context. Secondly, it implies that people have an unqualified 'right to consume', which in effect represents a denial that there are absolute environmental limits to consumption. There are also philosophical and, more specifically, ethical objections to reducing people to mere 'consumers'.

The third dimension which needs to be touched upon briefly is profligacy. People often criticise the economic 'system' or blame others for our throwaway culture, but many do not themselves keep products for as long as they could. One survey, albeit modest in scale, found that around a quarter of electrical appliances discarded at civic amenity sites were still functioning and a further quarter could be repaired for a minimal cost.[25] It would certainly be wrong to depict people in general as reluctant victims of fashion. Fashion serves as a means by which many people can display affluence to others and possession of a 'latest model' is an important influence on purchasing behaviour. This is nothing new – Thorstein Veblen defined it almost a century ago, in *Theory of the Leisure Class*, as 'conspicuous consumption'.

Not surprisingly, then, there is an inverse correlation between income and the average life expectancy of consumer durables. Relatively expensive products are replaced less frequently during economic recessions. From a global perspective, they tend to be maintained for much longer periods in the poorest countries. This international dimension is highly significant. Many consumer durables are imported into affluent, high-wage countries from countries where labour costs are relatively low. One of the consequences is that people in the richer industrialised countries are able to afford to purchase consumer durables, but when they need to be repaired this is relatively – perhaps prohibitively – expensive because repairs are carried out with higher paid domestic labour.

Environmental implications

The overall impact of these powerful and complex influences upon consumer behaviour has led to an economy in which many products have sub-optimal life spans. What advantages, therefore, are offered by seeking to change this?

First, the potential for environmental gains. A general increase in the life span of consumer durables would reduce the throughput of energy and materials, resulting in less use of finite resources, lower emissions of pollutants (including greenhouse gases), and a smaller amount of residual waste to dispose of as landfill.

Comprehensive data is not available, but a rough, common sense estimate would suggest that doubling the life span of

Figure 6: LIFE-CYCLE ASSESSMENT MATRIX FOR WASHING MACHINES

	Production +	Distribution +	Use +	Disposal =	TOTAL
ENERGY (MJ)	2,072	146	48,000	33	50,251
CRITICAL AIR VOLUME ($1,000m^3$)	37,025	1,654	2,457,000	705	2,496,384
CRITICAL WATER VOLUME (dm^3)	11,763	2,132	307,000	240	321,135
SOLID WASTE (kg)	51	4	622	36	713
WATER GENERATION (l)	6,152	154	280,000	0	286,306

Source: UK Ecolabelling Board (1992).

products should halve their net environmental impact. In the late 1970s the study by Porsche of long-life cars concluded that if cars were built to last for 18-25 years there would be a 55% saving in materials, while research by the Batelle Research Centre in Geneva found that increasing the average life span of cars from 10 to 20 years would almost halve the consumption of energy used in production (Nieuwenhuis and Wells, 1994, pp.160-1; OECD, 1982, p.58; Stahel and Reday-Mulvey, 1981, p.75). More recently, a hybrid cool storage facility, combining the features of a traditional kitchen cupboard and a refrigerator, has been designed at the University of Wuppertal; this is intended to last as long as the house and to need seven times less material than the ten conventional fridges which it would replace during its life span.[26]

Environmental benefits from increasing the life span of products by improved design and appropriate after-sales care would normally exceed those from recycling, not least because most of the components remain physically intact. In addition, the various methods of extending the life of products can usually be carried out locally, whereas the processes involved in delivering discarded products to recycling sites and in manufacturing and distributing replacements involves considerable transportation.

The main argument on environmental grounds *against* increased product life concerns the possible sacrifice of improved energy efficiency in new electrical products such as washing machines and personal computers.

Such research as has been published suggests that for major electrical appliances the scale of most environmental impacts is greatest in the use phase of product's life cycle, rather than during the production, distribution or disposal phases (e.g. UK Ecolabelling Board, 1992). Even so, it is extremely doubtful that improved energy performance could justify replacing a functioning product: the extra energy involved in replacing a car, for example, is likely to offset any benefit in terms of improved fuel efficiency in newer models according to Sweden's vehicle testing authority (Nieuwenhuis and Wells, 1994, p.166).

It should also be noted that environmental improvements in new models of products are sometimes offset by other innovations. In cars, for example, the weight of extra features such as electric motors for windows and sunroofs often cancels out gains in basic fuel efficiency. Moreover, technological change may *increase* the environmental impact: frost-free refrigerators, for example, have a higher energy consumption than conventional models, and the average new vacuum cleaner uses more energy than those being replaced. In any case, it should be emphasised that in most new ranges the products are *not* improved in terms of environmental impact.

Another concern about increasing a product's durability is the possibility of increased materials consumption for thicker surfaces or add-on diagnostic parts, and the use of non-recyclable materials, coatings and fillers. Such concerns may occasionally be valid. A more likely requirement for increased durability, however, is better quality materials, fixtures and fittings, which would not necessarily have a greater environmental impact.

In summary, therefore, the effects on the environment of longer lasting products will almost invariably be positive.

LIFE-CYCLE ASSESSMENT

At the level of the individual product, there remains a multitude of unanswered questions concerning the relative merits of recyclability and durability. In determining priorities and making choices, an immediate problem is that adequate technical data for quantifying environmental impacts does not yet exist. The most promising methodology is 'life-cycle assessment' (LCA), through which various environmental impacts are identified and quantified at each different stage in a product's life: production, distribution, use and disposal.

An estimate of product life is essential for accurate LCAs, as this determines the appropriate multiplication factor for the 'use' phase (the annual impact in use is then multiplied by the total number of years of service provided by the product). In determining optimum life, the production, distribution and disposal impacts avoided per year of additional life would need to be compared with any reduction of annual impact in use achieved through, say, greater energy efficiency.

The methodology is evolving and demands more research, but it should eventually enable the impact of products which are recyclable and durable to different degrees to be compared; for example, a product designed to last five years, one that will last ten years, one that is recyclable and one that is not.[27]

In a report on washing machines commissioned by the UK Ecolabelling Board, PA Consultants carried out an LCA and concluded that "for nearly all environmental impact measures, replacement with a more efficient model would seem to be clearly preferable to increased longevity" (UK Ecolabelling Board, 1992, p.36). However, their LCA (Figure 6) did not include the impact of raw materials extraction (which was deemed unquantifiable) and the calculations were based on a somewhat optimistic claim by manufacturers that the average washing machine lasts for 14 years. In addition, there is no certainty that consumers will choose the more efficient models as replacements, as they tend to be more expensive.

Consumer benefits

As a nation we spend around £36bn annually on consumer durables, a sum equivalent to over £140 per month for each household. Almost a half of this is accounted for by the purchase of vehicles.

It is obvious that many people enjoy shopping for new products. On the other hand, many find shopping a chore and have little interest in fashion. They simply want good service from products and would prefer *not* to have to replace items so frequently. Yet they have little choice, because for many types of product the main differences between models aimed at the 'mass market' relate to function and cosmetic features. Increasing the availability of longer lasting products would thus give consumers the benefit of greater choice.

An understandable concern for consumers is that such products might be too costly. It is possible that products designed for increased durability will be more expensive, but any increase in price may well be offset by the longer service life. One difficulty is in identifying which models are likely to be the most durable and whether a premium

price represents good value. A survey by the National Consumer Council found that 80% of consumers considered accurate information on product life expectancy and reliability to be 'essential' or 'very important', while 40% thought that information actually provided was 'fairly poor' or 'very poor' (National Consumer Council, 1989, p.20). Often they have little to guide them about a product's likely life span other than vague claims or manufacturers' reputations. Guarantees do not last long enough to act as a guide and extended warranties, often marketed as providing long term security, have been severely criticised by the Consumers Association for their poor value.[28]

At present, consumers are aware of the 'point of sale' price. In order to enable them to identify the products which genuinely offer the best value for money, however, they need to know the annual cost of getting the service provided by the product (i.e. the *cost per unit of service*). For example, a toaster costing £25 which lasts for six years provides better value than one costing £15 which only lasts for three. Charles Ware, author of *Durable Car Ownership*, has calculated that the costs of a Morris Minor maintained over 20 years would be roughly half those of a less durable car purchased and replaced every 3 years over the same period (Ware, 1982, pp.23-4). Such information should accompany any increase in price in order to reassure customers. Awareness of true costs would be particularly useful to poor people, who can least afford to keep replacing low quality items which appear cheap but are not durable. In practice, however, they might need low interest loans as well as information in order to afford more expensive products.

If there is to be a substantial move away from our acquisitive, individualistic and profligate culture, perhaps more fundamental change is needed. A leading specialist in product life, Walter Stahel, has argued that it is imperative to replace the current 'fast replacement' production system with one based on the 'optimal utilisation' of products. In the latter system, people would explore the best means of utilising the services which products provide rather than merely maximising their consumption. Stahel concludes that instead of acquiring and owning products households would increasingly hire or lease services (Giarini and Stahel, 1989; Jackson, 1993). It is, after all, the service which provides true value to the consumer – the clean clothes, mobility, heating and television programmes – not the hardware. The products would be owned and maintained by suppliers (either manufacturers or retailers) who would have an incentive to increase their durability.

Over the past fifty years people's expectations of durability have, for many products, fallen. However, just as they now expect products to be safe, there is no reason why they should not expect them to be durable. Product liability legislation was developed to protect consumers as individuals against unsafe products. The risks from a lack of durability are more diffuse, affecting the collective wellbeing of people on the planet, but this is no excuse for ignoring them.

Opportunities for industry

The potential benefits of increased product life spans to the environment and to consumers are reasonably self-evident. Industrialists, on the other hand, may be concerned that their companies would suffer from reduced sales.

Manufacturers and retailers are well aware that the markets for televisions, refrigerators and vacuum cleaners are saturated, and that few households are now without washing machines and telephones (Table 4). Dependent on replacement sales, they fear that longer lasting products would reduce their future income. Another worry is that the higher price of longer lasting products would reduce consumer demand. Many manufacturers of consumer durables tend to be instinctively conservative and most compete on similar terms, with a strong emphasis on price and style rather than durability. Where demand is elastic (i.e. sensitive to changes in price), a high-volume manufacturer which increased its products' durability and thereby incurred higher costs would take a significant risk.

Such concerns are understandable. However, it has been pointed out that the extra cost involved in increasing the design life of products can be exaggerated and can in any case be passed on to consumers to the extent that they are convinced that the product represents good value (Jackson, 1993, p.272). A practical example of the success which can be achieved by developing longer lasting products is the Swedish car manufacturing industry. Volvo and Saab, which

ALUMINIUM CARS: THE BEST OF BOTH WORLDS?

An example which highlights some of the complexities in seeking to minimise environmental impact through recyclability and durability is the prospect of increased aluminium in cars (Henstock, 1988, pp.119-24; OECD, 1982, pp.61-4). Some forecasts predict that the aluminium content in cars is likely to rise from around 5% to 20% (Henstock, 1988, p.121). Aluminium, like steel, is recyclable and an executive car made predominantly of aluminium, such as that recently launched by Audi, could last for 20 years, a considerable increase on the current norm of 11-12 years.[29] It would also have improved energy performance because of reduced weight.

Processing primary aluminium from bauxite is very energy-intensive, but producing secondary aluminium cuts energy consumption by 95%, and so the environmental impact of an aluminium-based car relative to a typical steel-based model would depend heavily on the proportions of primary and secondary material used.[30]

A further complexity is that primary and secondary materials are not always perfect substitutes. Most reclaimed aluminium, because it contains impurities, is believed to go into casting alloys rather than wrought alloys.[31] However, on the basis of American evidence, Henstock suggests that casting alloys account for a mere 20% of aluminium consumption (Henstock, 1988, p.120). Moreover, any increase in demand for aluminium from the car industry is likely to be for *wrought* alloys (because of the performance required for structural parts). As wrought grades cannot currently be made from recovered castings, increased aluminium in cars and consequent recycling could result in an excess of castings relative to wrought, threatening serious disruption in the aluminium market and the possibility of *increased* open-cast mining of bauxite.

More secondary material could, in principle, be used for wrought, but this would require better identification and segregation processes. Until then, different aluminium body parts must be recycled separately.

enjoy strong reputations for the durability of their vehicles, have nearly 40% of the domestic market where, even with a severe winter climate, the average life expectancy of cars is now over 17 years. They have performed well despite a period of rapid growth in the average life span of cars, from 9 years to 16 years between 1965 and 1982 (Nieuwenhuis and Wells, 1994).

Aside from cost and price considerations, manufacturers which increase the design life of their products and offer comprehensive after-sales services such as repairs and upgrading are likely to be rewarded with increased customer loyalty and thus would strengthen their position in the market. An association with the higher quality end of the market could benefit them, although they would need to assess their market position and the prospect for growth in the premium sector. Another advantage is that it might be possible to lengthen design cycles and thus spread development costs over a longer period. Such changes would enable companies to shift the source of their profitability from maximising sales volumes and benefiting from economies of scale to increasing the 'added value' of products through improved quality.

The planning involved in a strategy to increase product life spans could lead businesses to extend their 'environmental foresight', preparing them for future trends, legislation and breakthroughs in environment-friendly technologies. One trend already underway is towards a 'product stewardship' business culture, in which manufacturers accept responsibility for products throughout their complete life cycle, including the point at which they are discarded, the principle of 'extended producer responsibility'. The initial response of many manufacturers to this trend, reinforced by the threat of 'take back' regulations, has been to investigate the recycling potential of their products. It might be more advantageous to increase their life spans, thereby reducing the return flow of discarded products.

One of the concerns for industrial designers is the extent to which recyclability and durability are complementary. Designing products for recyclability and durability might involve similar requirements. For example, ease of disassembly makes separating materials easier at the end of a product's life, thereby improving recyclability. It also makes repair and upgrading work more practical and cheaper. In addition, the use of high value materials, either for electronic circuitry or structural parts, can make a product both more recyclable (as its scrap value will be greater) and more durable (being more hard wearing).

There may, however, be potential conflicts. For example, the type of materials or method of construction used to improve durability may inhibit recycling. Ceramics, composites and plastics may be more durable than the materials which they replace, but, as noted earlier, tend not to be recyclable. Use of galvanised steel inhibits rust in cars, thus lengthening life spans, but the zinc makes recycling more problematic. In assembling products with plastic casing the use of screws makes access for repair work easy, thus facilitating a lengthier service life, whereas plastic snap lock fittings can have a tendency to break. At the end of such a product's life, however, screws hinder recycling if it is shredded (rather than disassembled manually), because the output will be a mix of plastic and metal.[32]

Thus there may be occasions when industrial designers may have to make choices. According to Paul Burall, author of *Green Design*, if conflict *does* arise durability should normally take priority, as suggested by the waste hierarchy: "It is wrong to see recycling or ease of disposal as the only, or even the most important, concern for the green designer. The first consideration should be the life of the product itself" (Burall, 1991, p.53).

In practice, it is the marketing department of companies rather than the design department which is more likely to determine strategic priorities. Here, too, a company that wishes to communicate a clear and simple message will need to choose carefully. Selling recycled or recyclable products is an obvious way to give a company a 'green' image. On the other hand, durability could well be more easy to market, as it is self-evidently in the consumer's personal interest, whereas recycling depends on a degree of environmental altruism.

One of the constraints upon increased product life noted earlier concerned technological advance. Industry could prepare for this by designing products to be upgradable (although there are obviously limitations). Products could be designed with distinct functional modules (i.e. structural elements, the 'skin', wear and tear components, and control components), standard interfacing and low interdependence of components. Manufacturers are often aware of potential future improvements, such as increased energy efficiency, through unexploited research or by observing higher quality products not yet widely available in the domestic market. A Government commissioned report, *Energy Efficiency in Domestic Electric Appliances*, for example, has described likely improvements in the energy efficiency of refrigerators, freezers and televisions, while suggesting that little technological improvement can be expected in washing machines, cookers, dishwashers, kettles and irons (March Consulting Group, 1990).

Table 4
WHO OWNS WHAT

	% households	
	1964	**1992**
Refrigerator	34	99
Television	80	99
Telephone	22	89
Washing machine	53	88
Deep freeze/fridge-freezer	n.k.	85
Video	0	72
Car	37	68
Microwave oven	0	59
Tumble drier	neg.	49
CD player	0	33
Home computer	0	23
Dishwasher	neg.	16

Note: n.k. = not known (the earliest available figure, published in *Regional Trends 28*, is 47% in 1980/81).
neg. = negligible.

Sources: Central Statistical Office, (1993). *A report on the 1992 Family Expenditure Survey*, London: H.M.S.O. ; Central Statistical Office, (1994). *Social Trends 24*, London: H.M.S.O.; NEF estimates.

Manufacturers may have to consider more fundamental change. On the basis that the economic system must ultimately change from the contemporary 'fast replacement' production system, Stahel and Jackson argue that "commercial innovations are necessary to decouple the profitability of commercial enterprises from the throughput of goods for consumption" and that the source of future profitability could be the sale of services rather than products (Jackson, 1993, p.288).

A related idea is suggested by Paul Nieuwenhuis who, in a rare academic paper on product life, speculates that in future "car producers might make their money not primarily by making and selling new cars, but by selling spares, repair and afterware through their dealer networks to keep their own products on the road for a long time" (Nieuwenhuis and Wells, 1994, p.170). Such a transformation might appear rather dramatic, but manufacturers with foresight will be responsive to new market conditions. Nieuwenhuis highlights the fact that the status of used car sales has been raised in Sweden (where car life spans have increased dramatically), with strong marketing, high profile display areas and, in the case of Volvo, used car brochures.

Already a small number of manufacturers stress durability. For example, ASKO, the Finnish white goods manufacturer, states that its washing machines are designed to last for fifteen years with daily use and offers a unique five year parts and labour guarantee. Linn, the Scottish hi-fi manufacturer, claims that its products are designed for long term upgradability. The cars of top range manufacturers such as Rolls Royce, Mercedes-Benz and Porsche have always had to be durable, as have Land Rovers, which last, on average, for 30 years.

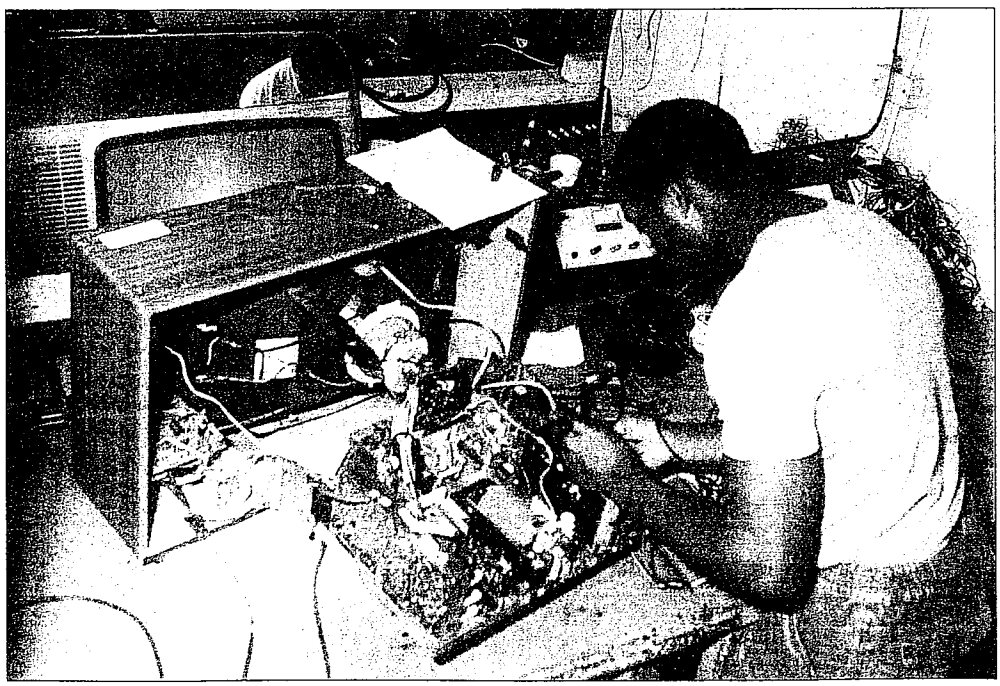
Companies which manufacture products intended for above average life spans have tended to be found at the premium end of the market. Significantly, though, volume manufacturers such as Philips, Braun and Miele have stated publicly in recent years that they intend increasing their products' life spans. They have evidently concluded that there will be net benefits from such a strategy, and that gaining a competitive advantage through increasing quality will outweigh any loss of replacement sales. John Cridland, the CBI's Director of Environmental Affairs, considers product durability to be one of the key issues emerging on the environmental agenda for businesses.[33] Even so, if there is to be a widespread shift towards increased durability much will depend on the extent to which the Government changes the commercial climate in order to encourage environmentally sound practices.

Issues for governments

Contrary to the fears sometimes expressed that increasing the life span of consumer durables would harm the economy, such a trend would, in fact, bring advantages in terms of traditional economic goals such as a healthy trade balance and increased employment. Repairs, re-conditioning and other service work would nearly always be carried out in Britain, whereas many new consumer durables are imported – around a half of all cars and domestic electrical appliances. Thus there would be a beneficial impact on the balance of trade. Another positive effect would be on employment, as such work tends to be relatively labour-intensive. This would have the added advantage of being geographically spread and weighted towards people with manual skills.

There could be other social gains, some of them not immediately apparent from the traditional economic indicators. If products are readily repaired and people are less frequently faced with the need to purchase replacements, the pressure for ever higher incomes might ease. In addition, the 'informal' sector of the economy, upon which socially deprived groups often depend, should gain. Second hand transactions often benefit charity shops, while a growing number of community based organisations repair old appliances and furniture and provide them at a discount to local people suffering from poverty. Repair work is also carried out in the expanding number of Local Exchange Trading Systems (LETS), through which people exchange skills outside the formal 'money' economy using community based local currencies.

Man repairing television



Perhaps the most fundamental conflict of all, however – and one which at some point the Government must resolve – is between the alternative economic scenarios described at the outset of this report. Is the aim an economy in which recycling is promoted as a means by which the throughput of energy and raw materials in the economy can best be sustained and, indeed, maximised? Alternatively, is it an economy in which there is a reduction in this throughput on the grounds that this is necessary for sustainable development?

Governments must ask whether recycling can satisfactorily absorb the volume

and variety of waste generated in a modern industrial economy. The key question is not whether recycling is *required*, but whether it will *suffice*. Is sustainable development possible with an economy in which products are recycled but no attempt is made to reduce final consumption?

It is hard to predict the effect of increased product life spans on economic output (GNP), the key indicator which politicians use to judge the performance of governments. Whatever the statistical outcome of a strategy promoting longer lasting consumer durables, however, it is important not to confuse the level of GNP with human welfare. As Jackson and Marks point out, expenditure on consumer durables cannot necessarily be equated with the value of services which they provide: "short term obsolescence of durable goods tends to inflate consumer expenditure without contributing to welfare, whereas improvement in the durability of goods increases the service value (welfare) associated with those goods without increasing personal consumption" (Jackson and Marks, 1994, p.12). The present use of output growth as a key economic indicator thus conveys an impression of ever-increasing affluence which is false, in part because it records the productive activity generated when consumer durables wear out prematurely. Any reduction in such activity would matter less if governments made a concerted effort to differentiate output from welfare and made use of new indicators of economic progress, such as the Index of Sustainable Economic Welfare, which the New Economics Foundation and other organisations are developing to complement GNP statistics.[34]

5 Conclusion and recommendations

Consumer durables all too often end up prematurely in landfill. The available evidence suggests that many do not last as long as in the past, most could be designed and manufactured to last longer, and some are discarded which still function. Far too little attention has been paid to durability by politicians, environmentalists, manufacturers and retailers in recent years, while many consumers are guilty of somewhat profligate behaviour. What, therefore, can we conclude?

First, despite increased environmental concern, *the British economy is not being steered onto an environmentally sustainable path*. For example, the Government has effectively rejected scientists' arguments that greenhouse gas emissions must immediately be reduced by at least 60%; its policy is to 'return' the level of emissions in 2000 to that prevailing in 1990. Little attention has been paid to possible medium term energy scarcities. The need for people in affluent industrial countries to reduce their consumption is barely on the political agenda, despite the implications for a world where population is rising fast and billions of relatively poor people aspire to the life styles of the rich. Many people in modern, liberal industrialised societies simply believe that they have a right to consume to their maximum potential. Politicians have not dared to deny their claim.

Second, *the move towards increased environmental sustainability will necessitate a substantial reduction in the throughput of industrial economies*. This requires a radical change in the relative price of labour and natural resources. As long as the full cost of extracting and using energy and raw materials is not included in the price of consumer durables (i.e. the environmental impact is not incorporated), there will be an undue economic incentive to replace items instead of repairing or upgrading them.

Third, *a strategy which merely improves society's capacity to absorb waste will not suffice*. It is a fallacy that there is no environmental impact involved in recycling. In order to overcome environmental problems created by the volume of consumption and waste in industrial economies it is necessary to take action which goes *beyond* mere recycling. Ultimately, it is more important to create longer lasting goods than to make them recyclable.

If pressure to move up the waste hierarchy is to be increased, some radical change is required. The following are proposed as recommendations to Government, local authorities, manufacturers, retailers, environmental and consumer organisations, and individuals.

Recommendations

(i) Action at all levels of government

Ecological tax reform is necessary to achieve the right balance in the use of labour and natural resources and thus a prerequisite for sustainable development. In Britain it should take the form of phasing out employers' national insurance contributions and phasing in higher taxes on energy (excluding domestic heating) and raw materials. It should be revenue-neutral. As a 'front end' solution it would be a far more effective means of reducing waste than proposals such as a landfill levy.

Changes to VAT should be made to provide an increased incentive to the sale of longer lasting products, preferably throughout the European Union (EU). The zero rating of repair work might encourage people to repair rather than throw away serviceable products. In Britain, the Institute of Wastes Management has proposed the reduction or elimination of VAT on products made entirely from post-consumer waste. Similar treatment should apply to products sold with significantly longer and more stringent guarantees than current industry norms.

In the EU Ecolabelling Scheme durability should in future be included among the criteria used in assessing relevant products.

Any EU proposals for 'take back' legislation should be carefully scrutinised to ensure that the reuse of products and components is encouraged rather than threatened.

Having publicly acknowledged the need for longer lasting products, the UK Government should, in developing its national waste strategy, outline the practical measures which it regards as necessary to encourage their manufacture and sale.

The Government should promote the new economic indicators which are being developed. These provide a more credible measure of progress than GNP, which only measures the level of economic activity.

Since the publication of the OECD report the available information on product life, far from being improved, has become out of date. The Government should therefore initiate a comprehensive research programme on product life to obtain the following:

- adequate data on product life
- improved understanding of the factors influencing life span, including consumer attitudes and behaviour
- independent life cycle assessments of recycled and longer lasting products
- an evaluation of the net employment impact of a strategy to increase product life
- an assessment of the potential for new forms of environmental innovation associated with longer lasting products.[35]

The Department of Trade and Industry is currently reviewing consumer guarantee legislation. If manufacturers (as distinct from retailers) assume more responsibility for guarantees, they might take more interest in long term product performance and have greater incentive to improve product durability. Reform might also help to pre-empt retailers from profiteering through the sale of extended warranties, which offer poor value for money.

One of the major obstacles to increased consumer demand for longer lasting products is the lack of information to enable them to judge whether to pay a premium price. Manufacturers and retailers should therefore be required by law to disclose the normal expected life span of consumer durables on the basis of reasonable conditions of use.[36] Manufacturers should be required to keep spare parts throughout this period.

In order to encourage more repair and reconditioning work and thereby extend the life of products, the Government should promote the development of second hand shops and markets, although it should examine regulations to ensure that consumers are confident that second hand products such as electrical appliances are safe and obtained honestly.

Local authorities should develop strategies higher up the waste hierarchy. These should include targets for waste reduction and reuse, to complement their recycling targets, and a programme to promote community awareness of their importance.

Waste disposal authorities should improve the data available on discarded products at civic amenity sites and elsewhere, as a first step towards recovering a higher proportion of usable products and components. Obtaining such information has been made harder as a result of the contracting out of such sites to private sector operators.

Waste collection authorities should explore ways of ensuring that small appliances and other household goods are recovered rather than lost amongst other rubbish in large wheelie bins.

(ii) Action by manufacturers and retailers

Industry should assess the marketing potential of durability as well as recyclability. One of the main reasons why in many product sectors competition is based so heavily on price and cosmetic appearance is that consumers lack adequate information on the design life of products. They would be more likely to buy higher value products if they had greater certainty that the benefits of an increased service life would outweigh the extra cost. Irrespective of any legal requirements, therefore, manufacturers and retailers should improve the quality of 'point of sale' information on the anticipated life span of their products.

Manufacturers should offer much longer life guarantees within an overall context of developing a stronger commitment to providing service and not simply hardware. This was a key suggestion of the OECD report. Such guarantees should be offered free of charge at the point of sale and cover labour and parts for at least 10 years for most household products.

Spare parts should be available for longer periods than current practice. Trade associations should amend their codes of conduct accordingly and manufacturers who guarantee parts availability in accordance with them should encourage retailers to display the appropriate information. Parts should be standardised where possible, which would be in the interest of consumers as this would increase their availability and make them cheaper.

Excessive delays for repair work is not unusual. One means of improving current practice might be for more companies to have computerised databases for repair and maintenance. Manufacturers ought to act more efficiently when supplying parts to independent service engineers and DIY repairers. They currently appear to lack an incentive because of the relatively small cash flow involved.

Regular servicing, together with high quality repairs, can make a significant contribution to extending product life spans. Service contracts should be encouraged, with explicit information given to the consumer as to the nature of servicing work carried out.

Industrial designers should apply the principles of 'eco-design' to their work, designing products for durability, ease of repair and upgradability wherever possible.

Manufacturers should evaluate the potential for a pilot scheme for leasing to households a comprehensive range of consumer durables designed for durability and ease of repair.

Consumers are often dissuaded from carrying out even basic repairs by manufacturers, who are concerned about product liability and aware of the profits to be gained from repair work. Products should be designed to be repaired by owners wherever possible and sold with comprehensive repair manuals.

(iii) Action by environmental and consumer organisations

Environmental organisations should devote more of their resources to campaigning for movement up the waste hierarchy. Now that the momentum for recycling has been generated, they should develop more comprehensive proposals to achieve 'reduction' and 'reuse', within a context of waste minimisation.

Organisations such as the National Consumer Council and Consumers Association should be more active in responding to consumers' concern about durability and to the greater

value for money offered by longer lasting products. Consumers should be encouraged to pay less attention to the 'point of sale' price and more to the anticipated 'cost per unit of service provided'.

The Sale and Supply of Goods Act was passed in November 1994 and durability is now one of the aspects of quality determining whether certain types of product are acceptable for sale. The interpretation of 'durability' by the courts should be carefully monitored by environmental and consumer organisations.

Such organisations have an important role in educating their members and the general public about the benefits of longer lasting products.

(iv) Individual action

Individuals must also play a part. As potential customers, they should demand better information about the durability of products and raise their expectations about the life expectancy of products.

Where there is no evidence from technical data that products have been substantially improved, consumers might do well to purchase end-of-range models, which are often heavily discounted.

Some manufacturers argue that the high incidence of returns to retailers results in substantial unnecessary waste. People should avoid returning undamaged products to shops, which is often a consequence of impulse buying.

Owners should understand the environmental significance of taking good care of their possessions. Periodic servicing can help to extend product life. Whenever possible products which stop functioning should be repaired, preferably locally, rather than discarded.

Fundamental change to our throwaway culture will be possible only if people resist the pressure to consume. Evidence that products which still function are being discarded suggests that many could make a greater effort to resist the temptation to buy replacement products prematurely.

Conclusion

The greatest of the environmental challenges which lie ahead is our need to adopt sustainable patterns of production and consumption. It is difficult to predict with certainty the speed at which a major transformation will be forced upon us, but the evidence is clear that change is imperative and it would be a great mistake to think that we have already done enough.

The development of recycling in recent years is welcome, but it will prove an obstacle rather than a stepping stone if it detracts attention from the more fundamental changes that are now required to reduce the excessive throughput of energy and materials in our economy. There is a longer life option which must now be chosen.

Footnotes:

1. Some definitions of consumer durables also include clothing and footwear, household textiles, recreational goods, and DIY goods.

2. The leading exponent in modern times is N.Georgescu-Roegen (see, for example, his essay 'The Entropy Law and the Economic Problem' in Daly (1980)).

3. Robert Ayres has calculated that 94% of all material (including ores, but excluding inert materials such as stone, sand and gravel) is converted into waste residuals as fast as it is extracted and only 6% is added to the stock of durable goods (Ayres, 1989, p.26).

4. This concept was the subject of a symposium at the American National Academy of Sciences in 1991. Research on a similar theme, 'industrial metabolism', linking the transformation of materials in the biosphere to that in industrial economies, is being carried out by (among others) Robert Ayres. See, for example, Ayres (1989) and Frosch and Gallopoulos (1989).

5. The sources for this data are Department of the Environment, 1992, p.162; H.M.Government, 1994, p.148; Poll, 1993, pp.8, 19, 33; Sarson, 1992, pp.2, 13. Data from another Government-commissioned study suggests that 600,000 tonnes of electrical appliances and a similar tonnage of other waste (mainly furniture and rubble) is taken to civic amenity sites (Environmental Resources Limited, 1992, pp.3, 5, 6, 147).

6. Manufacturers have claimed that the average service life of a washing machine is fourteen years, during which the first buyer keeps it for eight years and 'second hand' buyers for a further six years (UK Ecolabelling Board, 1992, p.27).

7. This was the majority view of the world's leading scientists on the InterGovernmental Panel on Climate Change. The minimum 60% figure was calculated on a global basis; Anderson has calculated that if international equity considerations are taken into account Britain should cut its emissions by 84% (Anderson, 1993, p.24).

8. 'Take back' legislation ends the traditional division of roles by which the private sector produces and consumes while the public sector disposes of the waste thereby created. Obligations for avoiding, recycling and disposing of waste are transferred to the private sector, thus giving industry an incentive to produce waste minimising products.

9. According to its proposal a further 13% would be incinerated (with energy recovered in the process, to heat buildings or generate electricity), whereas none is at present.

10. For example, according to a report on cooking appliances by market analysts Euromonitor: "Preoccupation with shortening product life is especially important in this market, particularly as the freestanding sector consists largely of replacement sales. Manufacturers are speeding up the rate of innovation and style changes" (Euromonitor, *Market Research Great Britain*, April 1992). A report commissioned by the Department of Energy noted declining life spans for vacuum cleaners, kettles and irons (March Consulting Group, 1990, pp.60, F7). Other independent authorities have similarly identified a trend towards shortened product life spans (e.g. *The ENDS Report*, No. 215, December 1992, p.14; Roy, 1991, p.16).

11. The durability of cars declined in the early post war years and they appear to have around the same life expectancy, 11-12 years, as they did in the early 1970s (Nieuwenhuis and Wells, 1994, p.157; OECD, 1982, p.42).

12. This contrasts with the Dutch national scheme, which in the criteria for chairs it is specified that they should be designed for ease of repair and that the availability of spare parts should be guaranteed.

13. Council Directive 91/156/EEC, amending Directive 75/442/EEC on Waste.

14. This fact has not gone unnoticed by more radical thinkers (e.g. Fairlie (1992) and Sandy Irvine, 'Recycle? Not if You can Help It', *Real World*, Autumn 1992, pp.4-6). For example, Friends of the Earth used to employ a Recycling Officer and have promoted returnable bottles, but have not yet actively campaigned on the life span of products. The Consumers Association has on several occasions covered recycling in *Which?* magazine, but has not yet given similar attention to product life.

15. A recent U.S. Environmental Protection Agency report has noted the lack of data to assess the nature and significance of such hazards, although like most publications on recycling, it unfortunately excluded coverage of consumer durables (U.S. Environmental Protection Agency, 1993b, p.1-4). The Department of the Environment is shortly to carry out a research project on the externality effects associated with recycling.

16. The two most important techniques used in recovering metals from scrap are pyrometallurgical (where scrap is heated until the metal fraction melts) and hydrometallurgical (where scrap is treated with a chemical which selectively removes some of the materials for recovery from solution). The latter is more environmentally friendly according to Sarson, as the solutions can be recycled and only small emissions to the atmosphere arise, but it can only be used to dissolve exposed material such as precious metals on circuit boards (Sarson, 1992, pp.28-9).

17. *The ENDS Report*, No.215, December 1992, p.14.

18. *New Scientist*, 4th September 1993, p.20.

19. Other problems relate to the large number of components, around 2,000, and the fact that a major component, the cathode ray tube, cannot be recycled. The dismantling time, often thirty minutes, is also significant (*New Scientist*, op. cit.).

20. *WARMER Bulletin*, May 1994, p.41.

21. Recycling vacuum cleaners, for example, is currently not feasible because recycled ABS plastic cannot compete in price with virgin material. *The ENDS Report*, No.223, August 1993, p.15.

22. For example, up to ten different types of plastic are used in television cabinets. These could, in theory, be replaced by polypropylene.

23. The term 'management' is unfortunate and unnecessary, as the context should be *minimising* rather than *managing* waste.

24. *Which?*, September 1991, p.521.

25. Tim Hunkin, 'Things People Throw Away', *New Scientist*, 24th December/ 31st December 1988, pp.38-40.

26. Wuppertal Institute leaflet, *Ecodesign*.

27. Comparisons between the environmental impact of manufacturing packaging from virgin materials and from recycled materials have already been made (Ogilvie, 1992, pp.105-6). Two difficulties raised with LCAs are determining the exact boundaries of studies and the method of aggregating environmental impacts. For example, a particular type of product might reduce the volume of solid waste but increase energy consumption: ultimately there is a need to determine whether reducing pressure on landfill or the threat of global warming is the greater priority.

28. *Which?*, September 1992, p.493. The Office of Fair Trading launched an enquiry into the sale of extended warranties in 1994. Criticism of the inadequacy of information for consumers is nothing new (see, for example, Packard, 1961, p.259).

29. *The Times*, 21st June 1994. A report on materials substitution in car manufacturing, cited in the OECD report, warned that increased longevity of cars with a greater aluminium content would depend crucially on the quality of design and manufacture (OECD, 1982, p.61).

30. A study of aluminium and steel cars comparing the energy consumption in both the manufacturing and use phases was carried out by the International Iron and Steel Institute, the findings of which were disputed by Audi and the aluminium industry (*The ENDS Report*, No.233, June 1994, p.25).

31. Virtually all aluminium used in manufacturing products is alloyed and these are classified commercially into 'wrought' alloys and 'casting' alloys according to the fabrication process used (Ogilvie, 1992).

32. The extent of conflict in design is thus influenced by whether the discarded product is to be shredded or disassembled manually, and more likely in the former case. It also depends on the added cost of making a product recyclable or durable.

33. Personal communication.

34. The Index includes an adjustment designed to take account of changes in product life, separating expenditure on consumer durables from the value of services flowing from the stock of durables (Jackson and Marks, 1994).

35. The ESRC Global Environmental Change Programme (Phase IV) invited research proposals on upgradability, which represents a welcome step in the right direction.

36. More information on this proposal is available from NEF. Manufacturers are already aware of the likely life span of products. Various techniques of accelerated life testing are available (e.g. use of higher loads, increased duty cycles, operation at higher than normal temperatures, assessing failure rates for components) and are already used in, for example, the aircraft and white goods sectors.

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THE *new economics* FOUNDATION

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1. Design Precedents

Because we need to understand more about how we have designed in the past in order to design more sustainably in the future, we need to start the design process with an understanding of what kinds of things have a determining influence on our designing. This might sound a bit nonsensical, but it really isn't. No design is 'original' in the sense that it has no heritage. Everything we design has some design precedent in the world and in our minds. For example, even if a piece of music sounds entirely new, with careful listening a mix of recognisable elements will emerge that nonetheless together in this new form might 'break new ground'. So before we begin designing anything, we have to carefully consider these precedents and what we can learn from them.

Exercises:

1. Create 3 headings across a page: Me; Product; Uses.
2. Under 'Me' write a short (20 word) statement about why you are designing this product. Then list all of the ideas you have or are starting to assemble related to this task: other designs you have seen and your impressions of them; elements you want to incorporate but you are not yet sure how to; influential images and other cultural forms. What is your overall impression of your product-to-be, what do you want it to communicate to the world?
3. Thinking about what needs your product must serve, what it must be able to do (function) and over what period of time, list under 'Product' as many specific products as you can that already do some or all of these things, even if not made specifically for the intended purpose. So for example, if you are designing a display for notes, messages, reminders (noticeboard) you might also list 'refrigerator' as a precedent.
4. Under 'Uses' list all the ways that you know people use the above products: how often and when are they used, are they used differently in different environments? What habits have they created: do people use them carefully and look after them or are they run fast and hard until they fall apart? You may need to interview users of these products to get a good picture of the range of these uses (See User Research on the left menu).
5. Select a 'proxy' product to work with. If possible, it should be nearing the end of its use-life. This product should be a 'benchmark' that is, what you consider to be the next best product around to what you are designing, perhaps a 'competitor'. By the time you finish this guide, you will know this product inside out and rather than replicating its successes, should be aiming to learn from its errors. The point here is to support front-end decisions by learning more about their consequences.