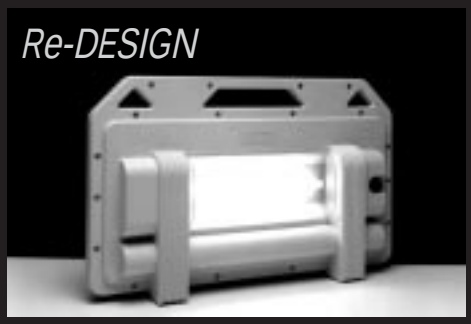
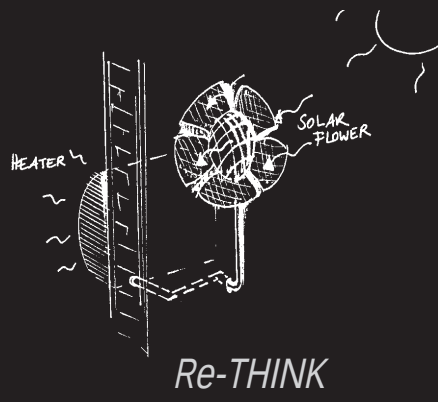
ISSUE 10 : JULY 1999

The Journal of Sustainable Product Design





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ISSN 1367–6679

Editorial information

Professor Martin Charter: Editor
and Journal marketing/production

Russell White: Gallery, Reviews, and Diary

The Journal of Sustainable Product Design encourages response from its readers to any of the issues raised in the journal. Entries for the Diary of events and material to be considered for review should all be sent to the Editor at the address below.

All articles published in the Analysis section are assessed by an external panel of business professionals, consultants and academics.

Subscription rates

The Journal of Sustainable Product Design is a quarterly journal appearing in the months of April, July, October and January each year. Subscription rates for one year (four issues) are £90.00 (UK) and £100 (non-UK) for the paper-based version, and £50.00 for the online version. Special subscription rates for developing countries and students are available on application. Cheques should be made payable to The Surrey Institute in £ sterling and sent to:

The Journal of Sustainable Product Design
The Centre for Sustainable Design
Faculty of Design
The Surrey Institute of Art & Design,
University College
Falkner Road
Farnham
Surrey GU9 7DS
UK
tel +44 (0)1252 892772
fax +44 (0)1252 892747
email: mcharter@surrart.ac.uk
internet: http://www.cfsd.org.uk

Editorial Board

Welcome to the tenth issue of The Journal of Sustainable Product Design

Professor Martin Charter

Editor, The Journal of Sustainable Product Design

Eco-design: a new core competence

If companies are to take advantage of the business opportunities and minimise the impact of changes that may emerge from a greener and/or more sustainable world, then new expertise and skills need to be developed. This will mean the need to create new forms of organisations, processes and products (solutions). Once we start to focus on products (solutions) we are starting to get to the strategic core of the firm. However, at present eco-design (eco-product development) or more broadly sustainable product design is not defined as a core competence. This is due to a lack of a perceived business need, unclear financial arguments and a weak commitment to the continuous integration of eco-design into the product creation process. Eco-design projects tend to be ad hoc and therefore knowledge is disparate and uncoordinated. There needs to be senior level commitment to the strategic importance of greener products and frameworks to manage eco-design need to be clearly defined and implemented. Building eco-design knowledge will come from collecting data and transforming it into information for decision-makers who then gain knowledge and experience over time. If managed well this knowledge will permeate into corporate culture eg. the sum of organisational eco-design knowledge is greater than its individual parts. There will need to be knowledge development covering both how to manage eco-design systems and processes, as well as understanding the technicalities of eco-design. Eco-design knowledge involves a rich mix of technical and non-technical informational inputs from materials and energy considerations, to reverse logistics and legislative changes to awareness of eco-benchmarking and competitive activity. To enable the development of an appropriate organisational infrastructure will mean moving from the existing engineering mindset of eco-design to a broader, more outward orientated strategic focus. Therefore to successfully manage eco-design will require a complex corporate neural network that captures, processes, stores and disseminates information from and to formal and informal systems. In the short-term this will primarily relate to environmental and financial aspects of eco-efficiency, but in the future social and ethical aspects will become an important part of the process.

Capturing eco-design knowledge

In today's turbulent times of corporate re-structuring, business process re-engineering, faster new product development and information exchange there is a need to develop systems to retain knowledge and expertise in the firm. Generally there is a lack of experience and skills in eco-design and more broadly eco-product development, therefore if the 'eco-design expert' leaves the firm then the knowledge leaves with him or her! (if a knowledge collection infrastructure has not been established). This may mean that competitive advantage may be lost. With the lack of availability of specialists, this will mean the need for the training of non-specialists who have been given the 'eco-design brief'. This is likely to be a huge learning and experience curve for the average manager. This will mean the need for the development of new training approaches and the 'knowledge delivery systems' to enable faster performance. A planned approach to knowledge building, education and training and

information collection is a good starting point.

The establishment of Product-related Environmental Information Systems (PREIS) structured to fulfill strategic, tactical and operational goals is a first step. Both formal and informal information should be researched. It has been highlighted in some surveys that eco-design knowledge often comes from outside the firm through informal networks, workshops and conferences. Some companies are now starting to use intranets to disseminate eco-design knowledge more widely. Some intranet managers are making links to external, as well as, internal websites for the benefit of internal and external business partners. For example, the environmental manager or eco-designer may consider eco-design tool X developed by university Z to be useful and this may be added to the intranet, or he or she may simply highlight a useful website. However, there should to be a policy to hunt and collect information, if pockets of project experience are not to be missed. For example, a product section of an environmental management intranet may successfully highlight eco-labels worldwide, market research summaries and new legislation but there may be no documentation procedures to collect information on ad hoc eco-design projects in separate business divisions or countries. For example, there might be a project being completed in a US division into the dismantlability of PC 'A' and a similar project in Sweden in PC 'B' but no common knowledge is shared or disseminated within the firm.

Developing, retaining and building eco-design knowledge and competencies will become a key element of successful environmental and business performance and strategic advantage into the next millennium.

Overview of this issue

Issue ten of the Journal of Sustainable Product Design continues the trend of recent issues and explores some of policy level developments covering greener markets and products. Nick Robins, Coordinator of Sustainable Markets Group, International Institute of Environment and Development (IIED) in the UK discusses sustainable consumption with real examples from around the world. He argues that present governmental approaches to sustainable consumption (beyond green consumerism) are addressing the issues in a piecemeal manner rather than from a strategic and systemic viewpoint. Professor Martin Charter and Inga Belmane, Coordinator and Researcher at The Centre for Sustainable Design in the UK further explore the emerging Integrated Product Policy (IPP) and Environmental Product Policy (EPP) debates and the relationship with eco-product development drawing on examples from the electronics sector. Cristina Rocha and Professor Han Brezet, Researcher and Director, Design for Sustainability programme at Delft University of Technology in the Netherlands discuss the new and emerging the concept of Product-Orientated Environmental Management Systems (POEMS) highlighting an example of its application in a the truck manufacturing company. Edwin Datschefski, CEO of Biothinking International, UK discusses eco-product development issues in the white goods sector and then highlights some of the future opportunities that may arise from the application of sustainable design to products in this sector. The Innovation section includes an article from Ursula Tischner, Director of ec(o)ncept in Germany which explores the day in the life of a sustainable solutions designer in 2020. The Sustainable Product Research Network (SPRN) section focuses on research projects from Sweden and the UK covering the potential for dematerialisation in developing countries, chain management in the organic food market, remanufacturing, product-related environmental communications and industrial designers involvement in eco-design. The O2 pages cover a new publication that highlights 90 examples of eco-design worldwide, and the development and implementation of a new eco-design project in Belgium.

Due to the high quality of articles in this issue the Interview and Review sections have been held over to the next issue.

As always The Journal for Sustainable Product Design welcomes thoughts, comments and ideas in relation to the articles in this issue. •

Making sustainability bite: transforming global consumption patterns

Nick Robins

Coordinator, Sustainable Markets Group, International Institute for Environment and Development, UK

Nick Robins has more than 10 years experience with international environment and development issues, focusing on European Union policy-making and business practice. He is currently the Coordinator of International Institute for Environment and Development's (IIED) new Sustainable Markets Group. His work aims to find practical ways of delivering the transformation in global markets – in trade, investment, corporate responsibility and consumption patterns – that sustainable development requires. He is co-author of a number of recent IIED publications, including 'Unlocking Trade Opportunities', 'Consumption in a Sustainable World', 'Rethinking Paper Consumption' and 'Incentives for Eco-Efficiency'. Before joining IIED in 1993, he worked at the European Commission in the run-up to the Earth Summit and also contributed chapters on corporate strategy and clean technology to the WBCSD's 'Changing Course' publication.

This paper reviews the lessons learned in the global policy dialogue on sustainable consumption since the Earth Summit in 1992. It draws on the conclusions of the 1998 Kabelvåg workshop, 'Consumption in a Sustainable World', hosted by the Norwegian Ministry of Environment. The paper shows how consumption has now become a global policy priority and then identifies some of the critical issues that remain. Globalisation means that changing consumption patterns is no longer the exclusive responsibility of the affluent economies. Furthermore, the paper explores how the sustainable consumption agenda has moved beyond the 1980s green consumer movement by taking a more strategic and systematic approach to the underlying factors influencing behaviour. Many of the solutions to consumption problems lie in collective choices, but governments in post-modern, secular societies have generally proved unwilling to stimulate wide public debate and action about new forms of 'quality of life'. The result is a series of policies seeking to achieve 'sustainability by stealth'. The paper closes with a set of priorities for improving global cooperation on sustainable consumption.

Global consumption in crisis

Almost forty years ago at the height of the post-war economic boom, Vance Packard sounded perhaps the first warning note about the downside to the modern consumer society. In 'The Waste Makers', Packard argued that America had become 'a force-fed society with a vested interest in prodigality and with no end in sight to the need for ever-greater and wasteful consumption' (Packard, 1960). Coining the phrases 'planned obsolescence' and the 'throw-away society', Packard pointed to the serious social, economic and environmental consequences of an unchecked expansion in consumption. At the time, few paid attention to his critique. But now, forty years on, the need to make consumption patterns sustainable has risen to the top of the global environment and development agenda.

The reasons for this turnaround are clear. The scale of global consumption has expanded dramatically, growing as much as four-fold since 1960, reaching $24 trillion in 1998. But this runaway growth in spending has put unprecedented burdens on

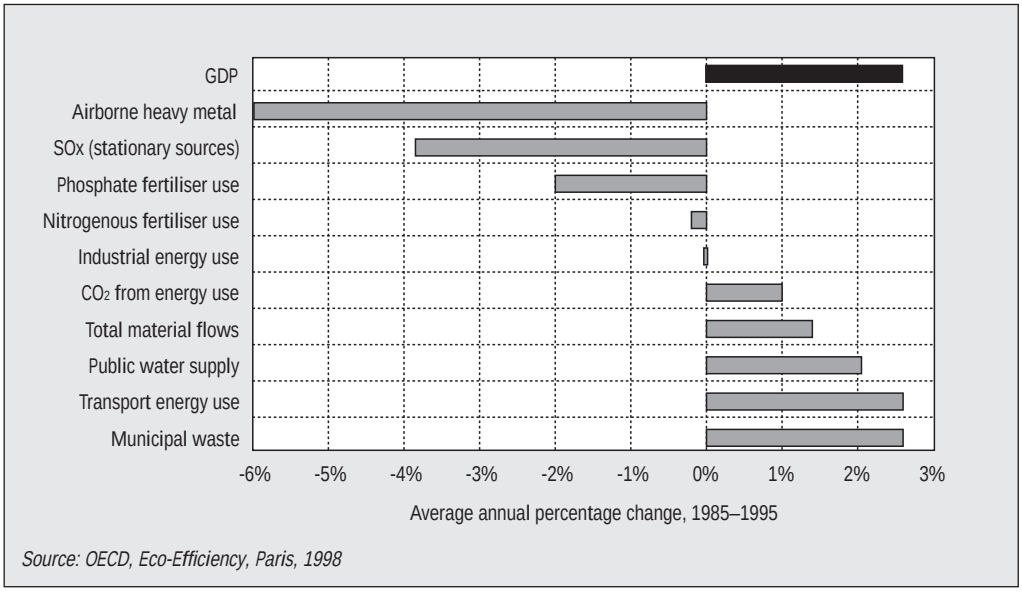

Figure 1. OECD trends in GDP and key eco-efficiency indicators, 1985–1995

the environment. As the 1992 Earth Summit recognised, 'the major cause of the continued deterioration of the global environment is the unsustainable pattern of consumption and production, particularly in the industrialised countries, aggravating poverty and imbalances' (UNCED, 1992). Since Rio, this policy conclusion has become translated into a much wider awareness that consumption patterns will need to be transformed over the coming decades in the post-industrial economies of Europe, North America and East Asia if sustainability is to be achieved. Here, the goal set by the Wuppertal Institute in Germany for a 'factor 10' reduction in the use of materials and generation of pollution by the middle of the next century has become a useful indicator of the scale of change required (Schmidt-Bleek, 1996).

The immensity of the changes needed in consumption patterns is illustrated by the problem of climate change. By 2050, the world's population could have grown to about 10 billion people. Now, the atmosphere can absorb about 10 billion tonnes of carbon dioxide (CO_2) a year before carrying capacity limits are breached. If distributed equally this would mean that each person on the planet could sustainably generate a tonne of CO_2 each year. But per capita emissions of CO_2 currently stand at almost 20 tonnes a year in the USA, 10 tonnes in Britain and four-fifths of a tonne in India (Carley and Spapens, 1998). The emission reduction targets agreed at the Kyoto Summit in 1997 provide at best a modest platform for these much deeper cuts in greenhouse gases. While many of these emissions are generated by industrial production, a growing proportion come from consumption. New types of action on the demand-side are required.

In fact, the long-term economic shift from a smokestack to a service economy has meant that while pollution from production has generally fallen across the industrialised world, the environmental burden from consumption has grown remorselessly (see Figure 1). The switch from 'production to pleasure' has meant, for example, that the growth in mobility and household comfort since 1973 has raised energy use almost as much as improved design has brought efficiency gains (Schipper, 1994). A new model of the Ford Ka, for example, produces only two per cent of the NOx emissions of a 1976 model of the Ford Fiesta (CSD, 1999). But these qualitative improvements at the micro-level

have been more than outpaced at the macro-level by the volume growth in car use and ownership.

This structural shift means that environmental policymakers are now being forced to broaden their gaze beyond technical solutions to encompass the messy and contentious social realm of consumption – and in particular to re-examine the links between consumption and 'quality of life'. As Juliet Schor has shown in the USA, the contemporary 'cycle of work and spend' can bring high social costs, not least in terms of rising consumer debt (Schor, 1998). Over 80% of Americans believe that they 'buy and consume far more than [they] need' (Merck Family Fund, 1998). Although there is evidence that a growing number of Americans (and some Europeans) are 'downshifting' to simpler and more sustainable lifestyles, many others feel stuck on a treadmill of pressures to conform to ever-rising consumption, largely due to inflexible working practices (Ghazi and Jones, 1997). Global expenditure on advertising now amounts to $435 billion per annum and is a powerful force for continued consumption, potentially neutralising the parallel growth in environmental awareness among consumers.

Understanding global linkages

But not only are today's dominant consumption patterns unsustainable, they are also inequitable. The world's richest countries make up only a fifth of global population, but account for 45% of all meat consumption, 58% of total energy use, 84% of paper use and 87% of vehicle ownership. At the other end of the spectrum, the poorest fifth of the world's population – more than one billion people – still lack food, shelter, housing, water and sanitation and access to electricity. Given these extremes, today's global pattern of consumption remains structurally skewed in favour of 'private affluence and public squalor', to use the phrase of Packard's contemporary John Kenneth Galbraith (Galbraith, 1958). For example, basic health care and nutrition for all would cost about $13 billion a year, while more than $17 billion is spent on pet food in Europe and the USA alone (UNDP, 1998). The task ahead, according to Ashok Khosla, president of Development Alternatives in India, is 'to 'raise the floors, bring down the ceilings and plug the leaks': in other words, meet the needs of the poor, limit excessive consumption by the rich and ensure all consumption respects environmental limits (Turaga, 1998).

Yet, globalisation is blurring the traditional distinctions between North and South. A global consumer class is emerging, sharing common lifestyles despite being separated by great distances – and generating similar environmental impacts (Barnet and Cavanagh, 1994). One estimate suggests that by 1996, the emerging middle class of China, India, Venezuela, Brazil, Argentina, South Korea, Taiwan, Indonesia, Malaysia and Thailand amounted to roughly 750 million, almost as many of the

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880 million consumers in the industrialised countries – not all of whom are affluent (Brandsma, 1996). Already the richest fifth of Chileans and Malaysians enjoy higher incomes than the average German or Japanese (Barnet and Cavanagh, 1994). Indeed, East Asians are now 'leaders of post-modern consumerism', renowned for their extravagance in luxury goods and prompting the establishment of a recent National Campaign against Excessive Consumption in Korea (Gong, 1999). In China alone, the spread of car ownership could reach current levels in the UK by 2020. This would mean 400 million more cars, doubling global iron ore use and massively increasing landscape destruction, local pollution and greenhouse gas emissions (Nordic Council of Ministers, 1999). Despite the recent shock to living standards in Asia, there is no reason to believe that the upward surge in consumption will not continue in emerging economies over the long-term. Meanwhile, the poorest fifth of the world's population continues to be left out of the global consumption, with the average African household consuming 20% less than it did 20 years ago.

Faced with this, the former premier of Norway, Gro Harlem Brundtland concluded that, 'it is simply impossible for the world as a whole to sustain a Western level of consumption for all. In fact, if 7 billion people were to consume as much energy and resources as we do in the West today we would need 10 worlds, not one, to satisfy all our needs' (Brundtland, 1994). The world appears to be faced with a consumption crunch: either both North and South move together – recognising the primary responsibility of the affluent to change – or the global prospect is bleak.

The trouble with consumption

The 1990s have witnessed a growing consensus that something must be done about consumption. But disagreement frequently starts when discussions turn to questions of what should be done, how much and by whom. In an attempt to work through these global tensions towards a shared vision of the way forward, the Norwegian Ministry of the Environment invited more than 50 participants from more than 28 countries to the 'Consumption in a Sustainable World' workshop at Kabelvåg in June 1998 (Robins and Roberts, 1998a).

One immediate lesson was that a lack of conceptual clarity and analytical rigour has often held back agreement and action. It is often unclear whether sustainable consumption refers to the use of natural resources – an environmentalist's interpretation – or to the expenditure on goods and services, the definition used by economists. A second confusion lies in the fuzzy boundaries of the consumption debate, whether it focuses exclusively on the demand side of the economy or addresses the life cycle linkages of production and distribution. Disagreement also exists over the extent to which sustainable consumption should concentrate simply on the environmental dimension or should also tackle the distribution of consumption. Indeed, it often appears that those engaged in the sustainable consumption agenda are not talking the same language (see Figure 2).

Talking the same language?

'The issue is not to stop consumption but to re-distribute it in a fair way.'
Business Executive, Colombia

'When we talk about sustainable consumption we are talking about usefulness per unit of value.'
Government Official, OECD

'Simply because we are a developing country, simply because our resources are valuable and our means are limited, we have to take care of resources and consume in a sustainable way.'
Independent Analyst, Egypt

'The only way that conflict (over) sustainable consumption between North and South can be resolved is that the discussion should start with alleviating poverty in the South – otherwise people will find it hard to accept.'
Environmentalist, Ghana

'If we are to improve consumption, we feel good about it, pay attention to it, do it well, have fun – in other words, celebrate consumption'
Researcher, USA

Source: 'Consumption in a Sustainable World', 1998

Figure 2 : Sustainable consumption – different perspectives

A systematic approach

Working through these uncertainties, a broad understanding of sustainable consumption emerged at the workshop. Sustainable consumption has grown far beyond the 'green consumer' movement of the late 1980s and early 1990s. Then, the emphasis was on providing eco-products for niche markets serving affluent consumers, supported by modest policy initiatives such as eco-labelling. Now, the focus is more systematic, emphasising the need to:

- make goods and services serve sustainable development: meeting basic needs, improving 'quality of life', raising efficiency and regenerating the environment
- reform the underlying patterns of demand, such as market forces, demographics, social and cultural values, technology, regulation, infrastructure
- use the demand side to lever long-term social, economic and environmental benefits in use and along the product chain ('rucksacks')
- influence the purchase, use and disposal choices made by corporations (supply chain) and public authorities, not just individual consumers
- identify innovative political, cultural and market approaches to comprehending and changing complex patterns.

Sustainable consumption is thus best seen as a strategic perspective. It seeks to tackle the 'hidden wiring' of demand which ultimately determines the success or failure of micro-level improvements to product design and marketing. The task is to create the conditions which improve the capacity to choose, use and dispose of goods and services sustainably: in other words, to bring alternatives in from the margins and institutionalise them so that there is a fusion of individual choice with equity and sustainability requirements. The Kabelvåg meeting showed that there is no shortage of inspiring examples of change in policy, corporations and citizen action in favour of sustainable consumption: Figure 3 contains a range of examples presented at the meeting. *The issue is now one of strategic design: re-wiring the consumption system.*

Examples of change

Mumbai Grahak Panchayat, India: a collective purchasing scheme for 16,000 households is providing good quality food at low cost and generating environmental benefits.

Green Purchasing Network, Japan: over 1000 companies, public authorities and citizen groups are introducing practical guidelines to promote the purchase of sustainable goods and services.

Pro-Local Supply, Austria: municipalities are stimulating local production for local consumption, boosting 'quality of life' and reducing transport.

Waste Collection Charge, Korea: a volume-based garbage fee is cutting waste generation and transforming the packaging industry.

Remanufactured Copiers, Xerox: taking back and reusing old copiers has reduced environmental impacts, waste and costs, and improved customer service.

Trans-Century Environmental Tour, China: a popular television programme is reaching a wide audience with features on good and bad practice.

Town Twinning, Belfort, France: a joint venture between Belfort in France and Mohammedia in Morocco is raising public awareness, stimulating participation in local policy and promoting solidarity across the Mediterranean.

Source: Consumption in a Sustainable World, 1998

Figure 3: Sustainable consumption in practice

Sustainability by stealth?

The importance of taking a strategic look at the consumption system as a whole has been highlighted in a recent report from the Nordic Council which assessed the feasibility of achieving a 'factor 4' and 'factor 10' improvements in materials use and pollution by 2030 and 2050 respectively. Ernst von Weiszaecker and Amory Lovins' bestselling book, 'Factor Four: Doubling Wealth, Halving

Despite the growth in national strategies, plans and policies statements… governments are seeking to achieve sustainability by stealth, introducing modest policy changes, but not communicating the need for more structural change or confronting vested interests.

Resource Use' contained a host of practical examples of technical innovation delivering far-reaching environmental and service improvements (von Weizsäcker and Lovins, 1998). But the systemic barriers to their diffusion remain daunting, according to the Nordic Council's report. The study assessed four case studies: transport in Denmark; forest products in Finland; real estate in Norway; and food in Sweden. In the case of transport, the report concludes that 'it does not seem possible to reach factor 4 and 10 targets without substantial changes to and reductions of the service offered to motorists by the present modes of transport'. In fact, progress will require 'substantial changes in values in preferences related to the environment; the service and mobility expected from the transport system; and the way production, consumption and daily life is organised' (Nordic Council of Ministers, 1999). The report highlights that there is still a fundamental gap to be filled between technical improvements at the micro-level in terms of new goods and services that can generate 'factor 4' and 'factor 10' improvements in efficiency, and changes at the macro-level in the overall consumption system.

Many of the solutions to unsustainable consumption thus lie in collective choices. Governments have the primary responsibility for putting in place the framework that shapes consumption choices and have a profound steering role through utility regulation and public expenditure in many critical consumption clusters, such as food, energy, water and transport. Yet, in secular, post-industrial societies, most governments have so far been reluctant to show leadership and stimulate public debate on the 'wider vision of welfare in which the satisfaction of needs, rather consumption *per se*, is the aim' (OECD, 1997). Indeed, despite the growth in national strategies, plans and policies statements, there remains an overriding impression that governments are seeking to achieve sustainability by stealth, introducing modest policy changes, but not communicating the need for more structural change or confronting vested interests. In Korea, for example, a recent initiative to tax cars according to engine size to encourage more fuel efficient vehicles was removed after pressure from US car producers keen to sustain exports of their luxury cars.

To fill the vacuum often left by inadequate government action are a growing number of initiatives that extend the responsibility of business for consumption. The Forest Stewardship Council (FSC) is a notable example, where the failure of governments to adopt an effective international agreement to curb deforestation led to the introduction of a market-based certification system. In the UK, around 100 companies accounting for about 15% of the UK market for timber products have committed to source only FSC certified timber in the future. UK supermarkets have also been a primary driving force for the introduction of integrated crop

management techniques for food production and more recently for withdrawing genetically-modified foods (GMF) from sale. Similarly, development campaigns have prompted many companies to adopt social codes of conduct to ensure decent labour standards in their developing country subcontractors. But while these voluntary initiatives can often move further faster than government action they are by no means a substitute for formal frameworks. In many ways, they demonstrate what is possible and prefigure new types of policy.

For government positions to change, sustainable consumption will need to become popular and politically attractive. This will mean going beyond the moralistic approach that has dominated many efforts to date. This can appear threatening, implying 'giving up' for the affluent and 'losing out' for the poor. Instead, an emphasis on improving 'quality of life' for all could prove more successful, stressing the value that individuals and institutions can achieve through changes in consumption behaviour. Sustainable consumption has to add up to a lifestyle that people both want and is within their reach – 'low-impact affluence' in the words of Germany's Wuppertal Institute (Sachs, Loske and Linz, 1998).

Achieving the global shift

After a decade of dialogue and dispute, sustainable consumption has now arrived as a global policy priority. The United Nations Development Programme (UNDP) has outlined a seven point agenda for action (UNDP, 1998).

A seven point agenda for action

- Ensure minimum consumption requirements for all
- Develop eco-efficient goods and services
- Remove perverse subsidies and restructure incentives
- Strengthen public action for consumer protection
- Strengthen international mechanisms to manage consumption's global impacts
- Build strong alliances between consumer, poverty and environment movements
- Foster synergies between civil society, the private sector and government.

Figure 4: *UNDP's checklist for sustainable consumption*

Alongside this, the United Nations Environment Programme (UNEP) has established a new sustainable consumption programme, one of whose first actions was to work with the advertising industry to develop a wider sense of corporate responsibility. An Oxford Commission on Sustainable Consumption has been also been launched in early 1999, bringing together international experts to tackle the social, cultural, ethical and institutional changes that will be needed. The 1999 session of the United Nations Commission on Sustainable Development (UNCSD) reviewed international progress on the issue, highlighting globalisation and urbanisation as two crucial trends for future work.

What separates today's efforts to achieve sustainable consumption from Vance Packard's proposals for reform in the 1960s is not necessarily any change in the content of what's required: in fact, there is an eerie sense of deja vu reading Packard's five points for more 'enlightened consumption' (see Figure 5). But what has changed dramatically is the arena for action. Globalisation and the growing integration of consumption patterns worldwide poses an unprecedented collective dilemma. As the American writer William Greider has put it: 'if industrial growth proceeds according to its accepted patterns, everyone is imperiled. Yet, if industralisation is not allowed to proceed, a majority of the world's citizens are consigned to a permanent second-class status, deprived of the industrial artefacts that enhance life's comfort, the tools that multiply human choices. The world has entered new ground, a place where people have never been before. We will have no choice but to think anew' (Greider, 1997).

Globalisation does not mean that local and national action are no longer necessary or important, but it requires five step changes in the ways we approach consumption (Robins and Roberts, 1998b).

- **Extending responsibility in the North**: In the global economy, consumers and producers will have to take a far broader sense of their responsibility for increasingly distant impacts. Upstream, there is already mounting pressure to improve standards along the supply chain and downstream, business is increasingly required to take a life cycle responsibility for the emissions and wastes that their products cause. But at a more strategic level, the post-industrial economies of the North will need to accept responsibility not just for the direct environmental impacts of their consumption patterns, but also for the demonstration effect these have on aspirations in emerging economies. For Hans-Peter Martin and Harald Schumann, there is 'no doubt about it: if humanity had to vote today on a choice of lifestyle, it would know what to do. Uniform pictures on a billion television screens nurture the same longings on the Amur, Yangtse, Amazon, Ganges and Nile' (Martin and Schumann, 1998). Achieving this will require a considerable imaginative leap for consumers, business and policy makers. A first step would be to focus on the sustainability of the goods and services marketed by multinational corporations in emerging economies, who, according to the Third World Network, are 'responsible for most of the world's resource extraction, pollution and generation of consumer culture' (Third World Network, 1997).
- **Leapfrogging in the South**: In many ways, the South has not yet invested in the physical infrastructure, technological capital, lifestyles and regulations that drive unsustainable consumption in the North. In India, the Tata Energy Research Institute (TERI) has recently assessed the country's environmental performance in the fifty years since independence and projected future trends. One of their key conclusions is that 'it is vital that we are not locked onto paths that lead to a sub-optimal dependence on a particular technology', such as the automobile (TERI, 1998). The issue for developing countries is therefore to take preventive action, 'leap-frogging' over conventional consumption patterns. But 'to leapfrog you need legs' and many of the developing countries lack the capacity in terms of institutions and expertise to analyse the situation, assess their needs and implement strategies to change course (Wijkman, 1999). New forms of international cooperation are clearly required to help fill these gaps.
- **Generating new cultures of consumption**: Linked closely to the leapfrogging imperative for the South is the importance of re-evaluating the role of traditional lifestyles and values in the face of mounting consumption. For Josefa Bautista, Vice President of the Development Academy of the Philippines, the critical issue is 'to look back to our ancestors' culture and reinculcate its treasure of sustainable living' (Carley and Spapens, 1998). For TERI in India, market signals can certainly drive home the environmental implications of consumption. But these need to be reinforced through 'an assertion of traditional Indian values. Blind aping of the West will lead us to disaster, environmentally, economically and socially'. The question is how developing countries can develop hybrid cultures of consumption that combine eco-efficient technologies with traditional ethical approaches to nature and society. For the North, where traditional values of frugality and caring for nature have been more thoroughly replaced by the current consumer culture, the task of reinvention is that much greater. One possible route is to encourage more links between the generations. For example, in the community of Steigen in the north of Norway, the Local Agenda 21 has helped to regenerate traditional knowledge about local food and materials by establishing a Generation Cafe, where older people can share their skills with others.
- **Building confidence and trust**: Running through the global policy dialogue on sustainable consumption is a sense of deep distrust by the South of the North. Sustainable consumption is seen as a way of denying developing countries the fruits of development and also posing new green protectionist trade barriers against their exports. The industrialised world is also seen

to have reneged on the Rio bargain in terms of increasing the volume of financial assistance to support the transition to sustainable development in the South. Given the increasingly global nature of the consumption crisis, practical mechanisms are needed that help to build up trust between governments, business and civil society internationally. IIED is currently engaged in dialogue with a number of governments and research institutes to launch a new Global Sustainable Consumption Partnership. The aim of the Partnership would be to bring together a number of countries North and South who would engage in the first coordinated assessment of current consumption patterns and also carry out a visioning exercise to lay down national scenarios for sustainable consumption. The country teams would then to engage in a thorough process of exchange and peer review, particularly enabling country teams from developing countries to evaluate the experience in the North. The Partnership will enable countries to root the global debate in national realities and to better communicate the complexities and dilemmas into international policy negotiations, notably the Rio+10 summit scheduled for 2002.

Much has been achieved in the global debate on sustainable consumption over the past decade. The need to change consumption – a highly contentious political issue – is now accepted. While many problems remain, 'sustainable consumption is only as difficult as we make it', according to one of the participants at the Kabelvåg meeting, adding 'there are many things which could be put into action now – let's do it!'

Developing enlightened consumption patterns

- Restoring pride in prudence, tackling built-in obsolescence
- Restoring pride in quality, ensuring better product labelling
- Respecting the eternal balance, protecting the environment
- Facing the unmet challenges, targetting social needs
- Achieving an enduring style of life, balancing consumption with values.

Source: The Waste Makers, 1960

Figure 5*: Priorities for sustainable consumption – déjà vu*

Conclusion

This paper has attempted to show why the transformation of consumption has to be at the heart of any strategy for sustainable development. The environmental burden from consumption is growing and eco-efficiency improvements at the product level are proving insufficient to cope with volume growth at the macro-economic level. The role of consumption in delivering 'quality of life' is also being questioned, and globalisation is both highlighting the inequalities in consumption across the world and resulting in high-consuming sectors within many emerging markets.

The sustainable consumption agenda has moved on from the green consumerism of the 1990s, and seeks to tackle the 'hidden wiring' of demand which ultimately determines the success or failure of micro-level improvements to product and service design. Many of the solutions to unsustainable consumption lie in collective choices, and the challenge for governments is now to develop new conversations with society to jointly resolve the embedded nature of the problems. To date, however, most governments have sought to achieve 'sustainability by stealth', introducing modest policy changes that do not question prevailing lifestyles and consumption expectations. New forms of policy dialogue are required to link the flourishing growth in corporate and community initiatives with the necessary policy reform at the national level to achieve critical mass.

Transforming consumption is now a global concern and the paper closes with four priorities for building greater cooperation internationally. The affluent industrialised countries need to take an extended sense of responsibility for their consumption patterns, not just the direct impacts, but also the aspirations and models they generate elsewhere. The South too has an opportunity to take preventive

action and 'leapfrog' over conventional consumption patterns. Together, the dominant culture of consumption will need to be re-evaluated, perhaps in the South by drawing on traditional values and in the North by a more thorough reinvention.

Finally, at the political level, confidence and trust needs to be built up through programmes of joint analysis and learning. •

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Integrated Product Policy (IPP) and eco-product development (EPD)

Professor Martin Charter and Inga Belmane

Co-ordinator and Researcher, The Centre for Sustainable Design, UK

The paper explores the current debate over Integrated Product Policy (IPP) and its relationship to eco-product development (EPD). IPP is a policy initiative of the EC's Environmental Directorate (DGXI) that aims to address environmental impacts of products, taking into account the life cycle perspective. The paper gives a brief overview of the IPP, presenting EC developments, and an example of a national Environmental Product Policy (EPP) approach from Denmark. The authors propose a simplified perspective which suggests that IPP is a strategy to *green* the marketplace through the integrated implementation of policy tools to *green* consumption (demand) and product development (supply). The co-ordination of tools on supply and demand side is necessary in order to achieve optimal results. This co-ordinated approach has not yet happened. The second part of paper focuses on the concept of eco-product development (EPD) and how it relates to IPP developments, particularly in the electronics sector. There is also discussion over the relationship between IPP and supply chain management, communications, EMS (Environmental Management Systems) and innovation.

Introduction

Integrated Product Policy (IPP) is a government policy toolbox aimed at greening markets that incorporates tools to *green* consumption (demand-side) and tools to *green* product development (supply-side). It is a part of a growing trend within certain environmentally advanced countries in Northern Europe towards environmental policies aimed at products and it represents a new shift in thinking towards 'front of pipe' eg. product development and design. Generally, existing approaches have focused on processes ('end of pipe' technologies and 'middle of pipe', eg. waste minimisation, cleaner production, and pollution prevention). IPP is a policy concept that takes a lifecycle perspective ('cradle to grave'), includes all relevant stakeholder viewpoints and considers the product development process from idea generation to product management and reverse logistics (ie. 'end of life' management (EOLM)). However, in reality the holistic model of IPP is yet to be implemented at EC or national level.

Martin Charter has held strategic planning, product development and marketing positions for Save & Prosper, Reed Exhibition Companies, the Creative Marketing Group, Greenleaf Publishing and The Earth Centre. He has over a decade of experience in 'business and environment' including publishing, consulting, training and research. He has an MBA from Aston University Business School and a postgraduate diploma in marketing. His publications include 'Greener Marketing' (Greenleaf Publishing, 1992), 'Greener Marketing 2' (Greenleaf Publishing, 1999), 'The Green Management Gurus' (Epsilon, 1996), 'Managing eco-design: a training solution' (The Centre for Sustainable Design, UK, 1997) and 'Environmental Management Websites' (Epsilon, 1996). He is currently the Associate Editor of 'The Journal of Corporate Environmental Strategy' (Elsevier, UK) and an editorial board member of Greener Management International (Greenleaf Publishing). He is a former editor of 'The Green Management Letter' (Euromanagement, the Netherlands). His training and research interests include eco- and sustainable product innovation and business creativity.

Inga Belmane is a researcher at The Centre for Sustainable Design, UK, currently working on Integrated Product Policy (IPP) and eco-product development project at the Centre. She has a BSc in Business Administration and has worked for both government and private business in Latvia. She holds an MSc in Environmental Management and Policy from the International Institute for Industrial Environmental Economics at Lund University, Sweden.

Background

To achieve a real impact on reducing product-related environmental impacts eg. reducing waste and emissions throughout the life cycle, then environmental considerations should be built into product development at the earliest opportunity and customers (domestic, 'business to business', distributors, public sector) should be steered towards the greener option(s).

It is important to make a clear distinction between IPP (Integrated Product Policy) and EPP (Environmental Product Policy). IPP is an EC initiative and is aimed at common environmental product policy formulation at EC level. EPP is a more specific term, which means environmental product policies at a national level inside and outside Europe.

Environmental Product Policies (EPP) have been applied in countries such as the Netherlands, Sweden, Denmark, Austria, and Germany for some time. This means that various approaches and instruments have been implemented in different countries, and this has resulted in a fragmented picture throughout Europe. One of the reasons for introducing a common EC approach to environmental product policy (eg. IPP) is the necessity of harmonising these natural approaches. Therefore, the concept of Integrated Product Policy (IPP) was introduced by DGXI as a blueprint for EPP harmonisation in Europe based on issues highlighted in a report by Ernst and Young and the Science Policy Research Unit (SPRU), which was published in March 1998.

However, the debate over IPP is still immature and in its early stages. As a part of the present IPP consultation process – initiated by DGXI – an additional study was commissioned to determine different approaches to EPP amongst national governments in Europe (Rubik, 1999). The response rate was very low, which reinforces the notion that both EPP and IPP are in their early stage of development across the member states.

Several countries are leading the EPP process, these include the Netherlands, Denmark and Sweden followed by Germany and Austria. EPP is also starting to emerge in countries such as Belgium, United Kingdom and Finland. Countries such as France, Spain, Portugal and Ireland seem to be lagging behind. On the supply side the Netherlands, Denmark, Sweden and Austria have established projects and programmes covering eco-product development.

Integrated Product Policy (IPP)

Definitions

IPP was first defined by Science Policy Research Unit (SPRU) and Ernst and Young (SPRU and Ernst and Young, 1998), in March 1998, as:

> *Public policy which explicitly aims to modify and improve the environmental performance of product systems.*

As a part of the to follow-up to the report by Science Policy Research Unit (SPRU) and Ernst and Young, a major workshop on IPP was held by EC DGXI in Brussels in December 1999, which resulted in a second report containing abstracts of presentations and conclusions from 12 working groups. Following this, in May 1999 Informal Meeting of Environmental Ministers was held at Weimar, Germany where IPP was a central area of discussion. The background paper prepared by Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (Germany) proposed another definition (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, Bonn, 1999):

> *Public policy which aims at or is suitable for continuous improvement in the environmental performance of products and services within a life-cycle context.*

The new elements in this definition include:

- services have now been added
- the life cycle perspective has been introduced
- the principle of continuous improvement has been incorporated.

The major change seems to be inclusion of services. Initially, Ernst and Young and SPRU report had focused on physical products rather than services. However, the results of the IPP workshop in December 1998 and Weimar meeting in May 1999, identified the need to consider services as well, although a longer timeframe will be

required to formulate IPP strategies for services. The inclusion of *intangible* products is a significant increase in the scope of IPP, as more research will be needed since there are big knowledge gaps regarding the service sector and its environmental impacts (James, 1999). However, the potential danger is that the scope of IPP may become unmanageable due to high level complexity of the issue. The inclusion of lifecycle thinking and continuous improvement highlights the importance of the relationship of IPP with quality and environmental management systems (EMS).

Key milestones

The key milestones in the development of Environmental Product Policy (EPP) and IPP are highlighted in Figure 1.

Environmental product policies are receiving more attention from policy makers both internationally and nationally. Recent major developments at EC level included the research and publication on 'Product Policy in Europe: New Environmental Perspectives' by Oosterhuis et al. (Germany) and 'Instituut voor Milieuvraagstukken' (the Netherlands) with support of DGXII in 1996, research and publication on IPP (SPRU and Ernst and Young, 1999) and the following workshop in December 1998. Also, the Informal meeting of Environmental Ministers at Weimar (May 1999) gave IPP the political 'go ahead' (Informal Meeting of EU Environmental Ministers, 1999).

Although it is not clear how IPP will evolve in future, it is clear that there is more attention being paid to products in environmental policy. Therefore it seems reasonable to speculate that EPP measures might emerge more intensively not only in the leading green countries but also in those currently lagging behind (eg. France, Spain, Portugal, Ireland, Greece). International activities, such as OECD (eg. Green Goods conferences, work on public procurement and 'producer responsibility') and activities within ISO (eg. work on environmental labelling, life cycle assessments) also highlight the international context of EPP. At national level, different EPP activities have developed in various countries, such as the publication of consultation papers (eg. UK, Denmark) and the adoption of national environmental product policy programmes and/or legislation (eg. Denmark, Belgium).

The next major step in the development of IPP will be a Green Paper, which is being prepared by DGXI and will be published in the third or fourth quarter of 1999. Until then, it appears no major decisions are going to be undertaken by DGXI. In addition, there appears to be a 'wait and see' attitude amongst the majority of stakeholders, particularly business, as they wait for the publication of the Green Paper before any significant decisions are made or any action is taken. Business appears to see IPP as a bit of a fuzzy concept and needs to see a more concrete model.

Components

The main report by SPRU and Ernst and Young highlighted five key components (or building blocks):

- managing wastes (eg. take-back obligations)
- green product innovation (eg. stimulating R&D, eco-design)
- creating markets (eg. public procurement)
- transmitting environmental information (eg. eco-labelling, product declarations)
- allocating responsibility (eg. producer responsibility).

The Weimar background paper (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, 1999) added two more components to the IPP building blocks:

- sustainable consumption
- chemicals management.

In the authors' opinion the addition of these new components adds to the confusion of what still remains an emerging topic. For instance, sustainable consumption is one of the overarching concepts behind IPP rather than just being one element of IPP. However, it was significant that consumption issues were stressed in the report since relatively little research has been completed into the greening of consumption compared to the greening of the products.

These components indicate that the idea of IPP is not new per se – as several instruments, such as 'producer responsibility', eco-labelling, product 'take back' and eco-design has been imple-

The chronology of IPP developments

1987: The Bruntdland report 'Our common future' was published, introducing sustainability as a principle of environmental policy.

1987: Creation of the French prize 'Ecoproduit' [Eco-product], rewarding environmentally more benign products

1992: The 5th European Environmental Action Programme (EAP) was published. Although it does not explicitely mention product-oriented environmental policy, numerous references are made to instruments and measures which are considered to be IPP measures.

1992: Rio de Janeiro, Agenda 21 stresses the importance of a change in production and consumption patterns.

1993: Foundation of ISO TC 207 'Environmental Management' with sub-comittees on Environmental Management Systems, Life Cycle Assessment, Environmental Labelling.

1993: Foundation of the Swedish 'Eco-cycle' Comission, which delivered its final report 'A Strategy for Sustainable Materials and Products' in 1997.

1993, 30 Sept – 1 Oct: First international conference on 'Green Goods' in the Hague, The Netherlands. This workshop was the start of a tradition of conferences in the product policy field. Since 1993, five 'Green Goods' conferences have taken place.

1994: Publication of the 'Policy document on Products and the Environment' by the Dutch Ministry of Housing, Spatial Planning and the Environment (VROM).

1992–95: Conceptual report 'Product Policy in Europe. New Environmental Perspectives' by Oosterhuis et al. (Germany) and 'Instituut voor Milieuvraagstukken' with support of DGXII within the 'Environment and Climate' programme.

1995: The OECD's Pollution Prevention and Control Group started its activities in the field of IPP, its important output includes the 'Preliminary results of (Sustainable) Product Policy Survey'.

1996: The Finnish Ministry of Trade and Industry published a discussion paper on 'Production, Products and Consumption Patterns in Sustainable Development'.

1997: Foundation of a Nordic IPP group (consisting of representatives from Denmark, Finland, Norway, Sweden and Iceland); an agreement on a Nordic IPP document is anticipated at the beginning of 2000.

1997: 'Common position' of the Council of the EU 'Towards Sustainability' listing diverse product-related issues and supporting sustainable production and consumption patterns.

1997: Adoption by the Belgian federal State of the Law for the 'Co-ordination of the Federal Policy on sustainable development'. A first attempt to manage classical policy approaches (from process to product) in an integrated way.

1996–98: SPRU and Ernst and Young study on IPP, with the major report published in March 1998

1996: Publication of a discussion paper 'An intensified product-oriented environmental initative' by the Danish Environmental Protection Agency. In 1997, the report 'A product oriented environmental initative' was published.

1998: The UK Department for the Environment, Transport and Regions (DETR) published a consultation paper 'Consumer products and the environment'.

1998: adoption by the Belgian Federal State of the new Law on 'Product Standards aiming at the promotion of sustainable production and consumption patterns to protect health and environment'.

1998, 8 December: IPP workshop, Brussels, Belgium with approximately 180 participants.

1999, 7–9 May: Informal Meeting of Environmental Ministers, Weimar, Germany.

1999 August: Publication of the results of the consultation process on 'Consumer products and the environment' in the UK.

Source: Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, 1999

Figure 1: The chronology of IPP

Products (supply) side	Consumption (demand) side
Eco-product development	Consumer information (eg. eco-labelling)
'Producer responsibility'	Indirect taxation
Grants/subsidies for EPD	Green(er) purchasing
Environmental management systems (EMS)	Subsidies
Eco-design competitions/awards	

Figure 2: IPP supply and demand-side tools

mented for some time. *However, what is new is the idea of a strategic and integrated approach.*

IPP toolbox

Until now vertical tools have been applied within national and regional EPP approaches usually in a specific and uncoordinated manner – this appears to have produced sub-optimal results. A good example is eco-labels. In certain geographical (eg. Scandinavia, Germany) and product markets (eg. white goods, washing detergents) eco-labels seem to had some influence on the greening of consumption and on consumer education. But in other European countries and other markets the results are more questionable. Eco-labelling schemes do not appear to have succeeded in countries such as UK, France and Belgium often due to lack of customer awareness and education. Also, the diversity of eco-labelling schemes in the marketplace often causes confusion for customers.

The current proposed IPP toolbox (see Note 1) is a mix of different policy measures, aimed at greening of consumption (demand side) and greening of product development (supply side). It has been realised in stakeholder discussions (Ernst and Young and SPRU, 1998; EC DGXI, 1998; CfSD, 1999b) that there will not be a 'one fits all' solution and a mix of instruments should be used on a 'case by case' basis dependent on different variables, such as environmental objectives, product categories, stakeholders' interests and the economic context. Only a combination of direct regulation, incentives (eg. economic) and informational elements is capable of coping with the environmental problems (Oosterhuis et al., 1996). For example, without education and information campaigns to raise customer awareness, eco-labelling schemes are unlikely to function efficiently.

The IPP toolbox aims at incorporating both supply (eg. eco-product development, environmental management systems (EMS)) and demand (greener purchasing, eco-labels, customer education) side measures. Figure 2 gives an example of different consumption and supply-side measures.

The IPP debate focuses on the concept of 'shared responsibility' (as opposed to 'producer responsibility'), where different tasks are shared by different stakeholders along the product's life cycle. Industry is more in favour of a 'shared responsibility' approach rather than passing all the responsibility to the producer.

Environmental Product Policy (EPP): Denmark's approach

The Danish EPP programme illustrates how EPP can be tackled at a national level and provides lessons for IPP at an EC level. Denmark is a good example as it represents one of the leading countries in the implementation of national approaches to EPP.

A range of publications has been produced on EPP in Denmark. In 1996, the Danish EPA published a discussion paper 'An intensified product-oriented environmental initiative' which was circulated for comments amongst a range of stakeholders. In 1997, the report 'A product oriented environmental initiative' was published which outlined the position of EPP in Denmark and presented an action plan for the period 1998–2002.

The objectives of Denmark's EPP approach are:

- to intensify the development and marketing of cleaner products, so as to reduce the total environmental impact from production, use and disposal of products
- to consolidate the competitiveness of Danish trade and to

focus industry on a future market, which increasingly incorporates environmental considerations and calls for cleaner products (Danish EPA, 1997). The evaluation of Denmark's environmental policy by OECD indicates that the relatively stringent Danish environmental policy does not pose barriers for economic competitiveness and economic growth and is actually considered to be an important sales argument for Danish industry (Danish Environment, 1999).

Denmark's main work areas have included:

- **Accumulation of know-how, methodology and competence**
  The 'Environmental Design of Industrial Products' (EDIP) project, initiated by Danish government has had a budget around 40–50 million Dkr. The major outcome of the project is a detailed environmental assessment tool for products, including supportive databases and software that can be used for product design.

- **Information tools**
  The Danish EPA is working on an overall information strategy. The Consumer Council and The National Consumer Agency of Denmark are also exploring the inclusion of environmental considerations into product comparisons and information on the environmental impact of different products. These information tools include:

  Environmental guidelines
  These are designed to be an information tool for purchasing professionals and are intended to improve decision-making, whilst at the same time encouraging suppliers to develop environmentally sounder products. These guidelines have been widely distributed to public sector purchasing managers. There will be around 50 guidelines published in the year 2000 which will mainly describe issues to be considered when purchasing products with significant environmental impacts, eg. office equipment, office furniture, cleaning agents, paint, lighting, transport equipment, kitchen hardware and equipment, and organic food products. Information about undesirable substances is also included (Danish EPA, 1998).

  Eco-labels
  There are two eco-labelling schemes in Denmark – 'Nordic Swan' (also operating in Denmark, Norway, Finland and Iceland) and the EC eco-label ('Flower'). The Nordic Swan has worked successfully in the Danish market, however, the EC eco-labelling has not been a success. There is also a special eco-label for foodstuffs (Danish EPA, 1997).

  Environmental product declarations
  Product declarations aim to provide information about the most significant environmental impact of a product during its life cycle, but do not necessarily provide information about the environmentally 'best' or 'poorest' products on the marketplace. However, it is not clear how these declarations will be used in the Danish environmental information strategy (Danish EPA, 1997).

  Environmental manuals
  Manuals are intended to provide information for final users about how to use, maintain and dispose of products. The Danish EPA is examining the need for environmental manuals amongst different groups and whether there should be mandatory environmental manuals required for specific product groups, eg. washing machines (Danish EPA, 1997)

- **Green taxes**
  There are several environmental taxes and charges in Denmark, mainly connected with certain raw materials (eg. sand, gravel, clay), certain products and waste types, (eg. batteries, cars, leaded petrol, disposable tableware, light bulbs, chlorofluorocarbons (CFCs), halons and pesticides). Proposed green taxes and charges in other countries have not succeeded due to practical implementation problems and high administrative costs (Oosterhuis et al., 1996). The Danish action plan (Danish EPA, 1997) created an inter-ministerial committee to evaluate existing green taxes with the results feeding into the development of new taxes and charges as part of EPP.

- **Green public procurement**
  Since 1994, activities related to greener public procurement have been incorporated within an 'Action Plan for Sustainable Public Procurement Policy'. In 1995, the Danish Government sent a circular to all state-owned and controlled institutions and companies stating

that government purchasing must include environmental considerations alongside price and quality factors. The preliminary results show that the circular has been positively accepted amongst the governmental institutions and has resulted in a change in purchasing behaviour.

- **Establishment of product area panels**
  The Danish EPA has established product area panels where stakeholders within one product group are brought together to establish a dialogue and strengthen co-operation in order to facilitate the development and marketing of cleaner products. The first three pilot product groups are:
  · electronics
  · textiles
  · transportation
- **Subsidies**
  The 'Programme for Cleaner Products' was launched in 1999 by the Danish government and will end in 2002. It is intended to give subsidies for the development and marketing of cleaner products, including the creation of know-how, methods, product development processes, greener marketing, and waste/ recycling systems (Hounum, 1999; Danish EPA, 1997).

IPP – a different perspective

The debate over IPP is new and evolving, and stakeholders are being invited by DGXI to provide input for discussion on the further development of IPP. The authors would like to present their thinking as an input for IPP discussion.

The Centre for Sustainable Design (CfSD) has evolved a much simpler perspective on IPP in comparison with current EC DGXI approach:

> *Public policy aiming at greening the marketplace through integrated use of supply and demand side tools.*

In this context, the key components are:

- green(er) consumption tools
- green(er) product development tools (with life cycle considerations and stakeholder involvement being key principles).

IPP is a policy initiative that includes both the supply and demand side of the equation. Governments or policy makers can influence both sides of the IPP toolbox, but business has little control over the consumption side, except through brand, product or corporate communications (eg. advertising).

There may be a misperception in business that IPP only covers the supply side, eg. eco-product development. To avoid perception gaps that may be already starting to emerge, the continued and balanced use of a consultative approach by DG XI, incorporating a wide range of stakeholder input, will be essential.

Uncertainty surrounding IPP

IPP is not fixed and many questions are being considered, such as:

- what are the objectives of IPP?
- what are the priorities?
- how will IPP be implemented?
- what implications will IPP have for different stakeholders: national governments, industry, consumers, retailers and environmental non-governmental organisations (NGOs)?

The question as to 'what is IPP' is still being asked amongst stakeholder groups and a clearer vision and practical interpretation of IPP needs to be formulated (CfSDb, 1999; DETR, 1999).

IPP and eco-product development

It is recognised in the literature and research that the environmental considerations should be taken into account in product development process if a significant environmental improvement in products are to be achieved (Oosterhuis et al., 1996; Ernst and Young and SPRU, 1998). Eco-design has been used in companies as a tool to incorporate environmental considerations into product design and development. It is being increasingly recognised by some leading companies that eco-design can cut costs of production and raw materials, reduce environmental impact and provide new market benefits (Oosterhuis et al, 1996; Philips, 1998) However, at present eco-design has not been widely accepted by industry (CfSD, 1996), particularly in small and medium sized companies (SMEs) (CfSD, 1999a).

Defining eco-product development (EPD)

The first phase of eco-design has evolved from an engineering mindset. The outcomes of this approach have tended to be

In a new IPP landscape, those who have developed EPD approaches will be better prepared for the opportunities arising from greener markets, as well as for threats of new regulations and economic measures.

interesting 'one off' projects in R&D but this has not led to ongoing programmes in companies (Rocha, Brezet, 1999).

The second phase of eco-design is about integration of environmental considerations in the complete product development process from idea generation to 'end of life' management (EOLM). This is called 'eco-product development' (EPD) process (Charter, 1999)

- idea generation
- concept development
- evaluation
- prototype building
- testing
- manufacturing
- launch
- product management
- 'end of life' management.

Therefore, eco(re)design (adaptation of existing products) and eco-innovation (new product development) are EPD strategies. The broader definition of EPD is used in this paper.

EPD is a supply side issue. At present, most EPD has focused on eco(re)design, the adaptation of existing products to incorporate environmental considerations and there has been relatively few examples of eco-innovation (the launch of new products/services explicitly incorporating environmental considerations). Eco-design or 'Design for Environment' (DfE) tends to be managed by environmental management function rather than being integrated into mainstream product development. A key issue is lack of 'buy in' from the marketing function – who are key role players in the product development process.

In a new IPP landscape, those who have developed EPD approaches will be better prepared for the opportunities arising from greener markets, as well as for threats of new regulations and economic measures. Although the IPP approach at the EC level is new and unclear, national approaches are moving fast eg. 'we are not waiting for EC' (Alhner, 1999) and there are the development of vertical EPP tools (eg. greener purchasing, national eco-labelling schemes, consumer education, green taxes, 'producer responsibility', etc). It means that companies will have to be prepared for emerging policies amongst national states regardless of how IPP develops in the future at the EC level.

Companies should develop EPD programmes, which should be based on sound management practice:

- **Policy**
  A set of principles and intentions should be established with respect to environmental product development (Roberts, Robinson, 1998).

IBM environmental policy statement on products

Develop, manufacture and market products that are safe for their intended use, efficient in their use of energy, protective of the environment, and that can be reused, recycled or disposed of safely.

Source: IBM Environmental Report, 1998

- **Objectives and targets**
  Broad goals should be set by the company in relation to environmental performance of products eg. 'to improve energy efficiency by 10% in the *use* phase of new products'. Targets should be measurable and quantifiable statements such as 'reduce components used in production by 20% within two years' (Roberts, Robinson, 1998).
- **Strategies**
  The company's business strategy should be the optimum allocation of resources in order to achieve competitive advantage. From an EPD perspective, it means developing 'green' products with a focus on reduced costs and improved efficiency, reduced environmental impact and market differentiation if price, performance, quality et al are as good or better than the competitor. Interestingly, adding the green dimension may also create innovative solutions and new business opportunities (Banerjee, 1999).
- **Programmes**
  For a given objective the environmental management programme should identify how targets will be met, who is responsible for each of the activities required to meet that target and when those activities should be completed (Roberts, Robinson, 1998).
- **Responsibilities**
  Responsibility refers to the roles, authorities and interrelations of the key personnel required to ensure the achievement of objectives and the chosen organisational structure (Roberts, Robinson, 1998).
- **Budgets**
  Appropriate budgets must be allocated to EPD.

Philips Eco-vision

An example of an EPD programme is Philips Eco-Vision programme (1998–2002). It focuses on green product development (Green flagship products) and manufacturing. These 'flagship' products are defined as products with demonstrably superior environmental performance in one or more of five green focal areas, which are:

- weight (reduction)
- hazardous substances (reduction)
- recycling (increase)
- energy consumption (reduction)
- packaging (reduction).

Philips have also recognised that green products can bring financial benefits:

- bill of materials -5%
- market share +2%
- price premium +3%

In addition, Philips understands that EPD can improve the environmental performance of its products and also generates new business opportunities that may emerge from eco-innovation.

Source: Philips, Environmental Report, 1998; Philips presentation at OECD conference, Sydney, March 1999

EPD: focus on electronics sector

The electronics sector is characterised by rapid technological change, complex supply chains and fast product obsolescence rate (Charter, 1999; Matthews et al., 1997). It has been highlighted by DGXI as a key sector for potential IPP pilot projects (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, 1999). In addition, electronics has been chosen as one of the key product groups in the Danish EPP (Danish EPA, 1997) and an action plan is now being developed (Jakobson, 1999). The increased attention to the electronics sector is also linked to proposed 'producer responsibility' legislation at EC level (eg. draft WEEE Directive) and national approaches to electronics waste legislation. From CfSD's initial research in the electronics sector there appears to be following key issues in EPD: supply chain management, communications, links with environmental management systems (EMS), and innovation.

Supply chain management

IPP discussions have not really addressed supply chain issues. However, supply chain management (SCM) is becoming more and more important in EPD. For instance, a lot of electronics companies are no longer manufacturers, but 'systems integrators' and significant environmental impacts result from their supply chains. A number of customers now demand that their suppliers are ISO 14000 or

EMAS certified (Barthel, 1999). So, the ISO 14000 certification process is indirectly linked to EPD through assessment of indirect impacts.

As a part of ETMUEL project (see Note 2) the following points and questions have been raised in the discussions with electronics companies:

- The international aspects of supply chain: where are the majority of electronics component suppliers located? CfSD's research shows that it has been hard to find component suppliers based in the UK (CfSD, 1999a). The work in Danish electronics product area panels indicates that majority of the component suppliers are from Far East (Jakobson, 1999).
- Should companies educate and train their suppliers worldwide (eg. produce eco-design checklists in Chinese) if they are going to reduce environmental impacts in national markets?
- Can suppliers worldwide comply with the European standards? For instance, is it possible for a component manufacturer in China, to 'design for dismantling', as implicitly suggested by the proposed EC WEEE (Waste from Electronics and Electric Equipment) Directive (EC, 1999).
- The above research has also indicated that amongst electronics component suppliers there is very little or no awareness about 'business and environment' issues, eco-design, and even the proposed WEEE Directive now in its third draft (CfSD, 1999a).
- How should information be passed down the supply chain? Are manufacturers of final goods able to educate all their suppliers about environmental issues? (when there may be thousands of components in the final electronics products or equipment) and what are the costs and benefits?
- The supply chain is a potentially powerful channel to influence small and medium sized companies (SMEs) to improve their environmental performance since SMEs are more likely listen to their customers (CfSD, 1999b).

Communications

Poor communications inside and outside companies have been major barriers to *selling* 'eco-design' (internally) or 'eco-products' (externally). Generally, EPD has been an isolated activity within environmental management or R&D and has, at present, been rarely treated as a mainstream management issue.

Internal communication: a major obstacle to the development and management of 'greener' products (EPD) is that the communication function with customers is often carried out by marketing and sales functions, which are two of the least 'green' business functions. In addition, marketing usually has siginificant influence on product decisions (CfSD, 1996). This has resulted in poor internal marketing of EPD to internal stake-holders eg. selling eco-design.

External communications: in order to establish customer needs, better dialogue with the market is necessary. Conventional market research techniques have not worked and this has led to a lack of knowledge about customer needs and expectations in relation to environmental issues. For instance, Rank Xerox have two questions on environmental issues in the main yearly customer survey – this displaces two marketing questions. The Environment Director lobbied hard for the questions and has to report back on business benefits resulting from asking those questions (CfSD, unpublished, 1999c).

Most EPD has focused on improving the internal eco-efficiency of the product, with little attempt to understand the *use* phase of products. Where this has been undertaken, there are cases of real eco-improvement. For example, the Kambrook (Axis) kettle: it was only when the researchers/designers observed how consumers *used* the kettle, that they started to define significant environmental improvements (Sweatman and Gerstakis, 1997).

Lack of awareness, understanding and poor communications may be some of the reasons why there is the emergence of 'rebound effects' – the situation when improving the environmental features of the product causes increased consumption. Good examples are light bulbs and washing machines, where cost savings have encouraged customers to increase the consumption (eg. leave the lights on, wash clothes more often) (C. Rocha, 1999).

EPD and environmental management systems (EMS)

The Dutch government and industry have developed the POEM concept, which links EMS and product development (Ministry of Housing, Spatial Planning and the Environment, 1998).

The Dutch approach: Integrating product management with Environmental Management Systems (EMS)

The Dutch government and industry has introduced a new component of environmental management: POEMS (Product Oriented Environmental Management System). POEM is an instrument to integrate product aspects into environmental management systems in companies. POEMS should systematically monitor and control the environmental impacts of products and should be considered as an extension and elaboration of EMS.

Source: Ministry of Housing, Spatial Planning and the Environment, The Netherlands, 'Product-Oriented Environmental Management – Its Theory and Practice', 1998.

The reasons for introducing the POEMS concept were:

- around 1000 eco-design projects have been completed in the Netherlands and the majority of them appeared to be ad hoc projects without continuation (Rocha, 1999)
- a more systematic approach was needed, incorporating both technical and management eco-design considerations (Ministry of Housing, Spatial Planning and the Environment, 1998).

The Netherlands has started work on POEMS and the preliminary findings are:

- POEMS can easily be integrated into existing environmental management systems (EMS)
- POEMS requires higher co-operation amongst different business functions compared to conventional product development
- the business benefits of POEM are not clear (Rocha, 1999).

Separately, an ad hoc International Standards Organisation (ISO) working group on 'Design for Environment' (DfE) has held three workshops. The last workshop concluded that there was a need for an ISO document that highlighted environmental aspects at each stage of the product development process. The proposal was to create a 'Technical report: for information purposes only' (Lehmann, 1999). It was agreed that it should be informative and provide guidance to companies but should not be an ISO standard. Discussions are continuing within the ISO TC207 committee and national standards bodies.

Innovation

Product innovations are considered to be necessary in order to expand and maintain a company's market share. (Oosterhuis et al, 1996). Innovation is one of the major business drivers for the electronics industry, combined with rapid technological change. For instance, market research in consumer electronics indicates that there is a need for fundamentally new products since in many West European countries consumer electronics products have low volume growth and profitability (Reed Business Information, 1998). Innovation is a key challenge for industry if eco-efficiency (eg. 'factor four' and 'factor ten') goals are to be achieved. Therefore, it is important to explore how to combine innovation with the environmental policies. EPP instruments differ in relation to their ability to stimulate innovation. Subsidies for research and development (R&D) probably have most direct potential influence on eco-innovation, although other instruments (eg. taxes and charges) may have an impact (Oosterhuis et al., 1996).

Concluding remarks

- The IPP approach is new and discussions are still in their infancy. The main questions are: What are the objectives and priorities of IPP? How will it be incorporated into legislation and other policy measures? And how to measure success/progress of IPP?
- IPP is a government policy tool which influences both supply and demand sides. However, manufacturers have little or no control over the consumption side. Environmental Product Policies (EPP) often appear to be focussed more to the 'greening' of supply rather than

the consumption side. The recognition of the importance of the consumption side in achieving sustainability goals is becoming more and more important.

- The majority of stakeholders have adopted a 'wait and see' approach to IPP until a Green Paper is published by DGXI in the third or fourth quarter of 1999.
- The synergies and overall benefits resulting from IPP will be achieved through the integration of supply and demand side measures. The development of greener products without greener markets is sub-optimal.
- Companies can develop their own EPD programmes, which can bring financial benefits and generate new ideas and business opportunities. However, the issue needs to be managed and new tools need to be developed to enable environmental considerations to be integrated into product development from the idea generation to the 'end of life' management phase. Companies with EPD in place will be better prepared for new policy developments (eg. new market opportunities, product liabilities etc.) that might emerge from the EPP or IPP debates at either national or EC level.
- There seems to be several key issues in relation to EPD in the electronics sector: supply chain management, communications, links to environmental management systems (EMS), and innovation.

Supply chain

Supply chain management (SCM) in the electronics sector might have a real opportunity to reduce eco-impacts since overall environmental product performance is closely related to how EPD is managed up and down the supply chain. Additionally, supply chains hold a large potential to *green* SMEs.

Communications

Poor environmental communications both internally and externally has been one of the major obstacles to developing and promoting 'greener' products. Can IPP help tackle these issues?

Environmental management systems (EMS)

The integration of EPD into existing EMS schemes is being tried in the Netherlands (eg. POEMS). Similar discussions are evolving within ISO where there have been suggestions of the need to prepare an ISO information and guidance document on EPD. However, it is too early to derive any major conclusions from these initiatives since the work has just started.

Innovation

Innovation is an important business driver in the electronics sector as well as one of the key eco-efficiency challenges on the supply side. Eco-innovation should be regarded as one of the strategic elements in greening of the supply side.

- There are several ways that governments can help progress the EPD process, such as through funding and subsidies, public information and education campaigns, co-ordination of information flows and support for greener purchasing. It has also been realised that increased environmental considerations can result in competitive advantage so there is more room to link the environmental requirements to industrial development.
- It is important to remember that all stakeholders must 'buy into' the IPP process, since IPP is based on 'shared responsibility' rather than 'producer responsibility'.
- IPP at the EC level is progressing slower in comparison to national EPP approaches in different EC countries (eg. Sweden, Denmark, Austria, Germany, the Netherlands) and non-EC (eg. Japan, Norway) countries. Therefore it is important for companies to develop and to continue to work on their own EPD programmes without waiting for developments at EC level.

Notes

1. Presented in the background paper for Informal Meeting of Environmental Ministers at Weimar, May 1999.

2. 'Eco-design and Training for Manufacture, Use and 'End of Life' for SMEs' (ETMUEL) is a project run by CfSD and funded by the Adapt programme of the European Social Fund. It is a two year training programme focusing on the implementation of environmental considerations in product development and design (eco-design) in the electronics sector. Further details can be found at www.cfsd.org.uk/nepd/etmuel.

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Product-oriented environmental management systems: a case study

Cristina Rocha and Professor Han Brezet

Researcher, Department of Environmental Strategy Studies, Instituto Nacional de Engenharia E Tecnologia Industrial (INETI), Portugal and PhD researcher at Delft University of Technology (TU Delft), the Netherlands and Professor at TU Delft and Director of the Design for Sustainability Programme, the Netherlands

Cristina Rocha is completing research into environmental issues and product development at both Instituto Nacional de Engenharia E Tecnologia Industrial (INETI) in Portugal and TU Delft in the Netherlands.

After finishing his studies in Electrical Engineering at the Delft University of Technology (DUT), Han Brezet received his PhD in Environment Sociology at the Erasmus University Rotterdam. Since 1992, after a career in cleaner production consultancy, he holds the chair on eco-design at the sub-faculty of Industrial Design Engineering at the DUT. In his present position, he is leader of the Design for Sustainability Programme of his Faculty and is research director of Kathalys, the Joint Centre for Sustainable Product Innovation of TNO Industry and DUT established in 1998.

This paper presents the concept of Product-Oriented Environmental Management Systems (POEMS), a management tool for improving a product's eco-efficiency which addresses the complete life-cycle and not only the production phase. The Dutch government is stimulating the adoption of POEMS by businesses, through an incentive scheme that has involved over 60 companies. POEMS is highly relevant in the context of the recent developments on the Integrated Product Policy (IPP) in the EU. A research project with a truck manufacturer was undertaken by the Design for Sustainability Programme at Delft University of Technology (TU Delft) in which a POEMS model was developed and initially tested with the aim of making eco-design part of the company's strategies and practices as well as creating a basis for environmentally driven product innovations. The findings of the project and the model are described.

Why product oriented environmental management systems?

One often mentioned limitation of the success of the eco-design concept (the integration of environmental aspects into product development) is the pilot project character of many existing initiatives. It is recognised that eco-design activities will be limited if they are not integrated into strategic management and the daily operations of companies as part of a dynamic process of continuous environmental performance improvement. However this has been rarely accomplished yet. In general, after completing an eco-design project, companies tend to return to their 'business as usual' activities and the improvement process looses its continuity (Rocha & Clerigo, 1998). In the Netherlands it is estimated that approximately 1000 eco-design pilot projects have already been undertaken

and it is therefore important to seek mechanisms to ensure that these efforts become 'normal business' and ensure that the significant knowledge gained during these projects is retained.

In order to deal with the challenging issues that underlie the sustainable development concept, companies will have to drastically change the way they address environmental product development and its management. Eco-design is now evolving into a broader concept described as sustainable product innovation (SPI), which includes more radical innovations, eg. questioning the function of the product. SPI also means influencing the existing patterns of (unsustainable) consumption which are an essential contribution to sustainable development.

The argument for radical environmental-oriented innovation relies on the challenge of achieving the right balance between production and population growth, on the one hand, and maintaining the earth's carrying capacity, on the other. Experts estimate that in order to reduce the level of pollution to 40% of the current level, an improvement in the eco-efficiency of a 'factor of 20' is required over the next 25 years (Weterings and Opschoor, 1992, as referred in Van Hemel, 1998). This means that the environmental impact of human activities has to decrease 20 fold and the use of raw materials and energy has to be 20 times more efficient. As an interim target, it has been argued that eco-efficiency has to be improved by a factor four within fifteen years (Von Weizsacker, Lovins and Lovins, 1996; Fussler and James, 1996).

Such far-reaching eco-efficiency improvements demand top-management policy changes, including the establishment of new 'sustainable business' units and 'green coalitions' in, between and outside existing companies.

Actions taken so far in the majority of companies seldom involve a willingness to experiment, improve and substitute products, except under public or regulatory pressure (Cramer and Schot, 1993). These authors state that an eco-innovative strategy, instead, aims at improving the company's capability to produce environmentally sound products, taking into consideration, for example, the following aspects:

- the need to incorporate environmental considerations into the business strategy of the whole firm, including departments responsible for innovation, such as R&D and marketing
- the need to create organisational conditions for synergy between the environmental function and other functions involved in formulating business strategy
- the need to promote co-operation among firms, through exchange of information and the establishment of environmentally-oriented supply chain management.

It is pertinent to explore the role that environmental management systems (EMS) might play in attaining such objectives, for a number of reasons:

- standardised EMS (such as presented in the voluntary Eco-Management and Audit Scheme (EMAS) and ISO 14001 standard) are appealing to industry as they become recognised as a useful structure to implement a company's environmental strategy, ie. to put strategic principles and objectives into practice, evaluate the results achieved and re-define the path, aiming at continuous improvement of environmental performance. An EMS provides order and consistency for companies to address environmental concerns through the allocation of resources, assignment of responsibilities and an on going evaluation of practices, procedures and processes. In spite of its relative newness and the initial resistance shown by companies, the uptake of EMAS and ISO 14001 within industry is showing a significant increase.
- eco-design can be seen as a continuous improvement process in line with the EMS. The ISO 14001 structure can be applied in relation to product impact reduction. In specific cases the process of incremental improvement is accelerated by a product innovation or breakthrough.
- some companies are taking the lead in fostering a systematic approach to their environmental product development efforts by implementing standardised EMS that integrate environmental product development issues. This is the case, for instance, in Philips Sound

and Vision (Cramer and Stevels, 1997) and ATAG Kitchen Group. This approach applies not only to large companies but also to small and medium-sized enterprises (SMEs). A research study conducted within the Dutch Innovation Centres (ICs) eco-design Project involved 77 SMEs and showed that an EMS could be the stepping stone towards eco-design, and vice versa (Van Hemel, 1998). The findings of this study showed that companies active in the field of eco-design had often already established a (partial) EMS. Furthermore, these companies were inclined to establish a link between their EMS and eco-design initiatives.

- both at EMAS Committee and ISO levels actions are being undertaken to explore a closer relationship between EMS and eco-design activities. There is the recognition that products are of increasing importance in assessing the overall environmental performance of an organisation. This aspect is being discussed both within the context of the EMAS revision process of EMAS and within ISO, where an Ad hoc-Group on 'Design for Environment' has been established.

In spite of the potential and opportunities that EMS brings to promote more eco-efficient products, it is recognised that such systems, as currently defined in the EMAS regulation and particularly the ISO 14001 standard, are not a guarantee of optimal environmental outcomes. The fact that they do not establish requirements for environmental performance beyond legal compliance and continuous improvement, together with the fact that cleaner production and lifecycle thinking are not objectively required have been strong points of criticism with regard to the effective contribution of these systems to the pursuit of the objectives of sustainable development. So, although an EMS provides the framework for sound environmental management, the extent of their contribution to environmental optimisation and the innovation of processes and products depends on the companies strategic choices (Cramer, 1997).

Environmental management systems are still in the process of development. Depending on the country and the specific industry sector, the experiences regarding the introduction of these systems may differ. Based on the theory that:

- EMS can be a carrier to enable eco-design to be part of the company's strategies and daily practices,
- EMS could enable environmental product innovation
- EMS standards are not sufficient to adequately address environmental aspects in product development processes,

the question is how a product-oriented environmental management system (POEMS), should be developed. POEM is:

an environmental management system with a special focus on the continuous improvement of products' eco-efficiency (ecological and economic) along the life cycle, through the systematic integration of eco-design in the company's strategies and practices

The core elements of such a system are:

- the eco-efficiency (ecological and, simultaneously, economic) of a company's products is considered at a strategic level, through the definition of an environmental product policy
- the environmental performance of the products (throughout the lifecycle) is evaluated on a regular basis
- environmental criteria are taken into account in the product development processes
- goals are formulated to ensure that – in addition to compliance with the environmental regulations – the company continuously improves the eco-efficiency of its products, in co-operation with other elements of the product chain.

In the following sections, a Dutch initiative to promote the adoption of POEMS is presented and a case study is discussed from the truck manufacturing industry.

Stimulating product oriented environmental management in the Netherlands

The Integrated Product Policy (IPP) approach is receiving increasing attention in several EU Member states as well as in international organisations like the Orgasnisation for Economic Cooperation and Development (OECD) and the United Nations Commission on Sustainable

Development (CSD). IPP addresses the whole lifecycle of a product, thus avoiding shifting environmental problems from one medium to another, as opposed to specific product policy, which addresses one particular environmental effect (Ernst & Young and SPRU, 1998).

At EU level, IPP calls for theharmonisation of different policy measures applied in member states and is being proposed as a basis for a common framework for EU and national countries' product policies, aiming at facilitating the development of greener markets through demand (consumption) and supply (products) side measures (Charter and Belmane, 1999).

In line with the IPP approach, an important objective of the Dutch environmental policy is reducing the environmental impacts of products during their life cycle, as stated in its 1993 policy document 'Product and Environment' (VROM, 1993).

To explore the concept of POEMS the Dutch Ministry of Housing, Spatial Planning and Environment (VROM) introduced a subsidy scheme in 1996–1998: the 'Stimulating Product Oriented Environmental Management' Incentive Programme (PMZ Programme). The objective of this programme was to encourage and introduce a process of continuous product improvement and permanent product environmental innovation, through the development of POEM systems (Directorate General for Environmental Protection, 1996).

The VROM Ministry's concept of POEM is broader than the definition of POEMS presented above, in the sense that it is understood to be an instrument to achieve integrated product chain management. Therefore companies that do not have product development activities also fall into the scope of the PMZ Programme. The first phase (1996-1998) encompassed in-company feasibility studies, development projects and practical experiments. A total of 66 projects were supported (VROM, 1998) and the last projects will have to be completed by the end of the year 2000. Only then will a thorough evaluation be undertaken.

The main preliminary findings of the pilot projects that started in 1997-1998 have been (VROM, 1998):

- POEM systems can be easily incorporated into business operations; its implementation is not hampered by major financial or organisational problems
- POEM is closely related to R&D, purchasing, production, sales and (especially) marketing. Therefore, almost every company conducting a pilot project placed POEM directly under top management
- if desired, companies can also use POEM systems as a means of comparing themselves to other companies. By comparing the environmental performance of products, companies are able to discover new opportunities for product improvement.

In spite of these encouraging results, some aspects of the POEMS concept, methodology and its applicability to different industry sectors still have to be clarified. During a workshop organised by the VROM Ministry in April 1999, a range of issues were raised including the importance of developing a clear commercial advantage for POEMS, the opportunity for a better clarification of the concept and the need for stronger communication concerning POEM (VROM, 1999). Furthermore it is not clear whether or not the projects within the PMZ Programme involve 'type 2' eco-design (integral re-design) and therefore what the motivation is in terms of eco-efficiency.

A follow-up initiative for the period 1999–2003 has been established by the Directorate General for Environmental Protection of the VROM Ministry, which aims at a widening of the implementation and communication on POEMS.

Case study at a truck manufacturer

Company T, a large European truck developer and manufacturer has addressed environmental aspects in product design for some years, due to legal requirements and market demands. Such initiatives resulted in low exhaust emissions, low noise engines and reduced fuel consumption, which is translated in lower costs during the *use* phase (the main concern of customers).

Whereas these concerns are already integrated into the company's Product Creation Process (PCP), new opportunities for eco-design are still to be explored. Recently an eco-design project was set up, resulting in a number of actions, including a pilot project on plastics recycling, the inclusion of eco-design guidelines in a dedicated tool and an eco-design newsletter.

The eco-design project at Company T aims at highlighting environmental requirements and opportunities of product design (like eco-efficient materials, reuse and recycling, the involvement of suppliers, etc.) with an integrated life cycle perspective, translated into increased cost efficiency, improved quality, improved customer satisfaction and increased market share. This is a recent initiative in the company and the benefits (ecological and economic) are not fully perceived yet.

Company T implemented an EMS and attained ISO 14001 certification in 1998. Although the EMS was primarily designed to address the environmental aspects of the production processes, it has already started to include product related issues.

In order to optimise the potential of the eco-design strategy in Company T, a project with TU Delft/DfS (Design for Sustainability Programme) was undertaken. The project's goal was to explore the possibilities of integrating eco-design activities into the framework of the existing EMS by means of POEMS. It was the intention that POEMS would not only formalise the current and planned activities in eco-design but would also be a catalyst for future activities in this area.

For the company, the rationale for exploring the link between the EMS and eco-design was the following:

- the company's present EMS model and its elements (which are in accordance with ISO 14001 standard) are considered to be a sound managerial structure to support continuous improvement of the company's environmental performance.
- since Company T is ISO 14001 certified it makes sense to extend the scope of the existing EMS to eco-design activities. It was agreed as a basic principle that integrating eco-design into business should not become a burden to the company and therefore POEMS should not be a separate management system.
- from the moment when the existing EMS formally includes the eco-design requirements, there will be a control system in place that will ensure that activities are performed and results evaluated.

The methodology for this project relied on a combination of documentation review, meetings, interviews and a brainstorming session where the current situation and improvement opportunities for POEMS were analysed and discussed. The project focused on the following main areas:

- a review of the existing EMS, from an eco-design perspective, that reflected not only formal statements and documentation, but also the general perceptions and opinions communicated during the interviews
- an analysis of current strategies and practices regarding environmental product development
- an evaluation of opportunities for integrating eco-design activities and requirements into the company's Product Creation Process (PCP).
- the development of a general model of POEMS for the company.

Main findings

The company has established an environmental policy and an environmental product policy, including the commitment to design environmental friendly products taking into account the whole lifecycle, whilst considering functionality, quality and costs. Nevertheless, this environmental strategy has not been extensively communicated throughout the organisation, and within the product development department, environment is perceived as being an issue of less strategic importance than, for example, quality. The main environmental concerns in product development are legal compliance and reduction of fuel consumption; with other eco-design possibilities are not explored.

As a result, clear environmental objectives concerning exhaust emissions, noise and fuel consumption are defined for product development, whereas

other aspects such as materials selection and 'end of life' management are still to be defined. There is also some resistance to eco-design amongst product developers as it is perceived as an extra burden to the product development process.

There has not been a comprehensive evaluation of the environmental aspects of the products, but a detailed LCA is planned for the near future.

As mentioned previously, the main activities of the eco-design project have been the definition of eco-design guidelines in an eco-design tool, the publishing of an eco-design newsletter and the undertaking of a pilot project on plastics recycling. The eco-design tool is a company-specific intranet-based site, including eco-design techniques, guidelines for materials and processes selection and for supplier involvement. There is still limited feedback on the utility of this tool and no decision has been made on how it will be integrated into the PCP.

The existing EMS is already addressing product development and management to some extent and there is a clear commitment to improve. The review completed in this project indicated the EMS has the necessary mechanisms to evaluate and control the achievement of the company's environmental objectives for product development. The next question is then how ambitious are the objectives and this of course is dependent on the company's strategic decisions.

From a chain management perspective, it has been recognised that suppliers play an important role in product development in the company. Approximately 70–80% of trucks are made from bought-in components, therefore a close co-operation between the company and its suppliers is essential for the success of eco-design. This co-operation already exists, but further criteria for supplier selection (eg. on the basis of the guidelines in the eco-design tool) is needed.

During the brainstorming session, the eco-design activities that were suggested for the company, as well as the POEMS model were discussed (see next paragraphs).

Suggested eco-design activities

The Product Creation Process (PCP) was recently formalised at Company T. It offers possibilities for more effective work utilising cross-functional teams, rather than the traditional sequence of 'department to department'. The PCP aims at speeding up the product development process and ensuring that functionality, quality and cost are considered from the very beginning of the design process. It is therefore an obvious opportunity for eco-design.

Taking into account eco-design models and best practice, a number of eco-design activities as presented in Table 1 were suggested for the different stages of the PCP. At the end of the concept stage, the product's 'programme of demands' is in principle fixed and any investment plans are approved. At this point, product targets and specifications are set up and the people involved in the project agree on all the consequences of the project. Therefore, eco-design requirements should be defined and incorporated at this stage, otherwise they will not be integrated in the product development process.

The development of new systems, processes or technologies is undertaken by the Advanced Technology Groups (ATG), within different development departments. Such activities do not belong to the formal PCP, but are considered as pre-development activities in which eco-design projects can also be integrated. This is the case for engine development projects that were undertaken with the objective of reducing exhaust emissions, noise and fuel consumption.

POEMS model

The POEMS model developed for Company T is a general model aimed at supporting the implementation of eco-design at two different levels:

- Projects: in specific ad hoc eco-design, R&D or advanced technology projects (results may be translated into environmental objectives and specifications for the PCP)
- Functions: the implementation of eco-design and the achievement of environmental objectives for product development and management requires co-ordination among various functions in the company business development, purchasing and suppliers management, product

Stage of the PCP	Eco-design activities
0 Orientation phase	· Eco-design objectives · Green marketing objectives
1 Definition stage	· Involvement of eco-design staff support · Environmental benchmarking · Suppliers information · Other stakeholders information (Government, EU, recyclers, users, environmental organisations) · Green options generation (assessment of environmental innovation potential) · Green options validation · Eco-design R&D agenda · Concept environmental program of demands (input to concept PBD)
2 Concept stage	· Eco-design support for environmental specifications and product concepts · Consult environmental material databases and other eco-design expertise (inventory) · Green perception (emotional) · Eco-design R&D agenda (technical) · Environmental 'programme of demands'
3 Engineering stage	· Consult environmental material databases and other eco-design expertise (optimisation) · Environmental validation (production, use, 'end of life', regulations) · Tactical green marketing and communication plan
4 Volume validation	· Eco-design after sales plan (user/dealer instructions, etc.)
5 Evaluation stage	· Evaluation of POEMS (procedures, expertise support) · Feedback to eco-design goals setting

Table 1: Suggested eco-design activities in relation to the stages of the PCP

development, manufacturing, marketing, sales and after sales assistance.)

Some of the elements of the POEMS model presented here go beyond the strict requirements of ISO 14001. The idea is to optimise the contents of the EMS (from an eco-design point of view) relying on the structure that ISO 14001 offers. To what extent this optimisation is achieved depends primarily on the company's commitment to an eco-design strategy and the ambitiousness of the eco-design objectives.

In order to analyse how POEMS activities relate to the eco-design inputs into the PCP, a distinction has to be made, amongst activities that:

- lead to the concrete definition of environmental objectives and performance criteria for the product
- ensure capability for eco-design, including resources and know how
- ensure control and routinisation (in the sense of systematic implementation) of eco-design.

These aspects are worked out through POEMS by asking the following questions:

- where do we stand (which is our product's/product group's environmental profile)?
- what do we want to achieve (in terms of the product's eco-efficiency)?
- how do we ensure that we have the capability to achieve improved environmental product performance?

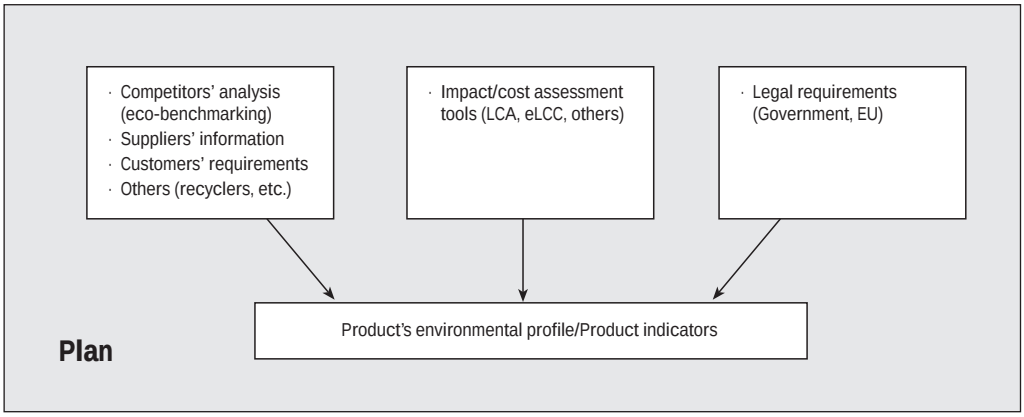

Figure 1: Where do we stand (which is our product's/product group's environmental profile)?

- how do we ensure effective routinisation and control of inclusion of eco-design in PCP/ad hoc projects?
- have product's environmental objectives been met? is the system effective? (set directions and reinitiate the continuous improvement cycle).

Figures 1 to 5 show how POEMS might follow the Plan–Do–Check–Act cycle and how it could support eco-design activities at Company T, indicating which departments/functions should be involved. It was recommended that the details of the system should be worked out through practical application (pilot project), in relation to the design process of a specific product or component.

The process starts with the analysis of the product's (or product groups') environmental profile. This analysis should take into account legal requirements and convenants, an evaluation of the impacts along the lifecycle and other stakeholders' demands and opportunities (Where do we stand in comparison to our competitors? Do we have the necessary environmental information on supplied parts and materials? Are customers environmental concerns being fulfilled?, etc.).

An LCA or other tools should be used for an evaluation of the products' environmental impacts and it was recommended that the results of the LCA were combined with an assessment of the environmental costs across the lifecycle (eLCC). This allows the identification of those areas that have most improvement potential from an environmental and economic point of view.

The results of the LCA or other assessment studies should feed into a comprehensive environmental performance indicators system, from which concrete objectives can be derived. ISO has recently released the final draft standard on environmental performance evaluation (ISO/FDIS 14031) that can assist companies in evaluating performance against their environmental policy, objectives, targets and other environmental performance criteria in the context of its EMS in general and in relation to product-related aspects in particular.

The previous phase in intended to define where to focus, in terms of environmental (and economic) aspects of the product's profile, and the next step is the definition of objectives and targets. Objectives and targets can either be managerial or performance related; at this stage we are focusing on the performance type. Stakeholders' views should be taken into account when defining eco-design objectives and targets, and these should be in line with the business strategy and environmental product policy.

Green options generation and validation activities will help to establish improvement opportunities. Some of them may be feasible in the shorter term, others will require the undertaking of R&D projects where environmental innovation potential is explored.

Depending on the availability of accurate information and on the

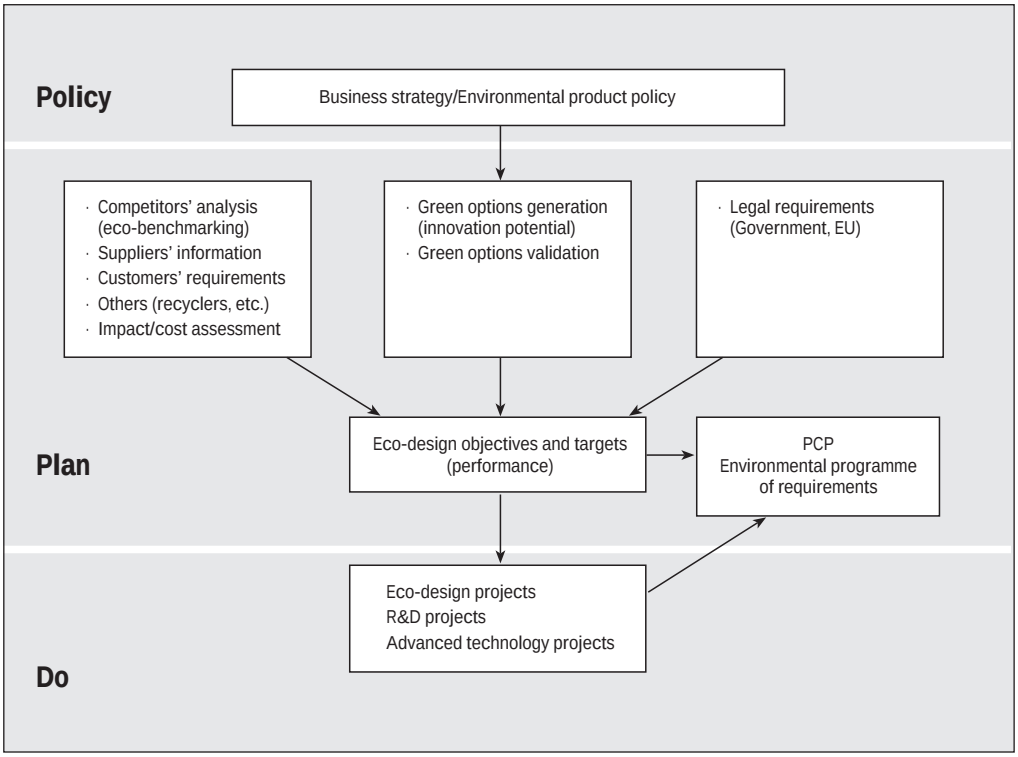

Figure 2: What do we want to achieve (in terms of product's eco-efficiency)?

technological implications, eco-design objectives and targets may:

- be directly translated into environmental requirements for the PCP (environmental programme of demands)
- have to be worked out through specific projects, eg. in the context of the advanced technology groups. Such projects' results will later on be an input to the PCP.

Managerial objectives and targets aim at building capability and routines for the implementation of eco-design. Building capability for eco-design requires the allocation of appropriate resources, assignment of responsibilities, building expertise (including the development/ application of adequate tools) and internal and external communication.

The detailed requirements for each of these elements should be worked out on the basis of the needs of the eco-design activities in the PCP and of other ad hoc eco-design projects.

In order to guarantee environmentally sound management, operating methods in the form of written procedures for eco-design should be established. Procedures clearly define methods of operation to be followed and guarantee continuity when people change jobs or new staff are hired.

The procedures should be established to support eco-design activities that are agreed as a 'standard' in the company, and the integration into existing EMS and quality procedures is recommended.

In the establishment of an eco-design procedure for product development, the following elements should be included:

- the assignment of eco-design responsibilities as well as creating and maintaining an adequate level of competence
- the inclusion of eco-design objectives, methodologies and

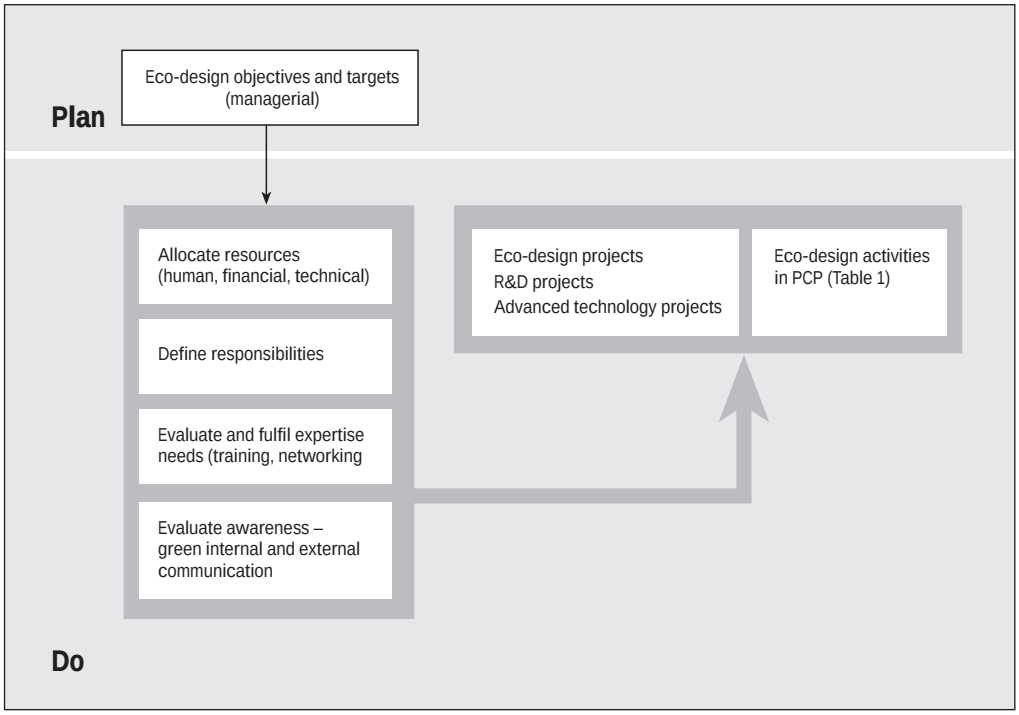

Figure 3: How to ensure capability to improved environmental product performance?

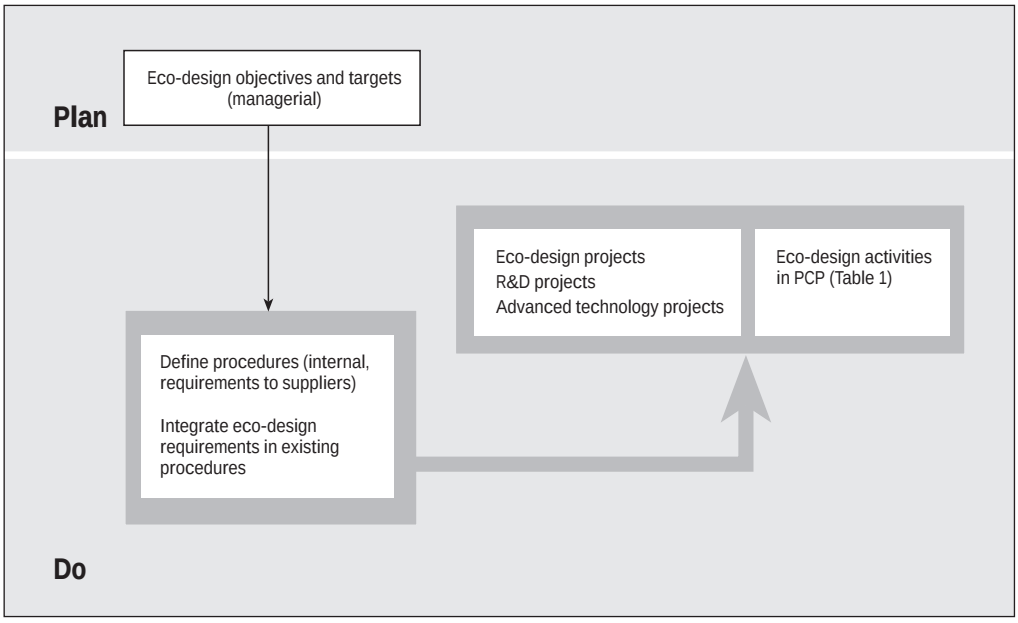

Figure 4: How to ensure effective routinisation and control of inclusion of eco-design in PCP?

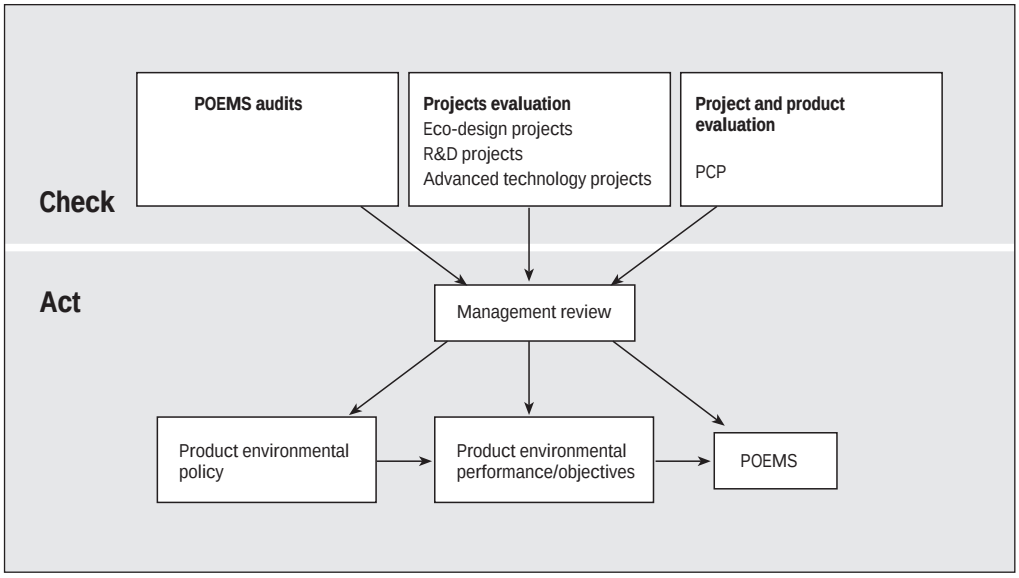

Figure 5: Have product environmental objectives been met? Is the system effective?

tools in the PCP and other relevant projects.

This is a 'review and set directions phase', described in ISO 14001 as the management review, which addresses the possible need for changes to policy, objectives and other elements of the POEMS in the light of the audit's results, product and project evaluations, changing circumstances and the commitment to continuously improve the products' environmental performance. POEMS is again analysed at a strategic level and as an on-going process.

Planned short term actions

The POEMS model and suggested eco-design activities were presented and discussed at the company. It was considered that POEMS is compatible with the existing EMS and that short-term initiatives will focus on:

- making the Board of Directors aware of the current situation of eco-design implementation and of the results of the project, and to request a clear statement of support on the strategic importance of POEMS to the company and a view on the level of ambition of environmental objectives for product development. This is viewed as a crucial aspect of the potential for the success of POEMS in the company.
- the inclusion of an environmental statement in the company's Vision.
- the constitution of working groups on the following areas:
  - strategic eco-design objectives, (following the Vision)
  - short-term eco-design targets for the new heavy line truck
  - procedures for eco-design in product development
- the development of a training and communication programme for eco-design. The existing eco-design newsletter and eco-design guidelines are important mechanisms that have to be enforced.
- the undertaking of eco-benchmarking, which is a recognised technique eg. for fuel consumption, but also addressing other eco-design aspects.
- the performance of a detailed LCA and lifecycle costing study, in order to identify opportunities for environmental and economic improve-ment.

Conclusions

'Producer responsibility' is becoming a strategic issue worldwide. As a result various countries in Europe are starting to evolve Environmental Product Policies (EPP). This is leading to a

fragmented picture across the EU with EC DGXI now exploring a harmonised approach – Integrated Product Policy (IPP). In the Netherlands, POEMS has been developed as an approach to EPP on the supply-side. TU Delft's Design for Sustainability programme has worked with a truck manufacturer to define the practicalities of POEM in a corporate context.

The results of the case study were encouraging in relation to the role that the POEMS model can play in the systematic implementation of eco-design. The project acted as a 'launch pad' for a number of start-up activities in eco-design in the company. So far no major conflicts between the existing EMS – its extention towards a comprehensive integration of product development activities by the means of a POEMS – and the PCP have been identified. But the details of its implementation are still to be worked out and future developments will be tracked.

One important finding of this project was that a clear top management commitment for eco-design as a strategic issue, translated into the availability of capabilities and resources, is the key factor for success of POEMS. The external environmental product policy context, as well as market demands, have so far been the determinants in terms of the company's strategic choices for product development. The opportunities that eco-design can bring from cost effectiveness and competitiveness have not been comprehensively explored and in this context an adequate product policy at EU level focusing both the production and consumption sides is essential.

The POEMS concept and its operationalisation is still in its infancy and it is not yet possible to have a clear picture of the mechanisms involved in such a process. There are various key questions that need answers.

- To what extent and under which conditions do EMS and eco-design enhance or oppose each other in product development practice?
- Which are the relevant (internal and external) factors and actors in this context?
- Will the implementation of product-oriented EMS enhance the company's competitive advantage?
- Will it foster innovation with regards to environmental product development?
- Is it possible to implement POEMS both effectively and efficiently in all product development companies?

These questions are still to be answered and constitute the core of a larger research project currently being undertaken by the authors at TU Delft. •

Abbreviations

EMS – Environmental management system
POEMS – Product oriented environmental management system
LCA – Life cycle assessment
eLCC – Environmental life cycle cost assessment
PCP – Product Creation Process
BD – Business Development Department
PD – Product Development Department
P – Purchasing Department
M – Manufacturing Department
M&S – Marketing and Sales Department
HR – Human Resources Department
H,S&E – Health, Safety and Environmental Affairs Department

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Progress towards sustainable design in the white goods sector

Edwin Datschefski

Founder and CEO, BioThinking International, UK

Edwin Datschefski is the founder and CEO of BioThinking International, a non-profit organisation promoting the idea that sustainability will be achieved by modelling industrial systems on nature — making them more cyclic, solar and safe, as well as more eco-efficient. After studying Biology at Bristol University, Edwin spent five years working on business and environmental protection issues for The Environment Council, and five years as a consultant to blue chip corporations, central and local government. Since 1994, Edwin has trained over 5000 people in environmental management and sustainable product development.

This paper is in two sections, the first part covers manufacturers' progress to date and the second part looks to the future, exploring what improvements would lead to sustainable white goods. Much of the progress to date has been driven by energy- and eco-labelling, and therefore this paper is informed by the US, Nordic, German and EU labelling criteria, as well as data from manufacturers. The section on future improvements is derived from a 'biothinking' approach to sustainability – making products cyclic, solar, safe and efficient.

Core white goods characteristics

There are a number of environmental aspects that are common to all white goods, such as the manufacture of the white metal cabinet, the degree of repairability and durability, recovery at end of use, packaging, consumer education and noise in operation.

Cabinet manufacture

Most white goods are made of steel with a surface coating, and impacts arise from the toxicity of coatings and the solvents released during the manufacturing process. The philosophy of the EU label has been to focus on the larger impacts that occur during the *use* phase of white goods, but nonetheless these impacts are significant in absolute terms. Only the Nordic eco-label specifically addresses surface coating, stating that 'paints must not contain pigment or additives based on lead, cadmium, chromium, mercury or their compounds. The paints must not contain more than 5% by weight of organic solvents.' This is a trend reflected in other industries, such as the automobile sector where Volvo has been using water-based metal painting systems.

Metal plating processes cause widespread release of heavy metals to watercourses, and unnecessary plating should be avoided completely. The Nordic eco-label is specific that 'metals must not be plated with cadmium, chromium, nickel or their compounds. In exceptional cases, small parts such as screws and hinges may be plated with chromium, nickel or their compounds.' In the case of washing machines, the washing drum can be chromed if it can

be shown that the drum can be recovered at 'end of life'.

The Nordic eco-label also reflects Scandinavia's more advanced views on toxicity, stating that 'plastic materials must not contain substances based on cadmium, lead, mercury or their compounds, chlorinated/bromated paraffins or bromated diphenyl esters.' The Blue Angel criteria for fridges also bans the use of cadmium and lead additives in plastic parts, but pragmatically allows up to 75ppm of such additives to be present (but presumably not added during manufacture) if recycled plastics are used.

Reliability

Despite the fact that most household appliances have become steadily more reliable, washing machines and washer-driers still top the poll of the least reliable pieces of equipment, according to a UK Consumers' Association survey of 15,000 Which? magazine readers. For washing machines, the most reliable brands were found to be AEG, Ariston, Candy Indesit, Miele, Tricity Bendix, and Zanussi. The least reliable were Hoover and Hotpoint.

Appliance recovery

Every year, 100,000 tonnes of white goods are discarded in the UK and recycling is erractic. For refrigerators, the freon is extracted from old machines by local authorities and by retailers when they supply new machines. However, the potential for recycling white goods is there — by weight, the typical appliance consists of approximately 75% steel.

To aid in recycling, plastic parts should be labelled, and both the EU, Nordic and Blue Angel schemes require this for plastic parts weighing more than 50g. Markings are permanent (usually embossed) and follow the usual material abbreviations:

- PET
- HDPE
- PVC
- LDPE
- PP
- PS
- all other plastics (which should themselves to conform to ISO1043).

The Nordic label requires that a 'plan shall be drawn up describing a method and estimating the costs of disposing of the dishwashers at the end of their service life. The estimate shall be made in current monetary values and shall be based on present price information for dismantling, shredding, disposal and sale of usable parts, or whatever else the handling may comprise. When selling a Nordic Swan-labelled dishwasher, the licence holder shall offer the facility of returning the dishwasher to the dealer at the end of its service life, possibly against payment of a fee. The objective is that the dishwasher shall be recovered.' This sort of approach has not yet taken off, but interest in such deposits is increasing, with a 'Disposal and Re-use of White Goods' Bill being proposed in the UK in 1998. The Bill proposed that white goods retailers should levy a 'green' deposit (10% of the purchase price) on all appliances sold. Purchasers would be issued with a 'log book'. If the machine is sold on by the original purchaser, the 'log book' would go with it. The deposit could eventually be 'cashed in' if the machine was responsibly disposed of at the 'end of (its) life'; either to a local authority for scrap or to a community organisation for parts recovery.

Miele was the first white goods manufacturer to introduce an appliance recycling system in Germany in June 1994. The reusable material provided by a product mix of Miele washing machines, tumble dryers, electric ovens and dishwashers is between 82% and 85% in terms of weight. These valuable materials are then recycled. This network is available to specialist dealers, the specialist trade and local communities.

Some local authorities offer an appliance pick up service, such as the one in Chicagoin the US which reclaims freon, takes usable parts to make other, and separates various metals for recycling. The shell of the appliance is then taken to a shredding facility and recycled to make other steel products. This scheme was created in 1994 when the Illinois general assembly placed a ban on the disposal of white goods into landfills in Illinois.

Packaging

While only a minor impact in the overall lifetime of an appliance, wholesale and retail packaging is being improved. For example, the US Green Seals for both fridges and washing machines state that:

- 'Packaging shall not contain

inks, dyes, pigments, stabilisers, or any other additives to which any lead, cadmium, mercury, or hexavalent chromium has been intentionally introduced.'

- 'The sum of the concentration levels of lead, cadmium, mercury, and hexavalent chromium present in any package or packaging components shall not exceed 100 parts per million by weight.'
- 'The product package shall have a minimum post-consumer content of 25%.'

Consumer education

The Nordic Eco-label criteria for washing machines quote some studies which have shown that users normally fill machines inadequately, usually with 2–3 kg of cotton laundry, instead of the optimal 5kg. As a result of part loads, the machines consume more electricity and water per kg of laundry. Most machines now have a half load setting to help address this tendency. Some more expensive machines have weighing scales built in and a logic chip which allows water and possibly detergent levels to be matched exactly to the load with minimal user input. Such approaches are likely to be much more effective than requiring calculations on the part of the user.

Consumers can reduce energy usage dramatically by washing at cooler temperatures, something which is not always made abundantly clear in user manuals. For example, washing at 30°C or room temperature can save up to 80% of energy — a huge improvement and as all machines have a temperature dial this is within the control of the consumer. The corresponding control available for water usage, via the economy or half loading buttons, does not offer such dramatic savings.

Label standard	Maximum noise level dB(A)
Nordic dishwasher	57
Nordic fridge	40
Nordic washing machine	72 during spinning, 60 otherwise
EU fridge	42

Table 1: Maximum noise levels (as defined by specific eco-labels)

All the eco-labels require clear information to be presented to consumers on how to minimise environmental impact, usually in the form of manuals. For example:

- 'If the water in your home is heated by an environmentally approved wood burner, or boiler fired with wood chips or pellets, by a heat pump which takes heat from the air, the ground, rock or the sun, or by taking solar heat directly during most of the year, the dishwasher should preferably be connected to the hot water system. This usually also applies if your home is connected to the district heating system.' (Nordic Dishwasher Label)
- 'Advice to use a full load whenever possible ... with clear examples of (a) typical maximum load(s) must be included, advice on varying the detergent dose according to water hardness, load size and the degree of soiling, information about the energy consumption and the water consumption of the machine for different temperature settings and for different load settings.' (EU Washing Machine Label).
- 'Information about the washing machine being made of parts and materials which are reusable and/or recyclable, advice that when disposing of the washing machine the consumer should enquire about, and follow the applicable water-management routes.' (EU Washing Machine Label).

Noise

Control of noise is useful in domestic settings. Several labels have noise standards (see Table 1). These standards are highly achievable, and one (unlabelled) Swedish washing machine, the ASKO 20605, washes at a noise level of only 52 dB(A), which is comparable to a whisper (see Figure 1).

Washing clothes

Taking our white box and adding heat, water and motion we get a washing machine.

The washing of clothes is achieved by adding a optimum amount of water and then applying time, heat, motion and detergent. Different countries have adopted different mixes of these elements in their machines, but

Figure 1: Asko washing machine from Sweden

Country approach	Time	Heat	Movement
US	40 minutes	60°C	High
UK	100 minutes	60°C	Medium
Italy	8 hours	Room temperature	Low

Table 2: Washing clothes – different national approaches

all achieve the same result (see Table 2).

US machines have more agitation and consequently wear out clothes more quickly, making this approach less desirable environmentally, although giving a benefit of quicker washing.

In Italy, washes can be much longer as machines are designed to exploit special electricity meters that limit electricity use to an agreed maximum load. If this load is set at 3.3 kW, then householders pay at the 'social tariff', which is about 40% cheaper than standard rates. As the standard rate is the second most expensive in Europe (after Belgium), this provides an extra incentive for low energy appliances

The biggest difference is made by running machines at lower temperatures and with optimal loads.

Energy

The difference between energy consumption in the worst and best machines is about 1:2. If all machines in the Nordic countries complied with the eco-label, about 0.7 TWh of washing and drying electricity would be saved per year.

The EU ecolabel requires the use of less than or equal to 0.23 kWh of electrical energy per kg of washload in a standard 60 C cotton cycle. Such machines will thus qualify for energy efficiency classes 'A' and 'B'.

The US Green Seal label uses an energy factor calculation based on volume, rather than mass of washload, making transatlantic comparison tricky. The Green Seal Class A Certification Level requires that the product shall have an energy factor greater than 2.5 ft^3/(kWh/cycle). The average European drum size is 1.65 ft^3, so this means that the AEG 86720 (an EU 'A' rated machine) which uses 0.89 kWh per load would have an energy factor of 1.85 ft^3/(kWh/cycle), so not qualifying for a Green Seal 'A' level certification.

US machines have traditionally been top-loading, vertical-axis machines that are heavy energy and water users. However, since the advent of the Green Seal label, and the fact that water and electric companies now offer rebates for buyers of efficient machines, a new breed of front-loading machines has emerged. These horizontal axis machines are quite large (about 8kg load) and when calculated per loading, are more energy efficient than EU machines and often comply with the EU water use threshold. Several brands, such as Frigidaire, Gibson and General Electric have a better energy factor than leading EU brands such as Asko, Miele and Creda.

The average new US vertical-axis machine is 2.72 ft^3, and uses 2.22 kWh per cycle, an energy factor of 1.23 or equivalent to approximately 1.35 kWh/kg — a poor rating but it is still possible to buy EU front loaders that use that much energy.

The Nordic Swan eco-label has a broader approach to energy calculations. Instead of the usual 60C 5kg load used by the EU, the Nordic energy performance is aggregated from tests at cotton 60C full load and 2kg, and non-iron 40C at full load and 1 kg load. These four modes are then averaged as follows:

E ft= 0.35 kWh/kg where E= (e1+e2+e3+e4)/(m1+m2+m3+m4)

For example, the 1992 AEG 610 would get a score of E=(1.1+0.75+0.8+0.4)/ (5+2+5+1) = 0.23, and so would easily qualify, whereas its cotton 60C full load usage of 1.1 kWh would be 0.22 kWh/kg, only just making the EU Label requirement of 0.23 kWh/kg. This would seem to imply that the Nordic Swan is a little less stringent than the EU label.

The only machines to hold the Nordic eco-label are the Miele W 986, WS 5425, and WS 5426, and the only machines to hold the EU label are the Edy/ Nordland range and the Hoover New Wave. However, there are several others on the market that qualify for the criteria, but have not applied for the label.

Water

The EU label says that a machine must use less than or equal to 15 litres of water per kg of washload. The US Green Seal Class 'A' certification level requires that maximum per cycle water use shall be no greater than 11.0 gal/ft^3/cycle.

The Nordic Swan takes its aggregate approach again:

W ft= 32 l/kg where W= (w1+w2+w3+w4)/(m1+m2+m3+m4)

Here the 1992 AEG 610 would get a score of W=(83+76+83+44)/ (5+2+5+1)=22, qualifying easily, whereas under the EU label it would score 16.6 l/kg, not quite the required 15 l/kg.

Detergent

The impact of detergents is due not only to the ingredients and chemicals present in the formulations but also to the sheer volume of the quantities used — over 3.5 million tonnes per year of heavy and low duty detergents were used within the EU during 1992. Excess detergent use increases the environmental loading of the wastewater, and until the early 90s, most machines lost quite a lot of detergent out of the bottom before it could be used for washing. Consequently, the EU label requires that the machine must lose less than or equal to 5% of detergent.

For example, the AEG OKO valve closes off the wash tub from the drainage system during all wash programmes. This not only reinforces the cleaning effect but also saves detergent, requiring 20% less detergent than a machine without a locking device.

The type of washing powder employed can make a big difference, with three main types being available: 'Standard', 'Improved' by means of meeting the EU Ecolabel (currently only the 'Down to Earth' brand achieves this) and 'organic' brands such as Ecover and Bio-D. The best form of detergent is reckoned by the Environmental Detergent Manufacturer's Association (EDMA) to be the concentrated powders, which have optimal packaging and about a quarter of the surfactants found in equivalent liquid detergents. Concentrated powders are also more likely to meet packaging goals, such as the EU ecolabel requirement for the sum for the primary packaging, of total packaging and virgin material to not exceed 9 g/wash.

The best method is to 'build your own' with a modular system (using various components to construct your own washing powder), according to the Öko-Institut, Freiburg, Germany.

Brand	Water litres/kg	Electricity kWh/kg
Creda 17088 Cascade Eco Wash	15.0	0.26
Hoover Quattro AE160	9.8	0.19
Edy/Nordland (Frenko)	10.4	0.21
AEG OKO_Lavamat 610	16.6	0.22
AEG OKO_Lavamat 86720	7.8	0.18
Frigidaire FWT445GE (estimated)	12.0	0.10
EU ecolabel criteria	15.0	0.23

Table 3: Water and electricity use comparisons

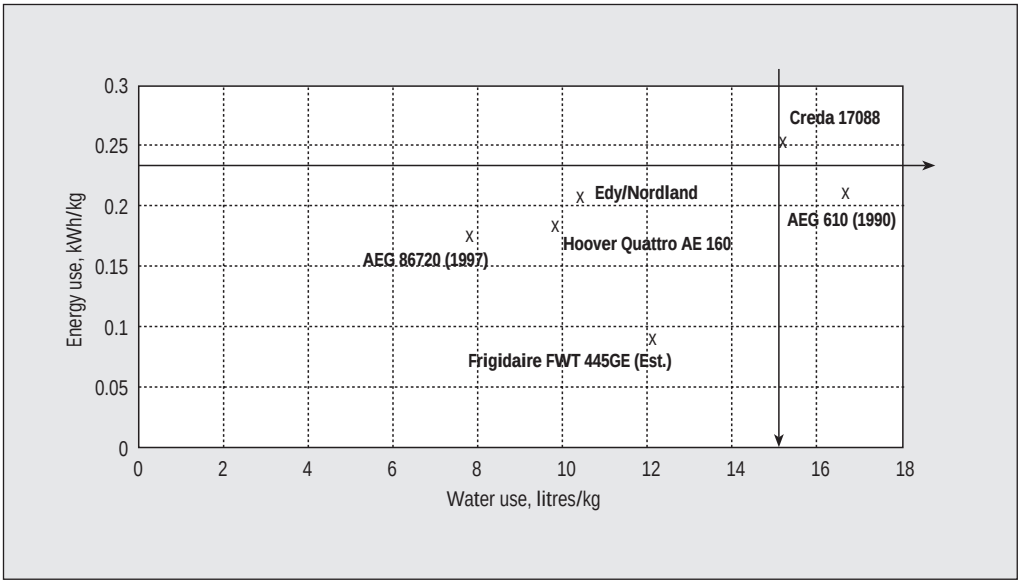

Figure 2: Energy and water use

Machine comparisons

Table 3 shows some comparisons of water and electricity use by brand.

Refrigeration

Taking our white box and adding insulation, a compressor and a refrigerant, we get a refrigerator.

Home refrigerators are a significant user of world electricity; hundreds of millions are currently in use, and 58 million new units are manufactured worldwide each year. The main environmental impacts result from the use of electrical energy and the use and possible emission of refrigerants and foaming agents that could deplete the ozone (O_3) layer and contribute to global warming.

Energy

The difference in energy consumption between the best and worst machines on the market is in the ratio of about 1:3. Improvements have been steady — in the US, new compressor technology which was introduced during the 1980s helped reduce annual refrigerator energy use from 1500 kilowatt hours (kWh) to 900 kWh per year in 1990. Between 1980 and 1990, according to the US Department of Energy (DOE) the energy-efficient refrigerator compressors saved US consumers $6 billion in energy costs.

Standard	Energy use per year in kWh (V = cabinet volume)
Green Seal 1993	0.48 V + 299
Green Seal 2001	0.31 V + 248.4
Nordic Swan fridge freezer	0.36 V + 230
Nordic Swan larder fridge	0.24 V + 130

Table 4: Refrigerators – energy use

Now new standards continue to drive efficiency, although gains are beginning to take off (see Table 4).

For example, the Danish firm Vestfrost produce Vestfrost SKF375 with a capacity of 296l which uses 0.88 kWh a day or 321.2kWh per year. The Nordic label requires an annual energy use of (296*0.36)+230 = 336.56, and the Vestfrost qualifies. The US Green Seal goal requires (296*0.31)+248.4 = 340.16, and so

it meets that, too. The Vestfrost has the EU ecolabel, which requires that the appliance must qualify for either energy class 'A' or 'B' as defined in Directive 94/2/EC, Annex V.

The Bosch KKI3301GB fridge/freezer is 300 litres and uses 412 kWh per year, and so would not qualify for Nordic or Green Seal. The Bosch KDR3701 larder fridge at 363 l and 135 kWh per year would meet those goals.

Users of refrigerators do not make as big a difference as they do for washing machines, but there are various guidelines that are worth following:

- the door or lid should not be opened more often than needed and no longer than necessary, especially with regard to upright freezers
- hot foodstuffs should be allowed to cool down before placing in the appliance, as the steam from the foodstuffs contributes to the icing up of the evaporator unit
- the evaporator unit should be kept clean from thick layers of ice and that frequent defrosting facilitates the removal of the ice cover
- the radiator on the back of the appliance and the space underneath the appliance should be kept clean from dust or kitchen smoke.

Refrigerants

Back in 1991, the author organised a seminar on 'refrigerators and the environment'. Large chemical firms such as ICI and Rhone Poulenc and some fridge manufacturers spoke at the event. They were all totally committed to replacing chlorofluorocarbons (CFCs) with hydrofluorocarbons (HFCs) such as R134a, a compound with a global warming potential three thousand times greater than carbon dioxide (CO_2). When a professor from South Bank University in the UK came to give his talk on using propane/butane as a substitute, people literally laughed at him and said it was unfeasible and dangerous.

Yet within two or three years, the 'greenfreeze revolution' took off, led by Greenpeace and the small German manufacturer DKK Scharfenstein. Now all manufacturers use hydrocarbon refrigerants, finding that they are efficient, have no ozone depletion potential and very low global warming potential. The explosion risk is negligible — a fridge contains as much propane as a cigarette lighter does.

The propane/butane mix of refrigerant is effectively required in order to meet the EU ecolabel, as it states, 'the refrigerants in the refrigerating circuit and foaming agents used for the insulation of the appliance shall have an ozone depletion potential equal to zero, and shall have a global warming potential equal to, or lower than, 15 (rated as carbon dioxide (CO_2) equivalents over a period of 100 years).'

The Green Seal Class 'A' certification also disallows HFCs by stating that, 'products shall not contain any chemicals that are ozone-depleting or have significant global-warming potential'.

Vestfrost is the first company in the EU to be awarded an ecolabel for refrigerators, and is one of the world's largest producers of refrigerators and freezers, with a turnover of DKK 1.4 billion. It introduced its first greenfreeze model in 1993 and the following year found production had increased by 39 per cent to 725,000 units compared to the previous financial year.

The four design requirements for sustainable products

The 'biothinking' model shows how technologies can become fully compatible with nature. The first three mimick the protocols used by plant and animal ecosystems.

Cyclic: The product is made from organic materials, and is recyclable or compostable, or is made from minerals that are continuously cycled in a 'closed loop'.

Solar: The product uses solar energy or other forms of renewable energy, both during *use* and manufacture.

Safe: The product is non-toxic in *use* and disposal, and its manufacture does not involve toxic releases or the disruption of ecosystems.

The fourth requirement is based on the need to maximise the utility of resources in a finite world:

Efficient: The product in manufacture and *use* requires 90% less materials, energy and water than products providing equivalent utility did in 1990.

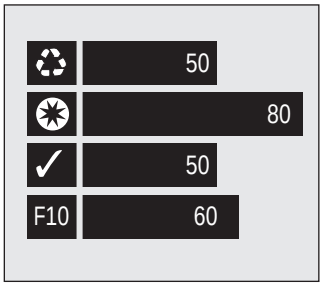

Figure 3: 'Biothinking' score for Frenko washing machine

Where renewable energy is available for hot water heating, as in Iceland or Sweden, then any of today's washing machines hooked up as hot fill will become 80% solar.

For a given product, it is possible to score each of these requirements out of 100, and this information can be expressed in a simple logo (see Figure 3).

Potential innovations that would move white goods towards true sustainability can be identified by considering each of the four requirements in turn:

Cyclic

Appliances can become 100% recyclable, from their current level of 70 to 85%. This would mean paying attention to metal paints and finishes, and perhaps opting for an unpainted box of brushed recycled stainless steel or recycled aluminium. The paints could be more cyclic in their manufacture and application, such as the vegetable-derived water based paints from companies like Auro and Holzweg. An improvement on this would be to have more re-use, becoming more like a refurbishment process, as exemplified by Xerox in their photocopier remanufacturing process. In this case, elements like motors and drums and refrigerants would be refurbished to meet their original quality specifications, and built into new appliances. Steps are already being made towards this by Miele, who 'take back' machines. In Japan, Sharp Corporation and Mitsubishi Materials Corporation announced in August 1999 that they would set up a joint venture in October 1999 in Osaka to recycle Sharp-made electric home appliances, including TV sets, refrigerators, washing machines and air-conditioners. The plant will start operation in April 2001 with an initial recycling capacity of 360,000 units a year.

Washing machines and dishwashers can be engineered to play more of a role in the water cycle. Given the use of a suitable detergent and a filtering system, effluent can be made good enough quality to flush toilets or be applied to gardens. The compounds removed from clothing (blood, sweat, food stains, etc.) are usually suitable for composting and could be treated in a bio-system such as a reed bed or mussel tank. Such a system could be engineered to look like a domestic appliance or could be centralised within a housing area.

Solar

Where renewable energy is available for hot water heating, as in Iceland or Sweden, then any of today's washing machines hooked up as 'hot fill' will become 80% solar. Adding renewable electricity, such as that supplied by a Green Tariff or the householder's own wind or photovoltaic (PV) supplies, would make the washing machine 100% solar, as would hooking up a refrigerator to such a connection.

Solar manufacture would tackle the 5% or so of lifetime energy that is not covered in the use phase. This would require connecting the steelworks and assembly plant to a renewable source. In the case of the aluminium mentioned above, the remelting process is already likely to be powered by renewable Icelandic or Norwegian electricity.

If a washing machine is set up as hot fill, or cold water washing is being used, then the agitation process is all that remains — a very light energy requirement which could in theory be met by a 'secondary renewable' source such as muscle power, perhaps via a pedal/exercise bicycle system.

Safe

Much of the water impacts are from the detergent, so eliminating detergent would be good for reducing lifetime aquatic toxicity. The use of laundry disks (see Figure 4) or balls has already become widespread. They work with a ceramic surface or replaceable crystals which change the tension of the water to make it 'wetter' in the same way surfactants do, although they do not replace stain removers or bleaches or conditioners. Such disks last for up to 700 washes, and a manufacturer could incorporate the same technology into the drum of a machine, and then sell a special kit of conditioner, bleach and stain remover that can be applied as necessary — although these products are already available separately.

Vegetable detergents would eliminate the use of petrochemicals, and several are already on the market. An interesting variant on this is the Soap Nut, literally a nut from India which has good cleaning properties. In most of Europe, you can find on the edges of forest a plant called soapwort (Saponaria officinalis), the leaves of which should be boiled in an enamel pan to make a nice gentle soap solution.

Eliminating the toxic emissions of the manufacturing stages would require looking at a wide range of suppliers' activities, but is possible. For example, while there are no zero-emission chroming processes at the moment, a ceramic or plastic washing machine drum could be used. Another example is the ecosystem impacts of metals mining could be avoided by using only recovered metals, and in the interim high impact metals such as copper could be reduced, as in the low copper motors used in Philips' Eco Vision vacuum cleaner.

Efficient

A large part of the mass of a washing machine is the base, which is needed for stability. A report from Merloni, the Italian manufacturer, compared concrete and cast iron counterweights. The former material won, registering less than half the ecopoints of the latter. Going one step further is to use water chamber as a base. This reduces both manufacturing and transportation impacts. However, a foolproof way of avoiding stagnation in this chamber is also required.

Using ambient outdoor energy is possible, as in the Fria concept fridge developed by Ursula Tischner at ec(o)ncept – which is built into an outside wall and has a larder section, making use of European winter conditions to maintain a cool temperature for various foodstuffs.

Three water inputs — the Nordic eco-label on washing machines postulates that machines are best connected to both hot and cold

Figure 4: Laundry disc electromagnetic detergent substitute

Figure 5: Soapnut natural washing powder

Figure 6: Fria concept fridge by Ursula Tischner of ec(o)ncept

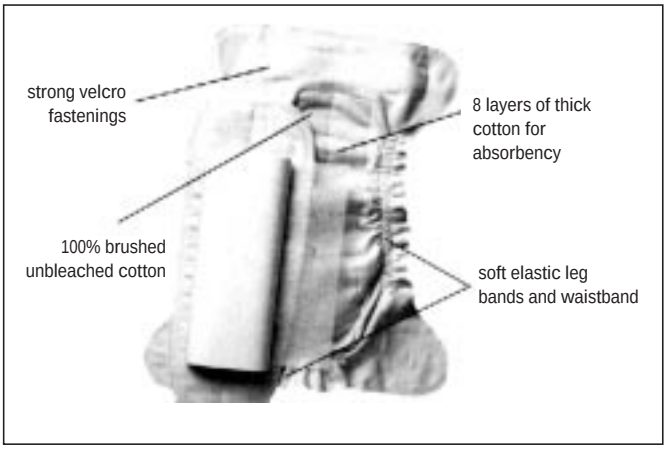

Figure 6: A 'superterry'-style nappy with flushable liner

water supplies. If a third line for lukewarm water from waste heat or solar collectors was added, then the system could become optimal.

Cold water detergents, and design of machines for their use, would result in up to 80% energy savings.

Apart from recycling waste water, it may also be possible to capture waste heat. Michael Rowe, an electrical engineering professor at Cardiff University's School of Engineering in Wales used a series of thermocouples to generate current from heated water, successfully powering a colour TV from bathwater. The University has received a $2.9 million grant from the Japanese New Energy Development Organisation (NEDO) to develop commercial products based on the idea. (Source: Environmental News Service)

Clothing design for stain targeting can be achieved for example by having shirts with removable cuffs, collar and even armpits. The 'superterry' nappy has a flushable paper liner and a washable cotton outer that needs to washed much less frequently than standard terries.

More precise control through improved electronics and coordination. Italian firm Merloni has launched its 'Ariston Digital' range of domestic appliances, which have the ability to communicate with one another and the outside world. Via an external telephone or within the house through the mains circuits, each appliance constantly transmits information to the Assistance Centre on their running conditions or possible faults. The Centre is therefore aware, at all times, of how much power is being consumed and can regulate the consumption accordingly, so as to avoid the risk of a black-out. They are also able to decide, should a black-out be likely to occur, which appliance should be given priority, eg. the washing machine over the oven. At the same time, they can make appliances run more intensely during off-peak, cheaper rate hours.

The appliances are equipped with a 'state of the art' regulation system, built with new hardware (specific microchips, 'mini computers' that regulate the appliances). New sensors, developed especially from Merloni Elettrodomestici, supply the microchip with all the necessary information to guarantee a better performance and the lowest possible consumption (water, power, etc.).

Conclusion

Over the past fifteen years, there have been substantial improvements in the eco-efficiency of white goods in use. The amount electricity needed to run a fridge for a day, and the amount of water, electricity and detergent needed to wash a kilogramme of laundry have approximately halved. However, the rate of improvement is starting to level off, and attention must focus on turning white goods into systems that are fully compatible with nature. In particular, more progress needs to be made to achieve the goals of:

- 'closed loop' appliance recovery and remanufacture;
- recovery and zero toxicity of washing machine effluent;
- effective low temperature washing;
- zero toxicity in manufacture
- use of 100% renewable energy in manufacture and use.

A free course on using the Cyclic, Solar, Safe principles is available at www.biothinking. com •

Green cotton

Novotex A/S in Denmark are involved in the private label production and sales of Green Cotton textiles which include: T-shirts, sweat-shirts, jogging suits, casualwear, shirts/blouses, skirts/dresses, trousers, jackets, tights, socks, suits, pullovers, cardigans, underwear, nightwear, bedlinen, towels and bathrobes. The Novotex eco-product development process aims to minimise environmental impacts throughout lifecycle of the 'textiles cycle':

- cultivation
- ginning
- spinning, knitting and weaving
- dyeing and printing
- cutting and sewing
- use and recycling.

The company have attained EMAS and ISO14001 for its environmental management systems, and the EU (flower) eco-labelling criteria for T-shirts and the Nordic (Swan) eco-label for textiles

Design philosophy

'Green Cotton is a basic product that comes in close contact with the body. The clothing that carries the Green Cotton label must be a pleasure to wear. Our priorities are comfort, quality, a good fit and utility.'
Source: Novotex A/S corporate brochure

Cycab

Since 1991, researchers from the Instit National de Recherche en Informatique et en Automatique (INRIA) and INRETS in France have been working on a new concept for intelligent transportation systems for the cities of tommorrow. The prime focus of the research and development has been on:

- car-sharing
- intelligent vehicles.

A pilot public transport system project for urban areas called Praxitele has been established in Saint-Quentin-en-Yvellines in France utilising 50 self-service electric vehicles from Renault based at five recharging stations.

The Praxitele project has been developed through the cooperation of a range of industrial partners:

- CGFTE (transit opeartor)
- Dassault Electronique (electronics company)
- ECDF (electric utility)
- Renault (car manufacturer).

This programme enables more efficient use of vehicles (private cars remain stationary for 95% of their lifetime), reduced environmental impact and reduced congestion.

The second project – Cycab – was established by Avenir-Havas in 1997. Cycab is an electric vehicle designed and developed specifically for car-free cities using manual or automatic computer control. Avenir-Havas in partnership with a number of cities is now studying the possibility of implementing a new transporatation system based on these vehicles. The objective

is to limit the use of private cars in cities by offering an attractive transportation alternative with lower noise, energy use and pollution, and that creates fewer parking problems.

Solar lantern

The SL48 lantern, designed by BP Solar International, converts sunshine into DC power through the use of photovoltaic cells. The power is stored by high capacity, high temperature nickel cadmium batteries until required. The company says the lantern is designed to last for years and is capable of resisting the roughest treatment in the worst conditions.

The lantern has been built by the company's Systems Development Unit, a group of specialist engineers, who design photovoltaic systems for applications which include lighting, water pumping, refrigeration and water treatment. It is currently developing a range of hybrid systems varying in size between 10 and 1500W which may combine solar energy, wind energy and diesel to produce a cost effective and reliable means of power generation.

Solar module

Type: High stability crystalline silicon
Power: 9/10 watts at 6 volts DC
Lifetime: 10 to 15 years

Housing
Construction: ABS/Polycarbonate
Impact resistant
Water resistant to BS 5490
Lifetime: 10 to 15 years
Dimensions: 560x90x337mm
Weight: 4kg

Spare parts
· solar module
· battery pack
· 8 watt tube
· switch/inverter assembly

Light Unit

Lamp: 8 inch 8 watt fluorescent
Light output: Equivalent to 40 watt incandescent
Lamp life: Typically 3 years (2000 starts)
Switch: Water resistant flick switch
Inverter: 6 volt high frequency type
Inverter life: Typically 5 years depending on service, environment and usage rate
Battery pack: 6 volt, 4 ampere hour Nicad
Battery life: Typically 3 years

The lantern incorporates a solar module, control electronics, rechargeable battery pack and 8 watt fluorescent tube in a tough polycarbonate case. The 8 watt fluorescent tube provides as much light as a typical 40 watt incandescent light bulb, suitable for general room lighting or for close work such as reading.

A day in the life of a sustainable solutions designer in 2020

Ursula Tischner

Director, ec(o)ncept, Germany

Ursula Tischner studied architecture and Industrial Design in Aachen and Wuppertal, Germany, and specialised in eco-design. From 1992 to 1996 she worked at the Wuppertal Institute for Climate, Environment and Energy in the field of ecology and design. At the Institute she was engaged in theoretical and practical projects and wrote a guide for environment-friendly product design on behalf of the Austrian Ministry for Science and Research, which was published in 1995. In 1996 she established ec(o)ncept, a consultancy specialising in ecological considerations in product design based in Cologne, Germany. Now she advises small and medium sized companies (SMEs) in eco-design and helps to implement environmental improvements. She undertakes research projects, gives lectures in the field of ecology and design, teaches at design schools and develops environmentally sound products and service-concepts.

The brief

I normally start my workday with a cup of coffee (fair trade and organically grown, of course) in the garden and first of all read my e-mails on my laptop. Ah, my customer in the household appliance sector wants me to design a new small heater for apartments in energy efficient buildings. He has sent a brief including information on the target group, the final price, and production costs. In addition, he has also indicated that he does not want to sell the device outright, and that it should be designed for leasing. Good, I thought, since the European Commission established 'take back' laws for all products in 2015 and leasing concepts and product 'take back' strategies have become more and more popular. Products are not sold but leased and if the user does not want to use them any more, they are returned to the producer and are systematically remanufactured/repaired/recycled. Attached to the e-mail I find the company quality guidelines, which also consist of the environmental and social aspects that the company has estsblished and agreed with their suppliers and 'end of life' partners.

Research

To give me an overview of the 'state of the art' of heaters I go to Internet and research the home pages of my client's competitors and the industry association where I download lifecycle assessment (LCA) data on the average heater. I also browse through the databases of the international and national standardisation organisations. Additionally I log into my client's Intranet to retrieve the latest market research data on the needs of the target group. I phone some typical representatives of that target group, who have applied as voluntary test users and have a short chat about their ideas on good heaters. I thought it was interesting that most of the consumers are aware of environmental issues associated with heaters and some also think about social and ethical issues when they buy a product or service.

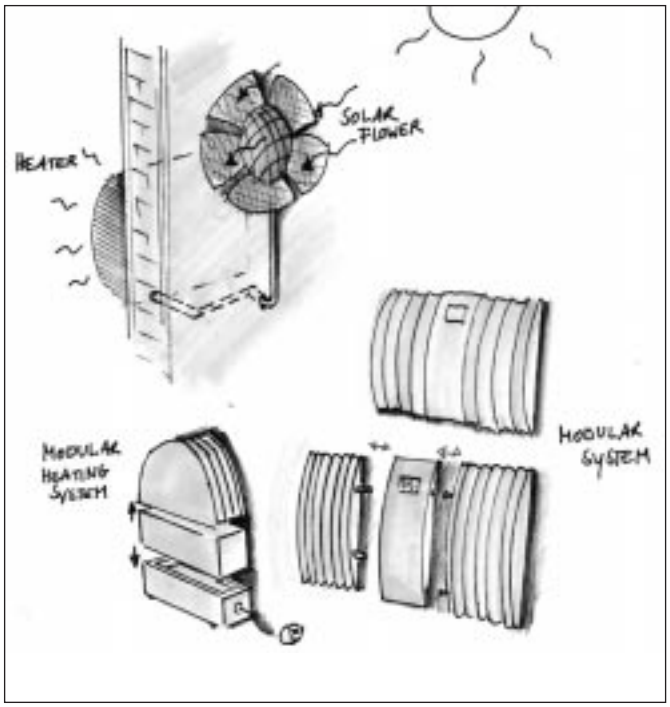

Figure 1: Eco-concepts

Product development

I then contact my client's product development team via Intranet and we have a videoconference to discuss the specifications of the new product. The team consists of the marketing manager, executives from the purchasing and the sales departments and production engineers, as well as the sustainability manager (the sustainability manager is a new position that the company has established recognising that many companies have had very bad customer relationships because they were not aware of the environmental and social impacts of their business activities. He coordinates business sustainability programmes and the environmental, social and ethical issues along the company's supply chain and throughout the product life-cycle). The product development team decides that because the product should be leased and taken back by the company, it is important to design a modular structure where technical components and all parts that have a short life span could be exchanged, while the durable components could cleaned and reused. We therefore decide that it may be useful to work together with local repair and recycling centres and use their optimised logistics systems to avoid transportation. These types of reuse and recycling partnerships are becoming more and more common today. The local sub-contractors organise smaller repairs and maintenance independently, collect the worn out products, separate the durables from the other components and return them both into the best recycling processes.

Ideas

After we agree on the scope of project development, the targets and timescales, I start to develop ideas for a new and better heater. First of all I define exactly the function of the product. Then I brainstorm by scribbling and sketching down ideas (I still like to scribble by hand although there are some very good 3D-modelling computer programs available now). I work through an eco-design checklist for household appliances on my computer with hot-button links to appropriate websites and databases – to make sure that I have not forgotten any of the relevant environmental aspects in the whole lifecycle of the product. Since our government started to fund systematic research on the lifecycle impact of products and services there is now very reliable data available. I also check an Internet database on new materials to find out, if any new renewable or smart materials have been developed. I do the same at the Network of Environmental Research & Development (a United Nations sponsored project) where the current findings of universities and research institutes are available free of charge. After this I develop three interesting designs, and scan the drawings into my project folder, write up

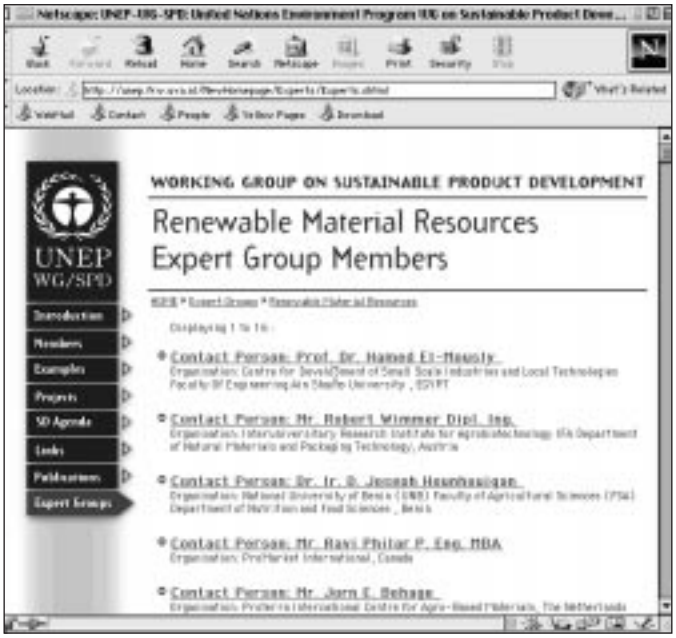

Figure 2: UNEP WG–SPD homepage

the description of the concepts and send them via Intranet to the product development team.

Marketing

Then I fix a date with the marketing manager and we meet in the city to have lunch together. I suggest trying the new SusFood bar which only provides organic meals and drinks from fair trade projects. Because my bike is at the repair service, I call the local community rikshaw service to take me to my meeting venue. There we discuss the marketing strategy for the new product. We want to communicate the environment-friendliness and social responsibility of our new product as a 'nice to have' aspect for the consumers because we know that our target group is aware of these arguments. Furthermore he tells me that they have had some adverse publicity resulting from their last Environmental/Social Audit – that is regularly completed by an Independent Consumer Organisation and published via Internet. As a result the company management has decided to have a strong emphasis on these 'softer'considerations in the design and delivery of their new products. He also asks me to think about icons for the product graphic that will communicate these considerations in a positive and attractive way. Finally we discuss the financial strategy that he has to work out with their financial partners as the leasing strategies need investment over time and have an extended pay-back period.

Information, design and solutions

Back at home I find a reply from the product development team in my email box. They are especially interested in the product solution no. 3 called 'dematerialisation'. This was a design where I tried to fulfil the function by using the smallest amount of material and energy. But now I have to detail the solution to establish if the concept could be achieved and if it is also environmentally and socially friendly from 'cradle to cradle'. Via Intranet I log into my customer's database to access information about their production capabilities and the suppliers with whom they have established supply chain and 'end of life' partnerships. The Intranet also gives me access to the main supplier databases, where I can find information on different product components and their environmental specifications. I am now able to do a rough LCA estimation for the whole product lifecycle by using the MIPS method (Material Input per unit of Service). Because some of the LCA results have been unclear I contact, via my videophone, some specialists from my expert network to discuss problematic areas. Through the use of a spider web diagram, a visualisation tool to compare different designs, I check if I can optimise the product by using another material or another construction. Then I check again to see if I am still in line with my customer's quality guidelines. I also consider the Black (forbidden) and White (allowed) material lists – these

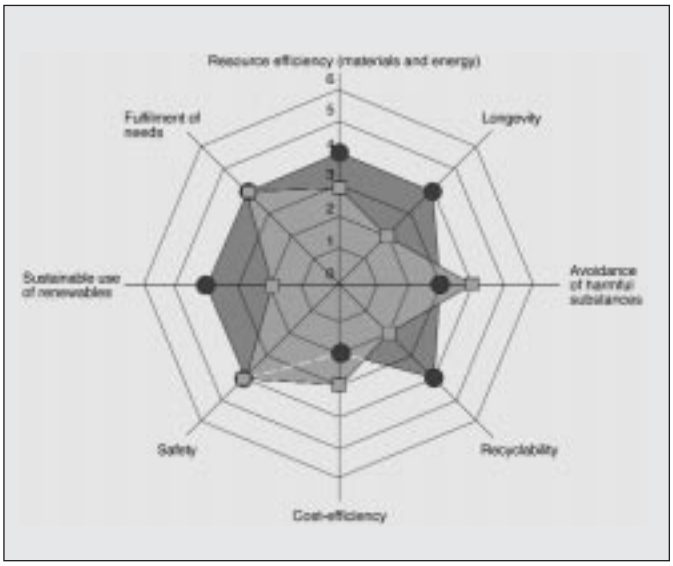

Figure 3: Spider diagram

have become increasingly important as the link between hazardous materials and health problems have become a global concern. At the end of the day I scan my product sketch into the computer and a program creates an animated 3D model. It also includes data for rapid prototyping, that could be used by the company to produce a real 3D model within a very short time. I send the 3D model animation and my description to my customer's product development team and finish my work for today.

…and finally

Sitting in my garden and drinking a glass of organically grown red wine from 2000 I think about the time – maybe 20 years ago – when it was still very rare to consider (as a product designer), the whole product lifecycle and the environmental as well as social aspects of solutions design and delivery. In 2000 it was still very difficult to get good information and there was very little communication along the supply chain and between the 'end of life' actors and the producers. And I feel quite satisfied with the work I completed today. •

Sustainable Product Research Network (SPRN)

Martin Charter

Coordinator, The Centre for Sustainable Design, UK

SPRN aims to disseminate information on current and future research in eco-design and sustainable product design.

SPRN will publish summaries of PhD, post doctoral or other research projects.

SPRN provides a resource for researchers to network and keep up to date with new research.

Areas of coverage include:
· sustainable product development
· sustainable consumption
· management of eco-design
· green marketing
· eco-design strategies
· eco-design tools
· life cycle costing
· new materials

Dematerialisation

Oksana Mont of the International Institute of Industrial Environmental Economics (IIIEE) at Lund University in Sweden is undertaking a PhD that explores the concept of dematerialisation as a means to leapfrog outdated technology. The key focus of the research is: can dematerialisation help countries in transition leapfrog by turning them into more service-orientated economies. The concept of dematerialisation will be studied by concentrating on issues such as 'added value' through services and the substitution of products with services. The project's goals are to analyse the dematerialisation concept and find successful examples of implementation in developed countries, as well as the policy instruments that supported these strategies. The target groups to be researched will be academia, industry and policymakers. The key objective is to analyse the development paths of specific industrialising countries to investigate if they are able to catch up with developed countries by leapfrogging post industrial technologies with knowledge-based services. The strategic issues that might facilitate such leapfrogging will be researched including key questions such as: can dematerialisation serve as a strategic tool for facilitating and sustaining development of industrialising countries?; where should investments be made in order to facilitate sustainable development?; and what are the barriers to that?

✉ *Oksana Mont, Researcher, International Institute of Industrial Environmental Economics (IEEE), Lund University, Sweden*
oksana.mont@iiiee.lu.se

Strategies to promote organic food

Pia Heidenmark is completing a PhD study at IIIEE into the organic food market. Interest in the supply of organic food has risen substantially in Sweden during the last decade and several retail chains now have organic food policies. However, supply is still unsatisfactory and the Swedish agricultural sector is lagging behind Denmark – where an ecological 'boom' has occurred. Danish food products are now penetrating the Swedish market because domestic supply connot fulfil demand. The purpose of the study is to find means to increase and improve

the communication and co-operation along the Swedish food supply chain by involving all actors in the process. The project will analyse strategies to increase the supply and demand for organic food products.

✉ *Pia Heidenmark, Researcher, International Institute of Industrial Environmental Economics (IEEE), Lund University, Sweden*
pia.heidenmark@iiiee.lu.se

Remanufacturing or the back-track factory

Remanufacturing has been covered from a wide range of perspectives and generally appears to be a promising approach to the future problems of waste generation and resources shortages. However, relatively few products are remanufactured today. Nicholas Jacobsson of IIIEE is completing a PhD study into how remanufacturing applies to industry and what factors are crucial for a further expansion of the concept worldwide.

✉ *Nicolas Jacobsson, Researcher, International Institute of Industrial Environmental Economics (IEEE), Lund University, Sweden*
nicolas.jacobsson@iiiee.lu.se

Environmental product information/communication as a product management tool

Karin Jonsson is completing a PhD research project at IIIEE covering environmental product information. This area is being increasingly recognised as a key component of proactive eco-product development. The continuous supply of relevant environmental product information has been identified as an important element of any environmental strategy that aims to improve the environmental performance of products from a life cycle perspective. A key consideration is that the management of environmental product information should remain cost-effective as well as credible. The issue of good information is being highlighted within recent discussions concerning Integrated Product Policy (IPP). This research will include a review of existing and planned environmental product information systems (EPIS) and an analysis of the process of transferring information to actors along the supply chain. The review will include national and sectoral initiatives such as environmental product declarations as well as company specific systems found in larger enterprises. The purpose of the research is to identify possible areas of improvement in existing systems and the informational needs of the stakeholders in the product chain.

✉ *Karin Jonsson, Researcher, International Institute of Industrial Environmental Economics (IEEE), Lund University, Sweden*
karin.jonsson@iiiee.lu.se

Involving the industrial designer in eco-design

Although the most proactive companies are clearly recognising the benefits and necessity of environmental commitment within their organisation, little research has been carried out to help companies understand how to involve industrial designers in the process of eco-design.

This collaborative project between Electrolux and Cranfield University, aims to address this problem and investigate how industrial designers can be actively encouraged to participate in eco-design. The intended outcome of the study is to provide new information and potentially new approaches to improve the way in which industrial designers tackle eco-design.

The aims of the project will be:

- to determine how eco-design thinking can be encouraged in industrial design
- to identify the most effective methods being used by companies to communicate eco-design thinking to their designers
- to look at how industrial design skills can be/are being used to benefit eco-design
- to identify ideas and approaches which may be suitable for use in mainstream industrial design.

The project will involve collecting data from companies and organisations that show particular prowess in design and/or eco-design. For example, information will be drawn from the work carried out by; industrial designers in inherently *green* companies, designers in proactive companies and eco-design focused design consultancies. Particular attention will be paid to creativity, communication and education processes.

By benchmarking a broad range of companies it is anticipated that a detailed picture of the

current best practice approaches to eco-design, being used by industrial designers, can be built up. Appropriate ideas will be selected from the findings to be developed for testing on the Electrolux design team, through live design projects, to help them tackle eco-design. Through a process of testing and developing, generic approaches to help industrial designers to develop their understanding and approach to eco-design, will be produced.

It is anticipated that the outcome of this project will lead to the development of a clearer picture of how successful eco-design can be achieved by industrial designers, in turn this should lead to a greater understanding of how the design profession should tackle eco-design. •

✉ *Vicky Lofthouse, Eco Innovations Group, Cranfield University, UK.*
v.a.lofthouse@cranfield.ac.uk

O2 France and O2 Belgium

Professor Martin Charter

Coordinator, The Centre for Sustainable Design, UK

The Journal of Sustainable Product Design has developed a partnership with the O2 Global Network to further disseminate information and ideas on eco-design and sustainable product design. O2 Global Network is an international network of ecological designers. The O2 Global Network is organised into national O2 groups which work together to provide various services such as: O2 Broadcasts, which report live from O2 events using email and the Worldwide Web (WWW); O2 Text meetings, a meeting place on the Web; the O2 WWW pages, which provides an overview of activities; O2 Gallery, an exhibition of eco-products on the Web; and, an O2 mailing list.

For further information on the above activities and the O2 Global Network contact: O2 Global Network
Tourslaan 39
5627 KW Eindhoven
The Netherlands
tel/fax: +31 40 2428 483

O2 Global Network new homepage: http://www.hrc.wmin.ac.uk/o2/
e-mail: o2global@knoware.nl
mailinglist: http://ma.hrc.wmin.ac.uk/lists.o2global.db

'O2 News' will update readers of the Journal on the latest eco-design issues from around the world and on O2's national activities.

Product design and theenvironment

A new publication about eco-design featuring 90 examples from around the world is now available. This is a bilingual French/English book published by the French Agency for Environment and Energy Management (ADEME) with O2 France. The book has been written for companies (designers, R&D, marketing managers, environmental managers, communication managers), consultants, laboratories and research bodies, design and engineering schools.

This publication aims to illustrate the eco-design concept and promote its increased integration in business. It shows the different forms of eco-design, through case studies that have been researched worldwide.

Chapter 1 covers each stage of a product's life (life cycle approach). Chapter 2 discusses the need to inform and appeal to consumers (communication). Chapter 3 emphasises the importance of co-operation and sharing (management). Finally Chapter 4 illustrates the inspiration that can be found in ecosystems and dematerialisation (natural principles, services, factor 4).

For each case history, key eco-design strategies are highlighted by a set of pictograms underscoring nine key eco-design approaches. •

o2france@wanadoo.fr
www.ademe.fr/htdocs/publications/cataloguedeseditions/

Large-scale demonstration project on eco-design

In Belgium, a large-scale demonstration project on eco-design started in September 1999. The project is funded by the European LIFE programme (ref. LIFE99 ENV/B/000639) and is executed by the Regional Development Authority of West Flanders (GOM West-Vlaanderen), VDAB Training and Education and Vito (Flemish Institute for Technological Research) in Belgium.

The goal of the project is to give Flemish industry the opportunity to build up knowledge and experience in the area of sustainable product design (eco-design) and to stimulate companies to implement eco-design.

The project runs over a 2.5 year period and includes the following stages:

- research to select 50 companies to participate in the project

- screening of the eco-design potential of selected companies by means of a Quick Scan instrument developed by Vito
- developing an eco-design project in 20 companies covering one specific product (selected after the screening of eco-design potential)
- implementation of eco-design in product development in 5 companies (selected out of 20 at the end of the previous phase) taking account of the company's specific situation. This stage in the project will be finalised by translating the 'green' product concept into a marketable product and the introduction of these products in the market
- dissemination of the results of the demonstration project.

The results of the demonstration project will include:

- fine-tuning of the Quick Scan instrument, developed to screen the eco-design potential of a company
- putting into practice a scheme for selecting the most appropriate eco-design instrument for a company;
- setting up a stepwise approach to integrate the eco-design concept in a company, with particular attention to the company's specific situation (culture, internal procedures, etc.)
- developing an economic assessment methodology which can be used to screen the economic viability of individual options for environmental improvement
- developing course material for teaching eco-design to the different actors in the product chain: product developers, companies, suppliers, customers and authorities.

The first phase of the project (selection of 50 companies) started in September 1999 and is planned to be finalised by the end of November 1999. Then, the screening of the eco-design potential of the companies will be launched. •

An Vercalsteren, UNITO
vercalsa@vito.be

16–17 September 1999

The 8th Annual Business Strategy and the Environment Conference
Leeds, UK
✉ Elaine White
Conference Co-ordinator
ERP Environment
PO Box 75
Shipley
West Yorkshire
BD17 6EZ
UK
+44 1274 530408
+44 1274 530409
elaine@erpenv.demon.co.uk

21–23 September 1999

The Future of Waste Management and Minimisation Conference
London, UK
✉ Jennie Hung
37–41 Mortimer House
Mortimer Street
London W1N 7RJ
+44 171 637 4383
+44 171 631 3214
jennie.hung@ibcuk.co.uk

21–24 September 1999

Pollutec Industry '99 – 15th International Exhibition of Environment Equipment, Technologies & Services for Industry
Paris, France
✉ Ilse Dopper
70 rue Rivay
92532 Perret
France
+33 1 4756 21 12
+33 1 4756 21 10
ilse_dopper@unmf.fr

21–24 September 1999

Waste Tech 99 – international exhibition & conference on waste management
Moscow, Russia
✉ Conference Secretariat
+7 095 975 3423
waste-tech@sibico.com or
sibico@dialup.ptt.ru

22–25 September 1999

'International Conference on Industrial Ecology and Substainability'
University of Technology of Troyes, France
✉ Conference Secretariat
Universite de Technologie de Troyes
Departement TSH
12 rue Marie Curie – BP 2060
F-10010
Troyes Cedex
France
+33 3 25 71 76 90
+33 3 25 71 76 98
conf.ecoindus@univ-troyes.fr

28–30 September 1999

Eco-Design from Life Cycle Analysis to Life Cycle Managementî
Paris, France
✉ Sophie Noel
Euroforum 35
rue Grenata
75002 Paris
France
+33 1 44 88 14 63
+33 1 44 88 14 99
sno.euroforum.fr

6 October 1999

Making Stark Choices: Greenpeace Business 4th annual conference
London, UK
✉ Conference Secretariat
Centaur Publishing Ltd
St Giles House
50 Poland Street
London W1V 4AX
+44 171 970 4770
+44 171 970 4799
wtct@planet.tn

13–14 October 1999

New Purchasing Factor 4+ Congress and Trade Fair
Klagenfurt, Austria
✉ Christopher Manstein
Klagenfurter Messe
Betriebsges m.b.H
Messeplatz 1
A-9021 Klagenfurt|
Austria
+43 463 800 71
+43 463 800 29

13–16 October 1999

Envirotech '99 – 5th International Exhibition on Environment Protection Technologies
Tunis, Tunisia
✉ Conference Secretariat
+216 1 773 822
+216 1 809 200
wtct@planet.tn

3–5 November 1999

Business for Social Responsibility Conference
San Francisco, USA
✉ Conference Secretariat
Business for Social Responsibility
609 Mission Street
2nd Floor
San Francisco
CA 94105 ñ3506
USA
+1 415 537 0888
+1 415 537 0889
http://www.bsr.org

10–12 November 1999

The Fourth International Conference on Ecomaterials
Gifu, Japan
+81 3 3503 4681
+81 3 3597 0535
wakako@snet.sntt.or.jp

10–12 November 1999

The Fourth International Conference on Ecomaterials
Gifu, Japan
✉ Conference Secretariat
+81 3 3503 4681
+81 3 3597 0535
wakako@snet.sntt.or.jp

14–17 November 1999

Sustainability: Ways of Knowing/Ways of Acting
North Carolina, USA
✉ Stuart Hart
Kenan-Flagler Business School
University of North Carolina
Chapel Hill
North Carolina 27599-3490
USA
+1 919 843 9731
+1 919 843 9667
greening99@unc.edu

22–24 March 2000

GLOBE 2000
Vancouver, British Columbia, Canada
✉ Conference Secretariat
GLOBE Foundation
504-999 Canada Place
Vancouver
BC V6C 3E1
Canada
+1 604 775 7300
+1 604 666 8123
info@globe.apfnet.org

13–14 April 2000

International Sustainable Research Conference
Leeds, UK
✉ Elaine White
ERP Environment
PO Box 75
Shipley
West Yorkshire
BD17 6EZ
UK
+44 (0) 1274 530408
+44 (0) 1274 530409
elainewhite@erpenvironment.org

25–27 April 2000

Exporec 2000
European Exhibition for Recycling
Brussels Exhibition Centre
Belgium
✉ Olivia Griscelli
+00 44 (0) 1707 275 641
+00 44 (0) 1707 275 544

5–9 June 1999

R2000: Recovery, Recycling, Re-integration
Toronto, Canada
✉ Anis Barrage
C/o PEAK Ltd
Director of Congress
Seefeldstraße 224
8008 Zurich
Switzerland
+41 1 386 4444
+41 1 386 4445
barrage@peak.ch

13-15 June 2000

Eco-Efficiency 2000 Conference: A Business-Oriented Event
Towards Sustainable Economic Growth
Stockholm, Sweden
✉ Conference Secretariat
ulf.aronsson@gw.nutek.se

29-30 June 2000

Eco-Management and Auditing Conference/Symposium on Culture, Organisations and the Environment
Leeds, UK
✉ Elaine White
ERP Environment
PO Box 75
Shipley
West Yorkshire
BD17 6EZ
UK
+44 (0) 1274 530408
+44 (0) 1274 530409
elainewhite@erpenvironment.org

2–4 July 1999

Renewable Energy 2000
Brighton, UK
✉ Rob Schulp
Reed Exhibition Companies Ltd
Oriel House
26 The Quadrant
Richmond
Surrey TW9 1DL
UK
+44 181 910 7976
+44 181 910 7989
rob.schulp@reedexpo.co.uk

3–6 September 2000

Tribology in Environmental Design 2000
Bournemouth, UK
✉ Christine Thwaites
Tribology Design Research Unit
Bournemouth University
Studland House
12 Christchurch Road
Bournemouth
UK
+44 1202 503759
+44 1202 503751
ted_info@bournemouth.ac.uk

September 2000

'Towards Sustainable Product Design', 5th International Conference
Berlin, Germany
✉ Martin Charter/Russell White
The Centre for Sustainable Design
Faculty of Design
The Surrey Institute of Art & Design, University College
Falkner Road
Farnham
Surrey
GU9 7DS
UK
+44 (0) 1252 892772
+44 (0) 1252 892747
mcharter@surrart.ac.uk

18–20 October 2000

2nd EURO ENVIRONMENT 2000 conference
Aalborg, Denmark
✉ Conference Secretariat
Aalborg Congress and Culture Centre
Europa Plads 4
PO Box 149
DK-9100 Aalborg
+45 9935 5555
+45 9935 5580
else_herfort@akkc.dk
steffen_thomsen@akkc.dk

Contributor guidelines

The Journal of Sustainable Product Design is targeted at Environmental directors, managers, Design managers, Product designers, Academics and Environmental coordinators in local and central government worldwide.

Submissions

Three copies and a $3^1/_2$" Macintosh – or IBM compatible disk should be sent to:
Professor Martin Charter
Editor
The Journal of Sustainable
Product Design
The Centre for Sustainable Design
Faculty of Design
The Surrey Institute of Art & Design,
University College
Falkner Road
Farnham
Surrey GU9 7DS
UK.

Email submissions should be sent to: mcharter@surrart.ac.uk.

A black and white photograph of the author(s) should be supplied.

Presentation

Articles submitted to the Analysis section (peer reviewed) should be between 2,500–5,000 words. Shorter articles of 1,000–1,500 words are also requested for the Case Study and Innovation sections. Manuscripts should be typed in journal style, double spaced (including footnotes and references) with wide margins, on one side only of good quality A4-size paper.

Manuscripts should be arranged in the following order of presentation.

First sheet: Title, subtitle (if any), author's name, affiliation, full postal address and telephone, fax number and email. Respective affiliations and addresses of co-authors should be clearly indicated. Please also include approximately 100 words of biographical information on all authors.

Second sheet: A self-contained abstract of up to 150 words summarising the paper and its conclusions.

Subsequent sheets: Main body of text, footnotes, list of references, appendices, tables (on separate sheets), and illustrations.

Authors are urged to write as concisely as possible. The main title of the article should be kept short, but may be accompanied by a subtitle. Descriptive or explanatory passages, necessary as information but which tend to break the flow of the main text, should be expressed as footnotes or appendices.

Bibliographic references: All bibliographical references should be complete and comprising of authors and initials, full title and subtitle, place of publication, publisher, date, and page references. References to journal articles must include the volume and number of the journal. The layout must adhere to the following convention:

Author, A., and B. Author, 'Title of book: Subtitle' (Place of publication: publisher, date), pp.xx–xx. or

Author, A., and B. Author, 'Title of Journal Article: Subtitle', in Journal, Vol.x No. x (January 19xx), pp. xx–xx.

These should be listed, alphabetically by author surname, at the end of the article.

If referring to works in the main body of the article, please use the 'short title' method in parentheses.

Footnotes: These should be numbered consecutively in Arabic numerals and placed before the list of bibliographical references. They should be indicated in the text by use of parentheses, eg. '(see Note 1)'.

Tables, graphs, photographs etc: All graphs, diagrams and other drawings should be referred to as Figures, which should be numbered consecutively in Arabic numerals and placed on separate sheets at the end of the manuscript. Their position should be indicated in the text. All figures must have captions. Authors should minimise the amount of descriptive matter on graphs and drawings, and should refer to curves, points, etc. by their symbols and place descriptive matter in the captions. Scale grids should not be used in graphs, unless required for actual measurement. In all figures taken or adapted from other sources, a brief note to that effect is obligatory, below the caption. Please ensure any photographs taken are of good quality. They may be supplied as prints or transparencies, in black and white or in colour.

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Authors are responsible for ensuring that all manuscripts (whether original or revised) are accurately typed before final submission. One set of proofs will be sent to authors before publication, which should be returned promptly (by Express Air Mail if outside UK).

Copy deadlines

Issue 11: 17 September 1999
Issue 12: 17 December 1999
Issue 13: 17 March 2000

Typography: design@emspace.co.uk

Environmentally printed by The Beacon Press
(ISO 14001 and EMAS accredited).

Text pages printed on Corona Offset, a NAPM
approved paper made from 100% post-consumer
waste which has not been re-bleached.

Covers printed on Conservation Bright White, a NAPM
and EUGROPA approved board which is 100% recycled.

Printed with vegetable based inks.

ISSUE 10 : JULY 1999

The Journal of Sustainable Product Design

The Centre for Sustainable Design

an initiative of

The Surrey Institute of Art & Design
University College