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Cleaner products - new tools, players and relationships

Evaluation of projects carried out under the Danish
Environmental Protection Agency's technology action
plan 1993-97

Arne Remmen
Aalborg University

Danish Environmental Protection Agency

Danish Ministry of the Environment

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Foreword

In connection with the establishment of the Product Oriented Environmental Initiative, the Environmental Protection Agency wished to undertake a sub-evaluation of the projects initiated under the cleaner technology action plan in relation to the sectors and areas which have been initially under focus in the Product Oriented Environmental Initiative.

Evaluation

The purpose of this evaluation has been to assess experience from the initiatives to date against the intentions of the action plan, and to provide constructive input to help flesh out a future product-oriented initiative, including the activities linked to the new programme for cleaner products.

Three sectors

The evaluation has focused on three selected sectors and on inter-sector product-oriented projects carried out under the Action Plan for Cleaner Technology 1993-97. The investigation has been carried out at the request of the Council for Recycling and Cleaner Technology. Experience with cleaner technologies has been evaluated in these three sectors:

- The textiles and clothing industry
- The electronics industry
- The transport industry

The projects evaluated completely cover the period 1993-97 in these three sectors. Advance copies of the reports were sent to the appointed product panels in the three sectors in the middle of 1999, and have since been reported on as Environment Projects published by the Environmental Protection Agency.

Selection of product-oriented projects

In addition, a report has been written about the experiences and results from cleaner technology projects in the “products” category. In this connection, a selection of the product-oriented projects has been made in cooperation with the Environmental Protection Agency.

This report communicates the overall results of these evaluations and seeks to provide:

- a general summary of the conclusions,
- a sketch of the current direction in the cleaner technology strategy,
- an indication of the challenges involved in the Product Oriented Environmental Initiative.

Looking back, and ahead

The general sketch of the projects completed might seem unreasonable, since this evaluation has been done with the initiation of the Product Oriented Environmental Initiative in mind. However, many of the projects were planned at a time when there was a different focus in the cleaner technology strategy. What follows should be read with this in mind: the evaluation is aimed constructively forwards, and as such the assessments may not do full justice to the results of the projects carried out.

Three main concepts

In chapter 1, the cleaner technology strategy up to the present time is outlined based on three main concepts: cleaner production processes, environmental management, and cleaner products. This is done with the aim of emphasising both that the focus has changed along the way in response to the experience gained, and that there is a potential dynamic in the concepts which can be employed in a product-oriented environmental initiative.

General conclusions

Chapter 2 summarises the main findings and the general conclusions from experiences with cleaner technology in the three sectors chosen. A number of recommendations are also put forward which specifically aim to pinpoint the challenges to the future Product Oriented Environmental Initiative in relation to the three main points of focus, i.e. products, players and the market.

Summaries from the sub-evaluations

In addition, chapter 3 contains the summaries from the four sub-evaluations of cleaner technology carried out in the textiles, electronics and goods transport sectors, and of selected product projects.

Evaluation team

Associate Professor Arne Remmen, MSc, PhD, was responsible for the evaluation. Research Assistants, Brian Dalby Rasmussen, Jette Holgaard and Research Lecturer Jesper Lassen have carried out the evaluations of the various sector initiatives. All of the above are from the Group for Cleaner Technology under the Department of Development and Planning at Aalborg University.

The evaluation was also carried out in association with the Centre for Social Research on the Environment (CESAM) under the Danish Environmental Research Programme.

Steering committee

A steering committee was appointed to monitor the evaluation, consisting of: Lise Fogh Pedersen (chairman), Preben Kristensen, Mariane Hounum, Ulla Ringbæk, Jørgen Jakobsen, and Kirsten Warnø – all from the Environmental Protection Agency, Tove Andersen, Federation of Danish Textiles and Clothing, Hans Dankert, the General Workers' Union in Denmark (SID), Carl Thørner, the business association for the Danish electronics industry (EI), Karen Banke, the Danish Confederation of Trade Unions (LO), Tina Sternest, the Confederation of Danish Industries, Dorte Harning, the Directorate for the Working Environment Service, Niels Remtoft, the National Association of Local Authorities in Denmark, Allan Andersen, the Danish Society for the Conservation of Nature.

We would like to thank the steering committee for professional sparring along the way in the evaluation process. We would also like to thank the many project coordinators in the enterprises involved and the consultants who have given up time for interviews, questionnaires, follow-up questions, etc.

Special thanks go to our colleagues who have provided critical appraisal during the preparation of this report. In addition to the above, these were: Christian Poll and Tage Andersen, the Environmental Protection Agency and Michael Søgaard Jørgensen, the Technical University of Denmark (DTU).

Arne Remmen,

Aalborg University, March 2000

1 From cleaner production processes, to environmental management, to cleaner products

In principle, cleaner technology has always been defined broadly and has included products. Note the official definition from 1990: "... that efforts are made to eliminate pollution and waste resulting from the production, usage and disposal of products, or to limit it as close to the source as possible. This involves changing the product or the production process so that the total environmental impact from the circulation of materials through society is reduced as much as possible" (the Environmental Protection Agency, 1990). But in practice, the strategy, in terms of the cleaner technology projects implemented, has changed focus during the 90's.

Changes in the cleaner technology strategy

Put briefly, the focus of the cleaner technology strategy has changed *from* almost exclusively being on technical development and demonstration projects, *to* broader activities aimed at promoting the dissemination of cleaner technology, and *then to* a far greater degree of integration of preventive environmental initiatives in relation to enterprises, networks and the authorities (For a more detailed historic examination of the action plans, see Remmen, 1995 & 1998).

Awareness of the problem and solution

These changes in the concept and the projects carried out indicate there has been a learning process for a number of the players involved, reflecting a changed awareness of both the environmental problems and of environmental policy and the cleaner technology strategy. The awareness of environmental problems has until recently focused mainly on resource usage and emissions from the production process in the form of smoke, waste and noise; but it is increasingly being extended to cover the entire production system and the product life cycle, including the choice of materials and design, transport, and the usage and disposal of the products. The cleaner technology strategy is changing accordingly, from a predominantly technical optimisation of existing production processes towards initiatives emphasising environmental management, sector-oriented activities, active involvement of the players, and the development and marketing of cleaner products, etc.

The cleaner technology strategy

Compared with ten years ago, the cleaner technology strategy has changed fundamentally in practice in many respects and is identical today with the principle of prevention of environmental problems throughout the product's entire life cycle.

Cleaner technology is increasingly being linked to a large number of activities, tools and measures:

- production processes and products,
- employee participation and management commitment,
- environmental management and life-cycle assessment,
- green taxes and green accounting,
- eco-labelling and green public sector procurement,
- collection schemes, standards and manufacturer responsibility,
- consumer information and environmental directions and recommendations,
- supply chain management and environmental cooperation in the product chain,
- BAT-notes on Best Available Technologies,
- the environmental authorities as service-oriented sparring partners.

The learning process

Changes in problem awareness and strategy have been a learning process in which experience from the projects carried out has gradually led to changes in the awareness of the environmental problems and in the strategies and policies employed to promote cleaner technology.

The most significant changes

The most significant changes have been:

- from cleaner technology projects *to* dynamic processes emphasising continual environmental improvements,
- from predominantly engineers being involved *to* most of the interested parties,
- from technical solutions *to* a broad range of measures,
- from cleaner production processes, *to* environmental management, *to* cleaner products.

Three prevention concepts

What follows is a description of what can be seen as the three main concepts for pollution prevention: cleaner production processes, environmental management and cleaner products. The aim is to outline the differences and to assess their relationship with an improved product-oriented environmental initiative. The development can be illustrated directly as an inverted pyramid:

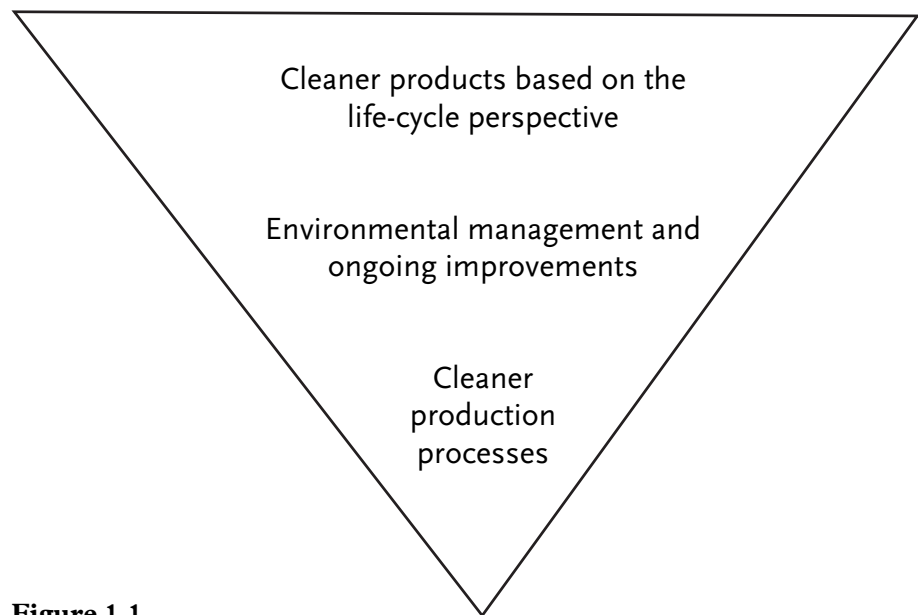


Figure 1.1
The inverted prevention pyramid

This inverted pyramid is aimed at illustrating that awareness of the problem, strategies, and policies have all been expanded and given wider coverage. At the same time, the number of incentives and players has been increased quite considerably.

Seen historically, environmental awareness and the pollution prevention strategy have become significantly more widespread as the limitations of the former approaches have become apparent. In other words, awareness of environmental problems and of the cleaner technology strategy is constantly undergoing dynamic change as a result of the inadequacy of the previous approaches and in recognition of new possibilities.

1.1 Cleaner production processes

Focus on production

Since the mid-80's, the cleaner technology strategy has predominantly focused on reducing resource usage and emissions from the production process. A number of technical development and demonstration projects were carried out as part of an emphasis in practice to show that environmental problems could be reduced at the source in the production. Since 1993-94, communication activities have been increased, for example in the form of newsletters and sector consultants, with the aim of ensuring the dissemination of the cleaner technologies developed.

The "easy gains"

The advantage of the cleaner production approach was that it was relatively easy to "go for the easy gains" – as environmental improvements and economic savings could be achieved via technical optimisation and changes to work routines.

Isolated projects

One weakness, especially with the earlier projects, was that cleaner technology was seen as an isolated initiative which was *finished* when the project in question had been completed and duly reported to the Environmental Protection Agency, and too little attention was also paid to organisational factors.

After the change of the Environmental Protection Act in 1991, cleaner technology became a primary focus and the environmental authorities began to be more interested in how cleaner technology could be incorporated into environmental regulation, inter alia, through the preparation of BAT-notes.

Incentives and players

The incentives for enterprises to introduce cleaner technology were initially production optimisation and financial savings combined with a degree of pressure from the environmental authorities to introduce cleaner technology. The players involved were primarily production engineers, environmental consultants, and the environmental authorities.

Cleaner production processes

Problems: - the enterprise's emissions
 - resource usage

Solutions: - technical development / demonstration projects
 - dissemination of solution options via communication

Incentives: - resource savings
 - compliance with demands from the authorities

Players: - process engineers
 - environmental consultants
 - the environmental authorities as service-oriented sparring partners

Production and product

In relation to the future Product Oriented Environmental Initiative, there is an obvious connection between process and product. Obviously the production process has to be optimised in terms of the environment in order to be able to speak of cleaner products (see also section 1.3). But how much cleaner does a production process have to be made before the product is cleaner too?

When a company changes from using ozone-depleting Freon compounds to using CO₂ to make plastic foam during the production of district heating pipes, is this a cleaner product? Well, it isn't it? But if PVC is substituted with another material in the production of rubber boots, does that mean we have "cleaner" rubber boots? When water usage has been reduced by 90%, and energy consumption by 70% in the dyeing of cotton, the dyeing process

has clearly become cleaner, but is the cotton jersey also seen as a cleaner product?

The immediate answer is, that as long as environmental improvements remain in the phases where the “most significant” environmental impacts arise in the product’s life cycle, a product is not considered “cleaner”. On the other hand, cleaner production does not mean that all the environmental impacts have been removed, but rather that a process has begun which aims to constantly make environmental improvements. Nor are cleaner products the last word, which is why it is interesting to investigate how environmental improvements in production can lead to cleaner products.

In future, the cleaner technology strategy will also include projects involving substitution and technology development in relation to the production process, so it is important to discuss and clarify how process and product improvements can be linked together and related. Because if one is able to imagine a product chain of enterprises which have optimised for the environment and introduced cleaner production processes and have optimised their choice of materials and product design, then it naturally follows that we have cleaner products. But let us examine this link more closely under environmental management.

A dynamic approach

The weakness of cleaner production, mentioned above, as an isolated initiative can be replaced by a dynamic way of thinking which focuses on what can keep the process moving. This dynamic can be illustrated as follows:

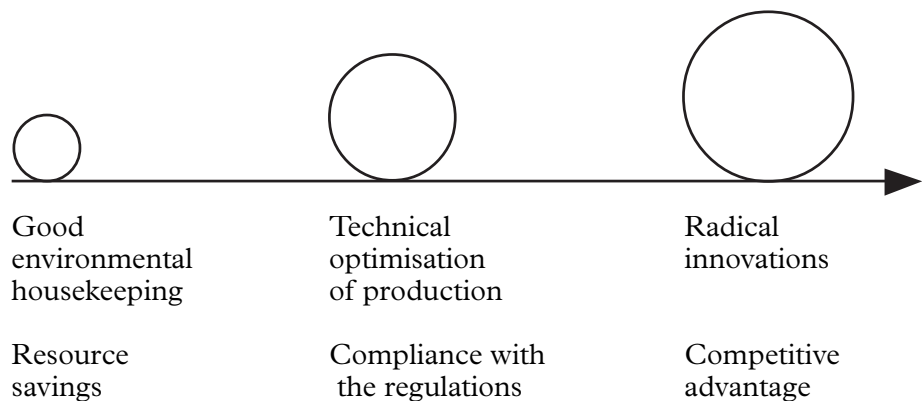


Figure 1.2
The dynamic in cleaner production¹

The snowball effect

The challenge is to establish a snowball effect where enterprises are stimulated to move on *from* good environmental housekeeping in the form of changes to working procedures, habits, behaviour and production planning, *to* environmental optimisation of existing production technology, and then *to* more radical changes to production and the product.

At the same time, the figure indicates a link between the focus of environmental initiatives and the incentive structure. Good environmental housekeeping can be achieved by ”picking the low hanging fruits“ in the form of resource savings. Technical optimisation can in principle lead to both resource savings and competitive advantages in the market; but a significant incentive is first and foremost the regulations of the authorities

¹ Inspired by a presentation by Søren Kristoffersen, the Danish Environmental Protection Agency

regarding introduction of the best available technology – set in future as EU requirements in the form of BAT notes. The more radical innovations go beyond the existing conditions for “what is worth doing” and “what is required”. These innovations can only be expected to become widespread if enterprises can expect to achieve a competitive advantage in the market by launching completely new processes and products. Thus, a gradual shift is taking place from narrow economic interests to a broader assessment of potential competition and market advantages.

The above figure should not be misinterpreted as normative – that it is best that enterprises begin with good environmental housekeeping and then start the snowball effect. This is, of course, the most manageable progression from an organisational viewpoint. But there are example of movement in the opposite direction, such as Novotex in the textile industry, where a new product – in this case Green Cotton – gradually led to the introduction of cleaner technologies. However the figure does indicate that there is a difference in how radical the production changes are, and that different incentive structures must be expected to lie behind the different initiatives.

An environmental management system is another way to make ongoing environmental improvements take root in an enterprise, apart from the “snowball effect” .

1.2 Environmental management

Organisational focus

Since 1992, the focus for preventive environmental initiatives has increasingly been environmental management in the form of either simple models for environmental management or certified/registered environmental management systems in respect to ISO 14001 or EMAS.

The focus has thus potentially shifted from techniques to organisation, from technical process optimisation to an enterprise’s organisational prerequisites for systematic, continual, and preventive environmental initiatives.

Ongoing environmental improvements

The requirements in the various manuals and standards are primarily aimed towards the organisation, and towards enterprises committing themselves to making ongoing environmental improvements, in addition to what is required in the environmental legislation. In other words, enterprises commit themselves to letting “1,000 small cleaner technology initiatives flourish” – instead of just one isolated project. The focus has thus been directed towards management commitment, employee participation and commitment, integration with other management tasks such as quality assurance and the working environment, staff training, etc.

Systematic activity

The advantages of environmental management are that environmental management – at least on paper – has to be a systematic activity within enterprises which focuses on ongoing improvements and on anchoring environmental work organisationally. Other potential advantages are improved public image, improved cooperation with the enterprise’s partners, further resource savings, etc. (see also section 2.1.3).

The increased use of green taxes on resource usage and emissions in the latter half of the 90’s has contributed to there being economic gains to be made by continuing environmental initiatives, while at the same time giving more enterprises an extra incentive to get started.

A potential weakness with environmental management is that it can be difficult to keep up momentum and to maintain the system so that the dynamic in the environmental initiatives is preserved. In other words, can the focus on ongoing environmental improvements be maintained when environmental management becomes routine and when the enterprise has to give attention to other development projects?

Environmental management

- Problems: - the enterprise's emissions and resource usage
 - organisational requirements
- Solutions: - continual environmental improvements
 - environmental management/a certified environmental management system
- Incentives: - a better image
 - exchange of experience and cooperation in the product chain, in the sector, in the network and with authorities
- Players: - management and employees
 - business associations, auditors and management consultants,
 - the environmental authorities as sparring partners

Integrated quality and environment work

It is worth noting that both the content and focus is different from monitoring, to control, to management, cf. the categorisation below:

Quality and environment work			
Content	MONITORING/ control <ul style="list-style-type: none"> • Rules • Data collection and measurement • Documentation 	STEERING/ certification <ul style="list-style-type: none"> • System structure/ handbook • Procedures and instructions • Standards 	MANAGEMENT/ strategy <ul style="list-style-type: none"> • Processes and policies • Ongoing improvements • Stakeholders
Focus	Backwards/ reactive <ul style="list-style-type: none"> • Fault correction and problems 	Forwards/ proactive <ul style="list-style-type: none"> • Prevention and goals 	Outwards/ interactive <ul style="list-style-type: none"> • Outgoing and engaging

Figure 1.3

Various approaches to quality and environment work

From monitoring, to control, to management

Seen historically, the content and focus in an enterprise's quality and environment work has shifted *from* supervisory arrangements, *to* control systems emphasising procedures and instructions, *to* management focusing on ongoing improvements. These shifts can be taken as an indication of a gradual learning process for enterprises, consultants, standards organisations, etc., as the limitations of the earlier approaches became known. Quality control is better than customer complaints. But prevention via quality procedures, etc. is better than final inspection of the product. And ongoing quality improvements are better than just being able to guarantee the same product quality, and so on. These changes to content and focus have also been supported by corresponding changes to the

understanding of the concepts as they are prescribed in, for example, the management literature.

Complementary approaches

These changes can also be seen as complementary, with the content and focus becoming gradually extended and ever more comprehensive, *from* an expert-oriented, statistically organised, control function, *to* systems with procedures and instructions aimed at preventing and reducing problems (ISO 9000 and 14001) *to* ongoing improvements focusing on engagement and motivation as in Total Quality and Environmental Management (TQEM).

ISO and TQM

As an aside, ISO 14001 is more TQM inspired than its quality predecessor, ISO 9000, comparing the fact that the graphic depiction of environmental management is always a circle or spiral, illustrating the continual improvements, as against the traditional system design with a stable quality pyramid. However, the latest version of ISO 9000 also focuses on ongoing improvements.

Whether an enterprise's quality and environment work is, in practice, built around the system or around improvements will largely depend on the enterprise's and the consultant's strategies for implementing and anchoring it in the organisation. In general there has been a tendency for the environmental management system to primarily be related to the productive activities within the enterprise's doors. A focus on ongoing environmental improvements should be expected, sooner or later, to lead to a focus on external activities, including transport and the product's environmental impacts throughout its entire life cycle (see also below).

New players

In parallel with this focus on the organisational anchoring of preventive environmental initiatives, business associations have been engaged in and made partly responsible for relating environmental management to the specific situation in the particular sector. This has particularly taken place in relation to the support programme for: "The Promotion of Environmental Management and Environmental Auditing in Small and Medium-sized Enterprises" (Christensen, et al, 1997).

Various players have by now become involved in environmental management in the form of management and employees, management consultants and auditors, advisors in the enterprises' networks (eg. the vocational training centres (AMU), the Occupational Health Service (BST), TIC), etc.; and the enterprises with an environmental management system generally report constructive cooperation with the authorities which have become sparring partners in environmental initiatives (Christensen, et al, 1999).

Standards and products

Generally environmental management is understood in respect to ISO 14001 and EMAS as being directed towards environmental impacts from production. This is, in principle, a narrow interpretation of the standards, since ISO 14001 generally talks about "activities, products and services", and EMAS contains similar formulations. During the revision of the EMAS scheme, Denmark has sought to have it made clear that EMAS-registered enterprises also have to reduce their products' environmental impacts (Andersen, the Danish Environmental Protection Agency, 2000). In the Environmental Protection Agency's leaflet, EMAS is "Your guarantee of an environmentally-friendly supplier", and it goes on to say: "An EMAS registered supplier also has to place environmental demands on his suppliers. The result is that the products you buy are produced with environmental consideration throughout the entire product chain. In this way you help to influence development in the direction of sustainable production and products" (the Danish Environmental Protection Agency, 2000a). EMAS is thus marketed as a means of promoting the development of cleaner products.

Environmental management and products

Some enterprises with environmental management have already expanded their focus from saving resources within the factory walls, to covering the entire product chain. Via projects supported under the Cleaner Technology Action Plan, experience has been gained in involving the environment in supplier management and similar activities with the aim of increasing the exchange of information and environmental cooperation between suppliers and customers (eg., see Arnfred, et al, 1997).

In the graphics sector, it has now become a competition parameter to have an environmental management system. These enterprises have extended their environmental initiatives to the product's life cycle and to cover eco-labelling of graphics products. This dynamic is mainly linked with the fact that credibility on environmental issues has been added as an extra competition parameter in the graphics sector, in addition to traditional parameters such as price and quality. Added to this is the fact that public institutions, via their procurement policies, have increased demand for stationery products bearing the Swan label, and the business association has been very active in promoting preventive environmental initiatives.

Environmental management as a step towards eco-labelling

In future, a number of enterprises will highlight one or more environmental advantages of their product in order to achieve a competitive advantage in the market, and certified environmental management is an option here, as mentioned before. The example of Novotex and Green Cotton further shows that at least one enterprise has been able to achieve international fame by concentrating on an environmentally-friendly product – without having definitive documentation of the product's environmental performance in the form of a life-cycle assessment.

Any enterprises which do not promise more than they can deliver or can document, can achieve similar competitive advantages based on the life-cycle perspective and the constant determination to make environmental improvements. One of the first steps – on Novotex's path to environmental documentation for what they had been doing for several years – was a certified environmental management system. This has since been extended to include both supplier management and eco-labelling of the product with the Swan and the EU Flower labels. (eg., see Gyrsting & Simonsen, 1998).

Life-cycle-based environmental management

The majority of small and medium-sized Danish enterprises will presumably choose an approach to focusing on their products' environmental impacts either via cleaner production and/or environmental management. This presents a number of challenges for both the development of tools/methods and for a stronger link between environmental management and the life-cycle perspective.

Life-cycle-based environmental management will be immediately attractive to small and medium-sized enterprises because it provides opportunities for gradual implementation and to reap the potential benefits of cleaner products along the way. A full life-cycle assessment, and a product-oriented environmental initiative based on this means there will be a long way to go before the potential market advantages are achieved.

1.3 Cleaner products

The Product Oriented Environmental Initiative

At the end of 1996, the Environmental Protection Agency published a discussion paper on “An Intensified Product Oriented Environmental Initiative”. This paper has since been further developed, inter alia, into an actual support programme which was launched at the beginning of 1999.

The problem awareness behind this was that the earlier cleaner technology strategy had been successful in terms of reducing the environmental impact from production. But in future, the biggest environmental problems would be linked to general resource usage in society and the use and disposal of certain types of products.

Competitive advantages

It has also been assumed that Danish industry can achieve a competitive advantage in the market by being among the “first movers” to supply cleaner “products with better environmental performance to a quickly growing global market” (the Danish Environmental Protection Agency, 1996, p. 10).

Awareness of the problems and solutions, as well as incentives for enterprises and the previously involved players from cleaner production and environmental management, are still fully “valid”. However, a number of further characteristics are added when focus moves on to cleaner products.

Cleaner products

- Problems:
- the product’s environmental impact during its life cycle
 - chemicals and dangerous substances
- Solutions:
- life-cycle assessment and screening
 - eco-labelling and procurement guidelines
 - standards, collection, manufacturer responsibility
 - consideration for the environment in product development
- Incentives:
- environmental product improvements
 - competitive advantages in the market
- Players:
- designers, product developers and marketing people
 - consumers, customers and public sector purchasers
 - the authorities: responsible for framework conditions

The conditions

The basic idea behind a product-oriented environmental initiative has been illustrated as a triangle connecting product, market and players. (The Danish Environmental Protection Agency, 1996). According to the Environmental Protection Agency it is necessary to connect three perspectives in order to create the conditions for this: (ibid. p.13):

- to develop products with less environmental impact and lower content of substances which are damaging to the environment and health, lower energy consumption and lower usage of non-renewable resources,
- to develop and market products which are competitive in terms of price, function, quality and the environment,
- that all stakeholders can and do participate in reducing the environmental impacts from products.

The foundation

The earlier cleaner technology programmes have supported various product-oriented projects, including isolated projects within the focus areas: textiles, electronics and transport. With transport and some of the evaluated

product projects as a partial exception, these projects have been predominantly oriented towards developing life-cycle assessment as a tool and a database, and towards eco-labelling and the development of purchasing guidelines for incorporating environmental criteria into public sector procurement. These are particularly important tools and instruments, but as was highlighted in the discussion paper on a product-oriented environmental initiative (see also section 2.1) these initiatives must be anchored more generally and deeply in the thought processes and routines of designers and product developers, in each enterprise's strategy development, in the awareness and approaches in each enterprise's knowledge networks, in the market, and in environmental regulation.

Eco-labelling

Enterprises which concentrate on eco-labelling their products and on achieving market advantages have to be able to document that the most significant environmental impacts have been reduced in relation to the set criteria for eco-labelling for the particular product category. This documentation will either require the detailed exchange of information in the product chain or the completion of a life-cycle assessment or screening.

Environmental declarations and product-chain cooperation

In parallel with this, small and medium-sized enterprises which supply larger enterprises will gradually extend their environment work to include the product, as part of environmental management. If these enterprises do not produce directly for the consumer market, environmental declarations can provide the requested information to customers, which they need, for example, in connection with eco-labelling of their products.

Definitions of cleaner products

Some enterprises have experience with life-cycle assessment and the development of cleaner products (for a summary of such experience, see Broberg, et al, 1998). It is worth pointing out here that in the literature, "cleaner products" covers widely varying concepts. A hierarchy of definitions for cleaner products can be laid out, in which a gradual expansion takes place in what the concept covers (Drewbury & Goggin, 1996).

It is possible to distinguish between:

- Environmental technologies: cleaning and filtering measures to reduce emissions and environmental impact,
- Green design: focus on single factors such as recycling and energy efficiency,
- ECO design: a radical life-cycle perspective where the most significant environmental impacts are reduced, from "the cradle to the grave".
- Sustainable design: includes Eco design and emphasises long term, radical, system innovations and an ethical approach and a shift in focus towards service instead of products.

The support programme for cleaner products clearly focuses on what is here called Eco-design. In addition, it is worth highlighting that the development of cleaner technology of course does not stop with cleaner products.

Expansion and narrowing?

With the Product Oriented Environmental Initiative, awareness of the problem and solution has been *expanded* quite significantly to cover the entire production system and the product life cycle. But the focus on tools in the product-oriented projects carried out to date gives reason for concern that awareness of the problem and solution has also become *narrower*, with factors such as organisational anchoring, economic/social understanding of the product chain and network cooperation, etc. being put into the background. The breakthrough of the Product Oriented Environmental Initiative will depend on the success of attempts to actively involve more player groups and to establish a market dynamic with demand for cleaner products (see also section 2.1).

Against this background, two challenges seem to be urgent, to connect the three corners – products, market and players – in the Environmental Protection Agency’s triangle with the aim of creating framework conditions for a product-oriented environmental initiative, and to support interaction and cooperation between the various players.

Innovation

The means for connecting the three corners can be summed up in one word – innovation. This might seem so obvious that it is not worth mentioning. In the area of innovation research, the focus has largely shifted *from* the individual process/product innovations *to* the framework conditions for innovation both at enterprise level in terms of organisational flexibility, skills, etc. and at society level with focus on knowledge networks, infrastructure, institutions, etc. (eg., see Næs Gjerding, 1997 and Lundvall, 1999). In other words, innovation is not just a technical issue, but just as much a social factor.

Distributed process

Instead of seeing innovation as a matter simply for the development department in each enterprise, innovation is rather a distributed process involving the exchange of knowledge and experience among various players, both internally within the enterprise and externally in relation to customers, suppliers, and the wider knowledge network. An important focus for a product-oriented environmental initiative must be to connect a “technology push” strategy – what technology has to offer – with a “market pull” strategy – demand for cleaner production technologies and products. This involves a general awareness of innovation with a focus on connecting the technical and social aspects, including the three corners of the Environmental Protection Agency’s triangle: products, market, and players.

Social innovation

When the focus is placed on social innovation, it becomes necessary, to a far greater degree than before, to focus on:

- the cooperation between players in the product chain
- consumers’ consumption patterns and composition
- the competencies of the institutions in the knowledge network
- local and regional environmental cooperation (industrial symbiosis)
- the focus of government environmental regulation
- etc.

Knowledge and

experience exchange

Following on from these, it is a further prerequisite for the development of cleaner products that all players become involved and committed and that new interaction and cooperation patterns be established between the players (see also section 2.1.2). The exchange of knowledge and experience along with cooperation and institution development are keywords in the innovation of new cleaner products. There is also environmental potential in the “environmental rediscovery” of existing products – that is, where known products are rethought and redesigned based on environmental consideration throughout the product’s entire life cycle.

1.4 Conclusion

Concepts for prevention

It is a clear strength that awareness of the problem and solution in relation to the prevention of environmental problems has been widened to include products. At the same time, this examination shows that the three concepts for prevention are not mutually exclusive, but are rather three different approaches for enterprises to a preventative environmental initiative. Each enterprise’s situation and strategic considerations have to be decisive for which approach to choose.

The starting point

Rather than consultants now focusing only on the “new” form of the Product Oriented Environmental Initiative and throwing cleaner production processes and environmental management “out with the bath water”, the challenge is instead to show enterprises how an initiative in one place can gradually be extended to become more comprehensive and to include products.

This outline of cleaner production processes, environmental management and cleaner products should be seen as an overview of the discussion on prevention and cleaner technology, not just in Denmark but also internationally. It is worth noting here that in some contexts, for example UNEP/UNIDO, cleaner production is widely used in equivalence to cleaner technology in the Danish context (eg. see Brezet et al: ECODESIGN, UNEP, 1997).

Different awarenesses

In the above examination, emphasis has been on highlighting:

within each concept

- that there are various approaches and traditions within each concept, such as good environmental housekeeping, technical optimisation and radical innovations in cleaner productions processes,
- that some of these approaches are more dynamic than others, eg. environmental management based on the TQM model above environmental monitoring.

Progression and

non-simultaneity

The form of the presentation might give the impression that the development outlined has been progressive, with awareness of the problem and solution becoming more comprehensive and the environmental initiatives more comprehensive. This “idealisation” can be found at the conceptual level and in the leading enterprises which have a proactive environment strategy in practice. But this picture is only part of the reality, which should hopefully be apparent from chapter 2. The other part of the picture is pronounced sector differences, non-simultaneity and limited dissemination of the cleaner technologies developed, lack of dynamism in environmental management systems, etc. This is the reality which still characterises most Danish enterprises which, at best, have a reactive environmental strategy.

Environmental innovation and economics

With the qualification contained in the above considerations, this examination also shows that the focus of the innovation aspects of preventative environmental initiatives in enterprises has shifted along the way from techniques, to organisation, to products, in parallel with the increased involvement of other players in the knowledge and development network, primarily business associations, suppliers, etc. As will become apparent later (sect. 2.1.3) these shifts have also contributed to a changed awareness of economics and competitive advantages in preventative environmental initiatives, from cost neutrality and resource savings, to improved image, to potential market advantages for cleaner products.

Summary

The changes in innovation focus and incentives can be summed up generally as follows:

Concept	Innovation focus	Incentives
Cleaner Production	Technical/the process Good environmental housekeeping	Eco-efficiency Resource savings
Environmental management	Organisational Sector cooperation	Image Dissemination/ communication
Cleaner Products	Product innovation The product chain	Market advantage Credibility

Figure 1.4
Innovation focus and incentives in prevention concepts

Environmental management

If one begins instead with the concept of environmental management, a similar change of focus can be observed. During the late 80's and early 90's, the focus was on *technical* environmental management emphasising environmental auditing – cf. the American term Waste Minimization Audit (EPA, 1988). With the launch of the British standard, BS 7750 in 1992, focus became increasingly directed towards *certified* environmental management – cf. the earlier description (sect. 1.2). In the future, attention will clearly be given to life-cycle-based */product-oriented* environmental management, partly due to the fact that enterprises can clearly extend environmental initiatives to the entire product chain while at the same time it is becoming environmentally uninteresting to carry on with resource savings in production.

Other concepts

As mentioned before, cleaner products cannot be expected to be the ultimate concept. Industrial ecology, sustainable design, cleaner forms of living, dematerialisation, sustainable production and consumption, etc. are examples of concepts and ideas which on some points are more comprehensive and which have had greater penetration internationally than in Denmark. Some of these concepts suggest that environmental problems in society should not only be reduced via technological development – and technical fixes – in the form of cleaner production and products, but will also require social changes in forms of living, consumption patterns and levels, etc.

These concepts and ideas can become an important part of creating a fruitful interaction between technical and social innovations, and placing even greater focus on social innovation in preventative environmental initiatives.

2 Experience with cleaner technology – general conclusions

This chapter summarises the conclusions and recommendations from the evaluation performed, with the special aim of pinpointing the challenges to the future Product Oriented Environmental Initiative.

Product Oriented Environmental Initiative

The Product Oriented Environmental Initiative, as it was formulated in the discussion paper from the Danish Environmental Protection Agency in December 1996 and in the subsequent statement on this in 1998, is without a doubt the most ambitious attempt so far to draw up a strategy for preventive environmental initiatives. The three preceding action plans for cleaner technology represent more of a consultant-driven project approach, in which the Environmental Protection Agency provided the framework for carrying out the projects, but the incoming project ideas and proposals have also had a large influence on the direction of development.

– a change of course

A new strategy for preventive environmental initiatives – which in many respects is a radical change of course – must give occasion to evaluate critically the strengths and weaknesses of the earlier cleaner technology strategy, focusing on where action should specifically be taken to increase the product orientation of the cleaner technology strategy.

The strengths of cleaner technology

The strengths of the earlier approach to cleaner technology – as outlined in section 1.1 and 1.2 – included:

- The shift from end-of-pipe solutions to prevention at the source,
- Good environmental housekeeping and technical optimisation of production,
- The environment as resource savings for enterprises,
- Cleaner technology and environmental management as an enterprise obligation,
- Increased emphasis on communication and the involvement of business associations.

The weaknesses

The preceding evaluations of the cleaner technology action plans (Jørgensen, et al, 1990 & Andersen and Jørgensen, 1995) and other assessments of these (Remmen, 1995 & 1998) provide the basis for highlighting some overall weaknesses in the dominating project concept *to date*. These are:

- Isolated projects rather than ongoing processes,
- Focus on production rather than products,
- Cost neutrality rather than market advantages,
- Dissemination and communication secondary to new technology development,
- Consultant and expert driven.

The projects and initiatives under the cleaner technology action plan from 1993-97 have sought to change these characteristics in many respects, for example by initiating more product-oriented projects. At the same time, the assessment based on this sub-evaluation is that the above weaknesses are exceedingly tenacious and cannot in any way be said to have been eliminated in the three sectors investigated and in the selected product projects – although they have been reduced.

From push to pull

With the implementation of the Product Oriented Environmental Initiative, the Ministry of the Environment and Energy has clearly signalled a change of course which primarily aims to change the former strategy *from* being focused on the available cleaner technologies – technology push *to* a strategy based on demand for cleaner processes and products – market pull. In the longer term this will help reduce at least most of the above weaknesses.²

The structure of the chapter

In the light of these overall characteristics of the earlier cleaner technology strategy, the conditions for the strategic implementation of a Product Oriented Environmental Initiative will be discussed in the following section – seen in the light of experience gained from the evaluation (sect. 2.1). Then the way in which the development dynamic and characteristics vary between the various sectors will be highlighted (sect. 2.2). Then general conclusions from the evaluation will be drawn together (sect 2.3), and a couple of blind spots in the earlier rudiments of a Product Oriented Environmental Initiative will be highlighted (sect 2.4). In closing it will be pointed out that the program administration will have to be adjusted in order to support the Product Oriented Environmental Initiative (sect 2.5).

2.1 On the road to a Product Oriented Environmental Initiative

In the discussion paper from 1996 the Environmental Protection Agency defined three chief cornerstones for the Product Oriented Environmental Initiative“– products, players and the market. This section will therefore emphasise the strategic conclusions from the evaluation carried out in each of these areas.³

2.1.1 Cleaner products and tools

The life-cycle perspective

Under the cleaner technology action plans, many resources have generally been employed to develop life-cycle assessment as a method and tool via general method projects and sector-oriented projects, including in textiles and electronics. At the same time it can be observed that the product projects evaluated up until 1998 have had a limited understanding of the life-cycle perspective and life-cycle assessment, since half of the product-oriented projects have simply been based on common knowledge of environmental factors in the sector, without the use of systematic environmental assessments (see sect. 3.4 and Environment Project 522).

The schism

This schism can be partly explained by the fact that the projects have been carried out at a time when life-cycle perspective, life-cycle assessment, and the Product Oriented Environmental Initiative were becoming more widespread and being developed. No doubt another contributory factor has been the fact that most of the method projects carried out were scientifically focused on developing life-cycle assessment as a tool, and have also been carried out by a relatively small group of experts in cooperation with large enterprises.

This is particularly true of the EDIP project, and to some extent of the life-cycle assessment projects within textiles and electronics.

New method projects

Method development projects have been commissioned with the aim of changing this situation, including a project on simplifying life-cycle assessment for use in small and medium-sized enterprises (the TIC project),

² Chapter 1 contains a more detailed description of the changes in perception of the problems and solutions in preventive environmental initiatives.

³ These assessments are based on the evaluation of the cleaner technology strategy in the three sectors and of the selected product projects. The reader is referred generally to these Environment Projects, and to the summaries of them in chapter 3.

another on simplifying life-cycle assessment (the ISME project), and a project on linking an enterprise's environment work with the life-cycle perspective (the Promille project). There are, in addition, a number of new projects commissioned under the Programme for Cleaner Products, on chemical assessment, on LCA and waste, on LCA and transport, and on updating the EDIP database (LCA News, no. 10). These projects had not been reported on at the time of writing.

*Anchoring the Product
Oriented Environmental
Initiative*

However, the question is whether these initiatives are sufficient. All the projects currently underway – with the Promille project as a partial exception – are based on a simplification of life-cycle assessment as a tool, rather than being based on the tools and approaches which designers and developers use in product development.

Without a thorough assessment, it appears that there is still a need for greater focus on:

- simple guidelines and tools so that enterprises can begin to improve their products environmental performance,
- organisational anchoring of environmental considerations in product development by means of management commitment, employee participation and the integration of these into the organisational structure,
- environmental communication and cooperation in the product chain.

In this section, the problem of tools and development cooperation will be further examined, while environment communication and cooperation between players in the product chain will be dealt with in the following section (2.1.2) and organisational anchoring will be considered later (section 2.4).

The toolbox

The target group varies significantly in relation to incorporating environmental considerations into product development, from smaller enterprises where the director is also the development manager, to large enterprises which have both an environment and development department. It is therefore necessary to have a general range of methods and tools in the toolbox.

Evidence

There are basically two different approaches to the life-cycle perspective. The scientific, evidence-based approach asks the question: *How can the most accurate evidence of the most significant environmental impacts for the product's entire life-cycle be obtained?* Life-cycle assessment / LCA in Denmark has been synonymous with this approach – so far.

Improvement

In contrast, the dialogue and improvement-focused approach asks this question: *How can a process be started in each enterprise based on the life-cycle perspective which aims to continually reduce the environmental impacts of the product?*—This approach has been quite absent in Denmark to date, but is internationally more widespread, for example as Design for the Environment (DfE), and is characterised by being based on simple design criteria and rules of thumb which enterprises can apply directly to product development (e.g., see Behrendt, et al, 1997).

Either/or?

In other words, the question is, should the focus for future tool development be scientifically correct methods, or design criteria for making direct environmental improvements to the product?

The balance – both

The aim should be to achieve a better balance between these two approaches. This will require that improvement and practice-oriented projects, especially, be given higher priority for a period of time, as a supplement to the present focus on evidence and scientific correctness. This should not be seen as an attempt to tone down the need for reliable environmental documentation – on the contrary. It is a call for much greater effort to be placed on "walking on both legs".

Motivating enterprises

It is necessary to further spread the individual tools and design criteria, with the aim of motivating enterprises to incorporate environmental considerations into product development. An operational approach based on the life-cycle perspective can lead to specific environmental improvements to products, and can in this way stimulate enterprises to continue a product-oriented environmental initiative. This takes into account the fact that most innovations are gradual adjustments and improvements to existing products. Longer term, this will clearly motivate more enterprises to prepare full life-cycle assessments of their products' environmental impacts, which are essential if an enterprise wants to use the environment offensively as a competition parameter on the market.

The level of detail must reflect the goal

A further argument for a more balanced approach is the risk of "data death" and information overload in life-cycle assessments. Full life-cycle assessments often end in a discussion of data quality. Enterprises must therefore expend more effort to work out what they want to achieve by integrating environmental considerations into product development, so that the choice of tool and method for environmental assessment is matched to the goal. If focus is on environmental improvements to the product, the conceptual elements in the life-cycle perspective or simple life-cycle screenings will be sufficient. If the results of the environmental assessment are to be used externally in relation to environmental declarations, sales and marketing activities or something similar, a detailed life-cycle assessment will be necessary (Jensen, et al, EEA, 1997).

Fundamental perceptions

The schism between evidence and improvements can to some extent be traced back to fundamentally different perceptions of the product development process.

Rational system

The first approach is based on a rational understanding of product development and sees environmental consideration as a new, extra parameter which has to be incorporated into basic specifications and project management manuals. It can follow from this, that at various milestones in the development process, environmental assessments must be carried out based on checklists and/or life-cycle assessments. It is the product developers, possibly in cooperation with environment specialists, who define how environmental considerations should be incorporated into product development. This expert-based approach is based on the assumption that there are no conflicts over goals and measures in the enterprise or in the business and development network.

Social system

The other approach is dialogue-based and builds on the supposition of an enterprise as a social system. The focus is on getting relevant players to show an interest in the environment and on establishing cooperation and communication across the traditional boundaries in the organisation. Attitude shaping, experience exchange, and action-oriented learning processes are in focus (Broberg, 1993).

Development work

These different approaches are founded on fundamentally different views of the work of product development in an enterprise and have a great impact on which methods and solutions will be used, cf. documentation versus improvements.

The expert-based approach also perceives decision-making as a rational process based on complete information. In the area of decision theory, these assumptions have long been challenged, and learning processes, conflicts and a rapidly changing world all contribute to this ideal not holding true. Focus must therefore be shifted to how opportunities and motivation can be created for incorporating environmental considerations into product development and how all the relevant players can be involved in this.

Contrasting or complementary approaches?

From an academic viewpoint there are fundamental contrasts between these different perceptions of the enterprise and product development, which are central for understanding the strengths and weaknesses of the chosen approach. But in daily practice in an enterprise, both perspectives are clearly drawn on: environmental considerations are incorporated both via changes to basic specifications, procedures and manuals, and via learning processes, attitude changes, and experience exchanges.

The above call for better balance in future method development and should thus be seen as a concern about what is necessary to convince small and medium-sized enterprises that they can immediately begin with a product-oriented environmental initiative.

As already mentioned, a number of method and elucidation projects have developed tools which will be useful in the Product Oriented Environmental Initiative in the future, as long as enterprises are motivated from the beginning to carry out full or simplified life-cycle assessments. Put another way, the present method development has focused on the development of the tool which has been equivalent to full life-cycle assessments. *This is a necessary but insufficient condition for integrating environmental considerations into product development and marketing.*

Tool focus

In most of the method and tool-focused projects, the perspective has been: life-cycle assessment as a tool for getting more precise data about the products' environmental impacts. Seen in this light, full life-cycle assessments are an indispensable tool. But this is too narrow. There is also a need for methods to establish closer cooperation between designers, manufacturers and marketing people and the other players in the product chain and in the enterprise knowledge and regulation network.

Integration of environmental considerations

Rather than just focussing on tools, it is appropriate to establish an even broader perspective and to openly ask the question: *which processes have to function differently in order to integrate environmental considerations into product development and marketing?*

With the Product Oriented Environmental Initiative, focus has been given to this type of question, which will hopefully contribute to the development of a comprehensive range of tools in the longer term.

Recommendations – products

Following on from the above, the recommendations and ideas below are significant to the aim of promoting the development of environmentally friendly products:

- Develop informative material and guidelines which support the life-cycle perspective,
- Investigate more closely which guidelines and tools designers and product developers need, especially for the creative element of product development,
- Carry out practical experiments which incorporate environmental considerations into product development via brain-storming, etc.
- Involve the knowledge network more actively in product development in the form of workshops with environment experts, critical users, etc., who have a different perspective on environmental considerations in product development,
- Investigate what actually motivates enterprises to get started on the development of environmentally friendly products.

These recommendations also illustrate the assessment that some characteristics of the strategy constitute specific barriers to the future Product Oriented Environmental Initiative. Barriers to initiatives are not

something static or final, but reflect just as much the characteristics of the previous approaches and measures.

The above conclusion regarding the integration of environmental considerations into product development leads us directly on to the problem of involving more players and establishing new communication and cooperation relationships between them.

2.1.2 **New players and cooperation relationships**

The previous cleaner technology strategy focused predominantly on the development of cleaner production processes based on projects carried out by experts and consultants.

Role of the players

This observation leads to three main conclusions concerning the roles of the players in earlier cleaner technology projects:

- a. primarily people with an environment and/or production background have been involved,
- b. communication and cooperation relationships between designers/product developers on one side, and environment/production people on the other side, has basically been absent,
- c. the relationship to marketing, retailing, consumers, and consumer organisations has been underplayed.

Acknowledgment of these facts lies behind the initiation of the Product Oriented Environmental Initiative, with the discussion paper especially highlighting the importance of a special focus on product developers, distributors and consumers.

This evaluation provides an opportunity to highlight the fact that the cleaner technology projects reflect the strong tendency for cooperation to take place between partners who are used to cooperating. Relatively few projects experiment with the establishment of new cooperation patterns and the involvement of all relevant interested parties.

Parties to date

With respect to the textiles sector, and to some extent the electronics sector, the cleaner technology projects have been carried out by people with an environment and/or production background. This has been significant both for focus and interest, and perception of the problem and solution. In other words, this has been critical to the character of the projects and the approaches employed in the environmental initiatives carried out to date (see the previous chapter).

New players

The Product Oriented Environmental Initiative represents a change of course in preventive environmental initiatives, with the result that great efforts must be made to support projects initiated and carried out by designers, product developers, communications and management consultants, the retail sector, consumer groups, educational institutions, etc. Other national programmes, such as the Danish Design Foundation and the Programme for the Promotion of Environmental Management and Environmental Auditing in Small and Medium-sized Enterprises have, to a limited extent, supported the “missing” players. However, this is not enough, since the separation of activities into various institutional contexts appears to be synonymous with a limited general knowledge of the “other” projects.

Synergy

Even greater focus must therefore be placed on creating the synergy and the new cooperation relationships between development, marketing, and production, which are necessary conditions for a product-oriented environmental initiative.

Communication and cooperation

A further condition is that focus must not be just on the *players* who are to be involved, but also just as much on the *relationships* which must be made to function differently. This was placed on the agenda in the discussion paper for the Product Oriented Environmental Initiative in 1996.

An example emphasising the necessity of changed cooperation relationships can be seen in a project which the British Department of Trade and Industry carried out in cooperation with the Textile Finishers' Association in the early 90's, which included the aim of identifying opportunities for waste minimisation and dye reduction in wastewater (DTI, Demos, 1994).

Despite the project's quite technical focus, right in the introduction it was spelt out that "improved communication and understanding between the various players in the textiles sector is of critical importance". At the same time one can note that textile designers follow the trends set by consumers and social and cultural development. It is against this background that fashion changes, and hence the dyes, choice of materials, etc., change, and the designer chooses palettes and styles based on these. In practice, textile manufacturers are completely separate from this process; while textile designers, conversely, are completely separate from the requirements and conditions which the environmental authorities place on textile manufacturers (see figure 2.1).

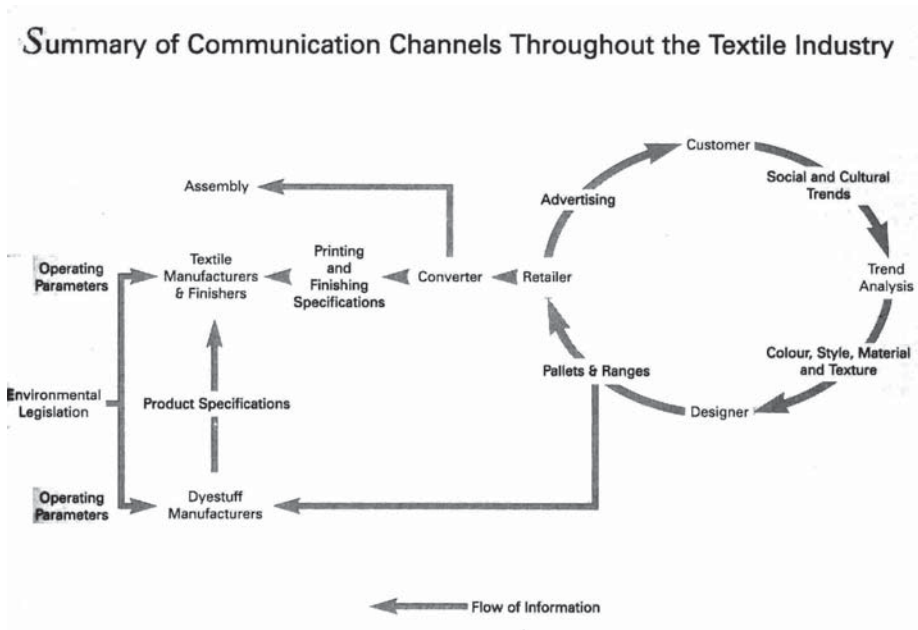
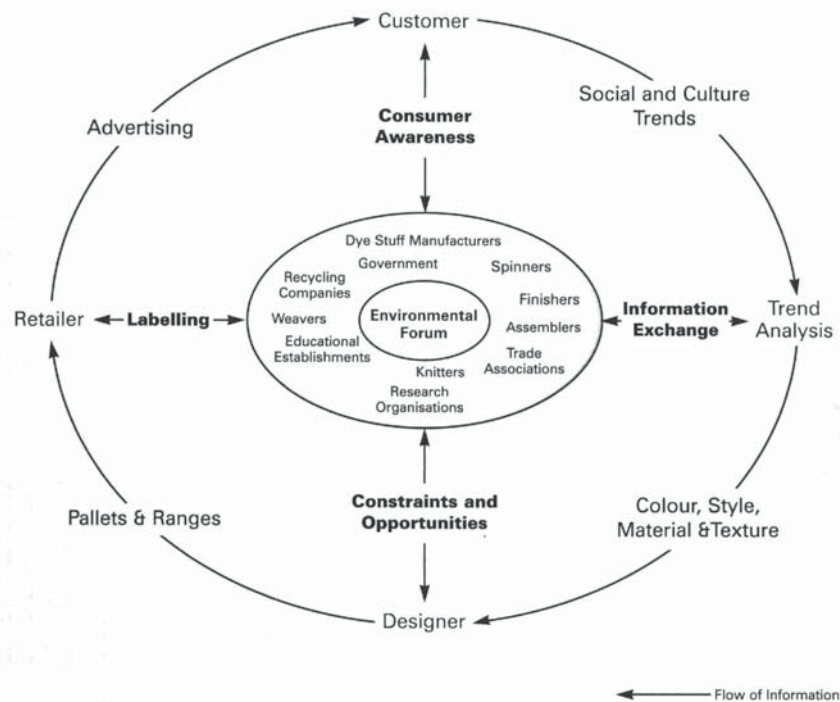


Figure 2.1
Communication channels in the textiles industry

A product-oriented environmental initiative in the textiles industry thus requires a different concept for communication and cooperation between the players in the product chain – a textiles life-cycle and in the business network. In the words of the report: "Through the establishment of partnerships for the exchange of information, those who have traditionally been excluded from product development can be brought into the centre of the communication process." (Department of Trade and Industry (DTI), Demos, 1994). (See figure 1.2).

New Paradigm for Communications Throughout Textile Industry



New paradigm for communications throughout the textile industry

The conclusions highlighted might appear trivial. Of course new players must come on the field, and of course new cooperation relationships have to be established in order to implement a product-oriented environment policy. But the above example shows that new players must be led to cooperate on, among other things, experience exchange, and that long standing traditions have to be broken down in order to establish these new communication channels and cooperation relationships. So the challenge is significantly greater than it might first appear.

Production focus

These conclusions apply particularly to the earlier production-focused initiatives in the textiles industry. The picture is more varied in relation to the electronics industry, where product projects have been carried out within enterprises, but these have almost exclusively focused on environmental assessment and on setting up guidelines for “sustainable electronic products”. This is absolutely essential, but has not contributed to gaining practical product development experience, with trade-offs between functionality, design, quality, etc., and with increased environmental cooperation between environment, production, development, and marketing people.

The signal change

Similarly, it has been hard to find any evidence in the cleaner technology projects evaluated that the cooperation and communication patterns in the two sectors were in the process of being extended to involve the missing player groups. However, the composition of the product panels appointed under the auspices of the Danish Environmental Council for Cleaner Products – especially for textiles – signals the necessary change of course, and the product panels’ action plans are also moving in this direction.

In isolated product-oriented projects, for example related to commercial laundries in the current evaluation, and in the context of the Programme for the Promotion of Environmental Management and Environmental Auditing in Small and Medium-sized Enterprises, positive experience has been gained

with involving business associations and with carrying out projects in “growth groups” as a measure to actively involve more players in preventative environmental work (Christensen, et al, 1997).

The product chain

The previous section highlighted some critical, different conceptions of the development process in enterprises. In a similar fashion, one can distinguish between fundamentally different conceptions of activities in the product chain.

– technical/material

A product chain can be described with an emphasis on the technical, material, and environmental aspects of the activities in the chain. Life-cycle assessment clearly has this focus with the aim of itemising and assessing the environmental effects in the various phases of a product’s life-cycle, from the cradle to the grave.

– economic/social

A product chain can also be described with an emphasis on the economic, social and communication relationships between the players in the chain. This focus is necessary in order to understand the conditions for implementing changes in the product chain with the aim of promoting the development of cleaner products.

However, the methods and tools for understanding the economic/social aspects are relatively unknown and untried in the environment field. But projects have been carried out, especially in relation to the communication aspects of environment work in the product chain, for example on raising awareness of products’ environmental properties (Environment - Quality Function Deployment) (Olesen, et al, 1997), on market-oriented environmental communication (Arnfred, et al, 1997) and on Environment Dialogue (Niemann, et al, 2000). But the funding for these has been “peanuts” compared to what has been spent on the development of life-cycle assessment as a tool. This bias is gradually being changed, for example by the appointment of the product panels under the Environmental Council for Cleaner Products.

The balance

The right leg – life-cycle assessment – is well developed and powerful; while the left leg – the player perspective – has been quite atrophied until now. To avoid misunderstandings, both legs are necessary for the Product Oriented Environmental Initiative, which is why the economic and social perspective of the player relationships in the product chain clearly must be given greater priority, to ensure balance.

Recommendations – players

Against the background of the perspective in this section, the following recommendations and ideas are presented with the aim of ensuring broader participation of the different actors:

- Multidisciplinary teams behind development work, with much greater participation by designers and marketing people,
- Ensuring the link between technical, environmental and production-oriented knowledge, and design, marketing and product-oriented knowledge,
- Involvement of consumers, the retail sector, consumer organisations and other players who have been absent to date,
- Liaison groups containing constructive critics who have a different background or a different perspective on the development task,
- Growth/experience exchange (ERFA) groups involving several enterprises,
- More active involvement of the knowledge network in the individual projects,
- Business associations or similar bodies as coordinators,

- The development and testing of tools to assess the economic, social and communication relationships between players in the product chain.

2.1.3 The market

The market

Another characteristic of the earlier cleaner technology strategy is that the technological innovative value – gradually in a broader and broader sense – together with the potential environmental improvements, have been the critical decision criteria in the assessment of whether a project should be given funding and initiated.

– a naive relationship

This does not mean that economics in terms of possible savings and competitive advantages have not been assessed or had no significance. The claim being made is simply that economics and competitive advantages have not been among the primary success criteria, and this has contributed to creating a naive relationship to the market in the cleaner technology strategy up until 1999.

Pieces of the explanation

This is supported by the fact that the market has been “non existing” in the projects evaluated. The focus on production, the expert and consultant-driven projects, the players involved, the implicit success criteria, etc., are all significant elements to explain this. The market has thus not been in focus up to 1999, but is increasingly becoming so with the Product Oriented Environmental Initiative, with the market becoming a central mechanism in relation to creating demand for more environmentally sound products. Added to this is the fact that the perception of the relationship between the environment and economics is only slowly changing to a more integrated perception (cf. the examination below).

The environment and economics

Based, among other things, on this evaluation, distinction can generally be made between different perceptions of the relationship between the environment and economics:

- the environment as a cost
- the environment as resource savings
- the environment as improved image
- the environment as market advantage
- the environment as responsibility for nature, people and economics

These different perceptions of the relationship between the environment and economics reflect the fact that, in step with changes in the cleaner technology strategy (cf. chapter 1), changes have also taken place in the perception of the relationship between the environment and economics, including the perception of the significance of the market for an enterprise’s environmental initiatives.

The environment as a cost

The original focus in the environmental regulation of industry using end-of-pipe solutions in the form of sewage treatment plants, chimney filters, etc. led to a perception of the environment as a cost to enterprises. Not only did enterprises have to make comprehensive investments in plant as a result of environmental requirements, there were also significant operational expenses associated with these. At the international level, the Polluter Pays Principle became an importance principle.

The environment as resource savings

One of the critical successes of cleaner technology has been that this strategy has contributed to changing the perception of the environment as a cost to industry. The slogan since the late eighties has instead been, Pollution Prevention Pays (3P), and the vast majority of projects focusing on cleaner production processes have resulted in good opportunities for cost reductions in the form of resource savings on water, energy, raw materials, etc., with associated reductions in the costs of emissions and waste disposal. Against

this background, the environment has been increasingly associated with cleaner technology and resource savings.

This aspect has been most apparent in the textiles industry, where the cleaner technology projects carried out at dye houses have shown potential for a 90 per cent reduction in water usage and a 70 per cent reduction in energy use, with associated reductions in emissions. This significant potential will be a competitive advantage for the Danish dye houses – if it is realised and if resource costs are similar in other countries.⁴

In the textiles industry there is an example of an enterprise, on its own initiative, achieving such large resource savings via cleaner technology projects carried out, that it is keeping the approach close to its chest – since the savings constitute a competitive advantage. Similar examples have been seen in other sectors, for example the Northern Jutland herring industry.

So even though the focus has been on cleaner production processes and on reducing resource consumption and emissions, these can still be associated with competitive advantages due to the magnitude of the savings; and some enterprises have also clearly gained an improved image via these activities, which might have indirectly contributed to market advantages in the marketing of their products.

The environment as

With the increasing focus on environmental management from the mid-90's, the perception of the environment and economics has been shifted further. Whereas cleaner technology was equivalent to resource savings, and the cleaner technology solutions developed were mostly cost neutral, the perception with environmental management has become more comprehensive and no doubt also more diffuse: the environment as improved image.

improved image

In a study from 1998 of 107 environmentally certified enterprises, the general picture was that these enterprises had started environmental management primarily to be at the leading edge, and due to image and marketing considerations. Where environmental management has been introduced, 45% of enterprises *as a whole* have assessed that they have derived economic advantages from it. When the enterprises categorised the types of advantages, 54% stated they had derived economic advantages, divided into resource savings (53%), a better image (42%), strategic advantages (28%), environmental tax savings (25%), and increased sales (19%). (Christensen, et al, 1999).

Thus resource savings still play a significant role, but in addition, a better image is particularly emphasised. Seen in light of the fact that market factors have generally been underplayed in preventive environmental initiatives, the above proportion of enterprises which achieved market advantages in the form of increased sales when they introduced environmental management might not actually be too bad. For the EMAS-registered enterprises, it is further the case that one quarter of these enterprises have recorded increased sales as a consequence of environmental management.

It appears that a number of enterprises with a certified environmental management system proceed on to a product-oriented environmental initiative, partly through eco-labelling of products. This tendency has been especially clear in the graphics sector, where enterprises with an environmental management system based on EMAS or ISO 14001 – once water and energy use could not be significantly reduced further – have begun to work in a more product-oriented manner. Graphics enterprises are

⁴ For a more detailed discussion, see Environment Project 502, the Danish Environmental Protection Agency, 1999.

The environment as a market advantage

clearly over represented as a sector, in terms of the number of eco-labelling licences. This can be taken as an indication that the environmentally certified graphics enterprises have moved on to their products, and have sought to achieve a competitive advantage via eco-labelling. At the moment there are no other sectors in Denmark where the environment has become a competition parameter to the same extent, excluding some categories of foodstuffs bearing the Ø label for organic products.

It has not been possible to find any evidence of strong trends that cleaner products are becoming a competition parameter in the sectors evaluated. In all three sectors, some leading enterprises have a clear vision that there is a potential market advantage in developing cleaner products. But there is no sign – as yet – of a clear trend for the integration of environmental considerations into product development and marketing.

The market has clearly been most in focus in relation to the selected product projects. Of 35 projects investigated, 20 have resulted either in a marketed product (6) or the production of a prototype (14). Of these 20 products, the assessment is that half will have higher production costs than comparable products, while four will have unchanged costs, and four will have lower production costs.

Of the 14 prototype projects, eight enterprises have plans to market their products, and two are developing products which are expected to be marketed. All up, about half the 35 product projects will result in marketed products in the short term.

The majority of enterprises involved in these product projects have a tradition for using environment in their marketing, but even so, only a very few have considered investigating the possibilities for eco-labelling. This is most likely due to the fact that official labels have not been developed for most of the products involved, but conversely, it is of concern that eco-labelling is not included as an option to be investigated. A market dynamic will necessarily require that the official eco-labels cover as many product categories as possible, and that the supported projects actively relate to eco-labelling.

The environment as responsibility for nature, people, and economics

The Brundtland commission's report "Our common future" from 1988 introduced a "magic" triangle in which the corners were labelled environmental, economic, and social factors. This was to highlight the fact that governments, at the societal level, had to seek to politically balance economic, social, and environmental development.

Some larger international enterprises have taken on this perspective in the form of "the Triple Bottom Line". These enterprises are signalling that they will strategically work for *profit* – the economic conditions, *people* – the social and working environment factors, and the *planet* – the environmental conditions. These ideas are the expression of a new strategic orientation in leading enterprises, with an increasing recognition of the fact that these three factors mutually condition each other. Initially it appears to lead specifically to annual reporting on all three areas in the form of economic, social and "green" accounting, cf. Novo Nordisk's publication of all three types of accounts for 1998.

The meaning of the 3P abbreviation has changed no less than three times over the last 10-15 years. 3P originally referred to the "Polluter Pays Principle", but then a shift to "Pollution Prevention Pays" took place with cleaner technology. Today it is used to refer to "People, Planet and Profit", which, for example, Brd. Hartmann used in the environment report for 1997 (Brd. Hartmann, 1998). Brd. Hartmann is also one of the relatively few enterprises which systematically works with life-cycle assessment and environmental considerations in product development, and which also has a

strategy for how each factory should gradually be “equipped” to work with these via environmental initiatives based on cleaner technology and environmental management.

The new meaning of 3P can be taken as an indication that the profit motive and market forces no longer completely dominate enterprises’ horizons. Social and environmental responsibilities are having increasing significance – especially for enterprises which proactively seek to shape their stakeholders’ perception of the enterprise. In other words, this responsibility for people and the environment is becoming a condition for an enterprise to be able to continue generating profit.

Break

This examination of the changes in perception of the relationship between the environment and economics indicates at the same time a break and continuity. The break took place right back at the change from end-of-pipe to cleaner technology; from the environment as a cost to the environment as resource savings. This can be seen as a paradigm shift, both in terms of technology and in the perception of the relationship between the environment and economics.

and continuity

The other changes are all within the prevention concept and thus represent a gradual expansion of the perception of the environment and economics from the internal to the external, from production to product focus, from savings to strategic competitive advantages – that is, from economics in a simple sense, with a focus on price and savings, to economics in a more comprehensive sense, taking into account social/ethical and environmental factors. Put in another way, an enterprise’s social responsibility is becoming an economic condition for running an enterprise.

Non-simultaneity

In relation to enterprises, this development represents non-simultaneity, since among Danish enterprises all these types of perception of the environment and economics are clearly represented, presumably even with over-representation in the earlier categories.

From productivity to innovation to credibility

It is worth noting that the perception of competitive advantages has changed along the way in this process. As implied above, there are differences between whether competitive advantages are achieved via resource savings in production or by strategically developing and marketing environmentally friendly products. Competition parameters on the market can no doubt generally be said to be gradually expanding from *productivity*, with a focus on price and costs, to *innovation*, in the form of design, quality, image etc., to *credibility*, via official labelling of products and holistically linking profit, people and planet.

Recommendations – the market

With the Product Oriented Environmental Initiative, focus has been decisively placed on market orienting preventive environmental initiatives. Against this background, the following recommendations and ideas can contribute to ensuring greater market orientation by:

- Refining the dynamic in cleaner production and environmental management, so that enterprises exploit the market aspects of these,
- Sharpening the product-oriented requirements in environmental management standards,
- Spreading knowledge of eco-labelling so that the market advantages of this become apparent to enterprises,
- Ensuring strategic market advantages for enterprises by concentrating on cleaner products,
- Commissioning experiments to shed light on how environmental considerations can be incorporated into integrated product development and into the cooperation between development, production and marketing,

- Exchanging environmental knowledge and information in the product chain,
- Ensuring that public institutions fulfil in practice the intentions of green procurement.

2.1.4 Measures – between the government and the market

Changes in policy

A common characteristic of the development trends discussed is that a modernisation of the government's traditional way of executing policy is taking place. A number of tasks are being managed by groups outside the public-administration apparatus, and policy is increasingly being aimed to make use of the dynamics of the market.

There has long been interest from political parties in how competition conditions in the market might be extended to include environmental factors. A significant proportion of the political measures which have been put into play in recent years only have an effect if the market conditions are affected. This applies first and foremost to eco-labelling, but a number of other measures such as environmental management, green accounting, etc., have significance for an enterprise's image and can be expected to influence market conditions indirectly.

The market dynamic

Back in the mid-90's, people in EU circles (figure 2.3) were already thinking about how cleaner products could be initiated by creating a market dynamic. If environmental auditing is upgraded to environmental management, and analysis of emissions, etc. to green accounting, then the model is up to date with current conditions in Denmark. Environmental management, green accounting, and eco-labelling have been the important measures to date used to influence consumer awareness of and preference for cleaner products.

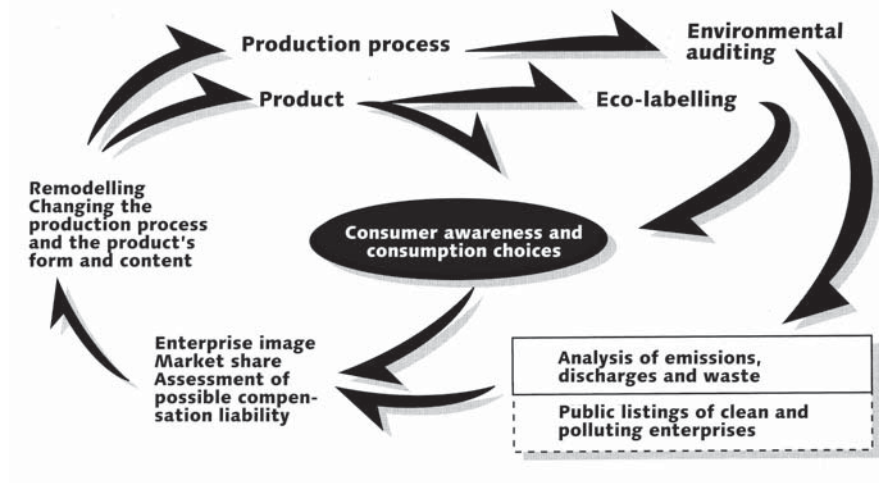


Figure 2.3

The consumer's options for promoting environmentally friendly production methods and products (the EU's 5th Environment Action Programme)

The figure indirectly illustrates a bigger problem in preventive environmental initiatives – the powerful split between process and product and between environmental management and eco-labelling (Remmen, 1996).

One challenge for the Product Oriented Environmental Initiative is to link these aspects together to a much greater extent (cf. one of the themes in chapter 1).

Industrial development strategy – .dk21

With the government's new industrial development strategy, .dk21, and with the appointment of a working group for a new green industrial development policy, plans are in place to ensure that the Product Oriented Environmental Initiative is not just an environmental sector program, but that this initiative is anchored in the context of the Ministry of Trade and Industry and the other sector ministries.

Value-based competition

These initiatives can presumably contribute to placing greater focus on the environment as a responsibility and on value-based competition. "With the transition to the knowledge society, where the stream of information, the pace of innovation and the public's level of knowledge is continuing to increase, value-based competition will win out. More and more enterprises in recent years are facing new demands from customers, investors, employees, and society around them. Enterprises are being required to take a position on central society issues such as, environmental development, social considerations, and the ethically responsible utilisation of new technology. Thus political decisions are being made increasingly via the market" (The Ministry of Trade and Industry, 2000).

2.2 Different development dynamics in each sector

Sector changes

In this section the similarities and differences in the development dynamics in the textiles and electronics industries will be assessed. The transport sector will not be considered at this point.

Globalisation

There are clearly similarities between the textiles and electronics industries in relation to how globalisation and changes to the international division of labour have led to significant restructuring in the two sectors. However, it is not necessarily just the parts of these sectors with the greatest environmental impact which are moving abroad, but rather the labour-intensive elements, of the textiles industry in particular. So the immediate consequence of this globalisation is that transportation's contribution to each product's total environmental impact – all else being equal – must have increased.

There are just as clearly differences between the two sectors in relation to which environmental impacts and which potential solutions are being focused on.

The environment in textiles

In the textiles industry, focus has been on resource consumption and discharges and emissions from production, especially in relation to water usage and wastewater, and energy consumption with the associated emissions. The solution has been the development of new water treatment techniques which can dramatically reduce water usage, while also reducing energy consumption significantly. Textile products, however, have only been the subject of relatively few studies, and just a single project has focused on actual product development.

The environment in electronics

The production processes in the electronics industry and their environmental impacts have, however, only been the subject of cleaner technology projects to a limited extent. Focus has rather been on the materials used in products and on formulating guidelines for the development of cleaner electronic products. This is because the significant environmental impacts from electronic products arise in the use and disposal phase. Following on from this, it is our impression that preventive environmental initiatives in the electronics industry are only just beginning to seriously gain a footing – apart from three or four well-known enterprises. Incentives generally derive from the problem of waste in relation to

electronic scrap, and from the debate around take-back of end-of-life products.

There is also a difference between the sectors in how cooperation works in relation to development projects carried out within what can be called an enterprise's development and knowledge network.

The textiles network

Environmental initiatives in the textiles industry have largely been carried out by two consultant/service institutions, the Danish Technological Institute (DTI) Centre for Clothing and Textiles, and the Institute for Product Development (IPU), especially in relation to cleaner production processes and cleaner products, while Cowi Consult has had a leading role in relation to environmental management. Out of 30 cleaner technology projects, only eight have been carried out without DTI or IPU involvement.

The electronics network

The picture is significantly more complicated in relation to who has taken the initiative for cleaner technology products in the electronics industry. In the vast majority of cases different organisations have taken the initiative and responsibility for carrying out projects. There are only two cases where the same organisation has been responsible for two different projects, Danfoss and Elektronikcentralen (now DELTA). The IPU and the DTI, on the other hand, have had a very subdued role in this sector, with the DTI only having been responsible for a single literature study back in 1992.

The business associations

The two central business associations have had different roles in environmental initiatives. The Federation of Danish Textiles & Clothing (DTB) has played an active role, both in relation to the development of a chemical assessment system and in communicating experience from cleaner technology projects. However, the DTB has consciously chosen to leave the responsibility for carrying out a sector environmental management project to a consultancy firm. The sector organisation for the Danish electronics industry (EI) has similarly played an active role in relation to the development of an environment database on cleaner technology, waste and waste processing, but has otherwise had a less dominant role in relation to carrying out and communicating cleaner technology projects. However, EI has chosen to be responsible for the environmental management project, using consultants as subcontractors.

The differences in environmental impacts between the sectors, outlined above, also have significance for which measures are employed and are effective in government environmental regulation.

Environmental regulation in textiles

The traditional "command-and-control" regulation surrounding chemicals and wastewater has helped to get environmental initiatives underway at the textile dye houses. Both chemical and wastewater regulations have been implemented in cooperation marked by consensus between the authorities and enterprises, which combined with the cleaner technology projects initiated, has increased awareness of the importance of prevention at the source.

It is not clear whether the environmental authorities will prescribe the use of the best available technology – which are also cost-effective. Experience from other sectors does not suggest that these options will be employed, even though the effects of the technologies developed can be "translated" into emissions requirements. Economic measures in the form of taxes on energy have been implemented in a way which has aroused great opposition in the sector; and the differences between local authorities in the costs of wastewater discharges have also been a source of irritation to enterprises.

It is our assessment that neither the normative nor the economic measures have had an effect yet in relation to initiating a product-oriented environmental initiative in enterprises. Only two enterprises have obtained official eco-labelling of their textile products with the EU Flower and the

Scandinavian Swan label, in the summer of 1999. Green public procurement has not broken through according to those interviewed in the sector.

Environmental regulation in electronics

In relation to the electronics industry, normative regulation directed towards the production process has only had significance in sub-sectors with requirements for environment approval, such as for printed circuit board production. However, product-oriented regulation has a much greater significance in this sector, in the form of the statutory regulation regarding electronic scrap, and planned regulations such as a take-back scheme for electronic products, manufacturer responsibility for waste disposal, standards, etc. In terms of eco-labelling and purchasing guides, these have been prepared for photocopiers, computers, printers, fax machines and other electronic office equipment.

Generally speaking, regulation of the electronics industry is still “on the drawing board”, with the clear trend that it is directed towards products, since the environmental impact derives primarily from the use and disposal of these. Clearly, international regulations and agreements, especially in the EU context, also have enormous significance in this sector.

Sector differences

It can be observed that awareness of the problem and solution in relation to preventive environmental initiatives varies quite significantly between the sectors, and that the incentives for getting started are different for the enterprises in these sectors. Something which works well and helps create interest in one sector can be quite absent in another. The main players and the relationship between the parties involved can also be extremely different, as has been the case in the textiles and electronics industries.

Sector knowledge

Against this background there might be reason to seek more detailed and broader knowledge of the sector prerequisites for enterprise environmental initiatives and greater insight into how cleaner processes and products can be developed and the knowledge disseminated in the individual sectors. Expensive technology development projects have been carried out, especially in the textiles industry, and yet dissemination of the very beneficial solutions happens, at best, quite slowly.

More detailed knowledge of the sector conditions, information channels and patterns of communication might have influenced the way these development-oriented projects were tackled, and have contributed to greater priority on activities relating to experience exchange and knowledge dissemination in the sectors.

The incremental steps method

A clear strength of the cleaner technology strategy is the incremental method, where a platform for a product-oriented environmental initiative is gradually created through active involvement of the business associations and by extending the repertoire of measures, etc. The product panels appointed for textiles and electronics have a cleaner technology base to build on; but the dynamic in the Product Oriented Environmental Initiative is only now beginning to be established in these two sectors.

2.3 General conclusions

From an overall perspective, a shift has taken place in the perception of the problem and solution lying behind preventive environmental initiatives, from cleaner production processes to environmental management to cleaner products (see chapter 1 for more details). These changes are especially evident when one considers the environmental initiatives in the sectors along with the two support programs for environmental management.

In terms of the action plans for cleaner technology, a shift in focus has taken place *from* technological development *to* dissemination *to* the beginnings of

an integration of enterprise environmental initiatives, environmental regulation, etc. (Remmen, 1995 and 1998). This general characteristic is clearly in the action plans and in the intentions behind the initiatives, but penetration into the individual sectors is quite varied.

2.3.1 **Cleaner technology in the sectors**

Cleaner technology in the textiles industry

In the textiles industry, the commissioning of the framework program in 1993 meant that focus on technical demonstrations and development projects lasted a long time; while focus on dissemination only appeared in around 1997-98, because people were waiting for the results from the development projects. The commissioning of the Dantex project in 1990 laid out a path which has come to dominate the cleaner technology strategy in the textiles sector since that time. In parallel with this, work was being done on integration of cleaner technology into environmental regulation, business association initiatives, etc., while focus was also being placed on tool and method development directed towards products.

Cleaner technology in the electronics industry

The cleaner technology projects in the electronics industry are also atypical in that there has always been more focus on the products than on the production processes. Initially focus was largely on the substitution of environmentally harmful substances such as CFC, PVC, and heavy metals. While in the period from 1993-97, these projects continued in parallel with a more comprehensive and product-oriented environmental initiative. In addition, the trend has been for large enterprises in particular, such as Danfoss, NKT, and TDC, to be on the field – possibly with the implicit expectation that these enterprises could act as driving forces for preventive environmental initiatives in the electronics industry. In any case, it can be observed that there has been no separate focus on communication and dissemination in this sector.

Cleaner technology in transport

The transport sector differs from the other two sectors in that no support has been given to cleaner production – ie. reduction of the environmental impact from the production of the means of transport. In a way, the cleaner technology projects in the transport sector have always been product related, since focus has been on investigation of environmentally friendly forms of transport and on demonstration and development projects. The projects have largely been consultant-driven, and no projects have placed special focus on communication and dissemination. The projects have been relatively small, with an average cost of DKK 500,000, while the average has been about DKK 1 million in both the textiles and electronics industries. There has been no coordination and prioritisation of the cleaner technology strategy in relation to the significantly more extensive development funds of the Transport Council and the Ministry of Transport.

2.3.2 **Results**

The above differences in approach between the sectors mean that it is difficult – if not impossible – to compare the results across the sectors. But the following main results can be highlighted in relation to the individual sectors.

Results in textiles

The cleaner technology strategy in the textiles industry has been relatively targeted, compared with electronics and transport, since the framework program and the parties involved have contributed to focused initiatives directed towards textile wet processing. There has been no equivalent joint strategy in relation to the product-oriented projects. 30 cleaner technology projects have been carried out in the period from 1990-97, with a combined

allocation of funds of about DKK 30 million. Just over half of these funds have been utilised in relation to dye houses.

Textile wet processing

Initiatives in textile wet processing have been characterised by a scientifically oriented approach, which has primarily been formulated and executed by consultants. Cleaner technology in wet processing deals with both simple process changes and restructuring working procedures, as well as completely new dye machines and equipment for processing and recycling process water.

For textile wet processing, a total concept for the reduction of environmental problems has been worked out and on a demonstration basis, the potential for a wastewater-free dye house has been shown. Pilot and full-scale investigations have been completed dealing with the treatment and recycling of washing, dyeing and rinsing water. In the short term, significant reductions in resource consumption have been achieved, and in the long term there is great potential for a 90-per-cent reduction in water usage and a 70-per-cent reduction in energy consumption and in the associated emissions. A number of ideas for optimisation and resource savings at textile printing shops have also been collected and developed.

Textile products

Some of the product-oriented projects in the textiles industry have developed new tools with a general character relevant to other sectors. This is true of the projects on log books and supplier management. The product-oriented projects have been quite diverse and have almost exclusively had the character of elucidations. Only the project on “washable suits” has resulted in actual product development, although this has not been taken further.

Results in electronics

Just over DKK 10 million has been spent in the period from 1993-97 on cleaner technology projects in the electronics industry. Four of the projects, costing just under DKK 4.5 million, have focused on substituting the use of dangerous substances. A further four projects, costing just over DKK 6 million, have focused on the development of cleaner electronic products. Finally, two smaller projects have dealt with the problem of waste and regulation. Environmental assessments have been carried out in seven of the 10 projects, and in all but one case, the EDIP method has been used.

Substitution and electronics

The substitution projects have focused on harmful substances such as solder containing lead, PVC in cables and tin/lead associated with printed circuit board production. Only the project on PVC-free cables has been finally completed, and the technical possibilities for substitution are good, but because of higher prices and lack of knowledge about cable lifetimes, the competition situation is currently assessed as being less good.

Electronic products

Electronic products contain a number of different materials, leading to emphasis on both choice of materials and disposal. The strength of the product-oriented component of the cleaner technology strategy has been that guidelines have been developed for sustainable electronic products. One of the projects focused on developing an operational tool for product developers – a handbook containing specific guidelines and an introduction to life-cycle assessment. One critical problem is that knowledge about and application of LCA in the sector has been extremely limited, cf. below.

Results in transport

In relation to the transport sector, about DKK 5 million has been allocated to support 11 cleaner technology projects. This represents relatively few projects and quite modest funding compared to the other sectors. In the area of goods transport, the main focus has been on analysis; while in relation to passenger transport focus has almost exclusively been on carrying out life-cycle assessments of busses and cars.

Product orientation

The projects evaluated have been predominantly product-oriented. But only

within transport

two projects have sought to do actual product development in the form of a solar hybrid car and an environmentally friendly oil burner for heating in busses. Only the latter project can be said to have gained any commercial or market significance.

2.3.3 Dissemination

Dissemination studies have only been carried out in relation to the cleaner technology projects in the textiles and electronics sectors, since the extremely diverse character of the projects in the transport sector and the selected product projects makes a study of the dissemination and awareness of the project results impossible.

Overall impression

The overall impression of the cleaner technology strategy in the two sectors is that the majority of the projects have been successful, but that dissemination of the results has been quite limited. This applies to both sectors, even though the reasons for this are undoubtedly quite different.

Dissemination in the electronics sector

There was generally good awareness in the electronics sector of cleaner technology; but awareness of the projects completed was quite limited – with the exception of the project on conductive adhesives. The results of the projects can generally be described as constructive, although the interest from other enterprises in the electronics sector has not been overwhelming. A seminar on accessible guidelines for environmentally friendly electronic products received no support and was cancelled. In addition, there was only limited interest in an information database on cleaner technology, recycling and waste management in the electronics sector; despite the fact that disposal is an important phase in an electronic product's life-cycle.

Pieces of the explanation for the limited interest

Based on interviews with 20 electronic enterprises, the explanation is apparently to be found in the limited spread of preventive environmental work in the form of environment policy, environmental management, and environmental requirements for suppliers. This is combined with the fact that there has not been any preventive environmental work in the electronics sector resulting from government requirements regarding environmental approval, and the fact that customers and consumers have expressed only limited interest in the environmental impacts of electronic products. The new requirements relating to electronic scrap, the efforts of the business association for the electronics industry (EI) relating to product-oriented environmental management, the appointment of the electronics product panel, etc., are new trends which may contribute to increasing interest in the environment in the electronics industry.

Dissemination in the textiles industry

Preventive environmental work is definitely on the agenda in the textiles industry, especially among the dye houses. More than half the dye houses in the dissemination study had a written environment policy and were working systematically on ongoing environmental improvements by setting environmental goals and preparing action plans. Nine enterprises also had some form of environmental management, of which two were EMAS registered and one was certified. Virtually all the dye houses also placed environmental requirements on their suppliers of raw materials, dyes, and accessory agents.

Good awareness – but limited use

Against this background, it is not surprising that awareness of both cleaner technology and of the projects carried out was quite good. Despite this fact, only the slightest number of the technologies had been put to use to any appreciable extent, compared to the potential.

In general, the degree of dissemination of the cleaner technologies developed depends on a number of factors, including the machine manufacturer, patent protection, relationship to the supplier, number of enterprises

involved, etc. It has been significant, for example, that some dyeing machines have a modular construction and allow for ongoing technological modernisation and upgrading, also in terms of the environment, while machines from other manufacturers do not provide this facility. The limited dissemination can also be explained by the fact that relatively few enterprises have been involved in the individual projects, and that there have not been clearer requirements on the parties carrying out the projects to ensure ongoing communication.

From awareness to application Viewed as a whole, there is reason to point out that the existing cleaner technology projects should be pursued to their conclusion. It is not satisfactory that there is widespread awareness of the developed technologies, if these are not being put to use in the sectors. For example, over DKK 15 million has been invested in projects directed towards the use of water, chemicals and energy in the textile dye houses. The parties involved should assess whether the dissemination and application of these cleaner technologies can be ensured via an increase in information initiatives, the initiation of economic schemes relating to environmental investment and/or via regulatory pressure.

2.4 Blind spots in the product-oriented projects to date

At least a few factors stand out as completely or partially absent from the product-oriented initiatives under the cleaner technology action plan from 1993-97. These “blind spots” relate to consumption levels and transport, and the organisational anchoring of product-oriented environmental initiatives in enterprises.

2.4.1 Transport and consumption as blind spots

A pronounced characteristic of the cleaner technology strategy up until the launch of the Product Oriented Environmental Initiative has been that environmental impacts from the transport of goods have not been included as a significant factor in the projects in the textiles and electronics sectors and even less in the product-oriented projects. Similarly, consumption and the consumer have not been in focus in the earlier cleaner technology strategy, as the perception of the Danish Environmental Protection Agency is that this has not been warranted.

Transport as a blind spot

Globalisation in the various sectors has meant that goods transport is increasing, and the extent of transport has meant that the resultant environmental impact represents a significant problem – at society level. However, energy consumption for transport often represents a relatively small part of an enterprise’s total energy consumption – in one of the transport projects it was calculated for one enterprise to be about 7 per cent – and a similar proportion of the products’ total environmental impact.

In other words, it can be observed that the earlier cleaner technology projects, along with tools such as environmental management, green accounting, and life-cycle assessment, have not necessarily focused on the transport of raw materials and products. There is thus a deficiency in the tools and approaches employed to date in relation to an enterprise’s environmental initiatives in the transport area, and this needs to be addressed.

Consumption as a blind spot

The earlier cleaner technology strategy contains the paradox that it is possible to conceive of *environmentally friendly production of environmentally harmful products*. Against this background, the Ministry of the Environment has focused on the development of cleaner products. This has been underway for several years. It is therefore surprising that the problems

associated with consumption patterns and levels have been so absent in the cleaner technology strategy to date. Eco-labelling is basically the only activity which has focused on consumption; but it is worth noting that this takes place in a form whereby only the consumption pattern is changed, or in the best case, is pushed towards cleaner products. The future initiative relating to cleaner products also contains a possible paradox: *cleaner production of cleaner products – but with environmentally harmful consumption.*

Let us consider a couple of examples: Significant technological improvements at the dye houses have meant that clothing production is much cleaner and that environmental consideration has been given in all the phases of the product from the organic cotton through to the retail outlet's counter. But if changes in fashion mean that the product quickly becomes obsolete, then the environmental improvements vanish in the changeable nature of fashion. Similarly, it is well-known that the technological and design-related obsolescence of electronic products such as mobile telephones takes place much faster than the products actually wear out.

Consumption levels are thus a factor to be independently taken up as a theme in any future environmental initiative directed towards sustainable development (Aal, 2000). That the problem is significant is indicated by the fact that “longer product life times” and “better product maintenance options” are the only two factors which have *not* been included in the work of Danish enterprises with life-cycle assessment (Broberg, et al, 1998). At the same time, these are the only two factors which could have affected actual consumption levels.

2.4.2 **Organisational anchoring of environmental considerations in product development**

Organisational requirements

None of the cleaner technology projects evaluated had focused on which organisational factors are necessary to ensure that environmental considerations become integrated into product development. Based on experience with environmental management, the necessary conditions include: management commitment, motivation, engagement and resources of employees, and organisational anchoring of environment work.

Environmental consideration in product design

A similar view can be seen in the handbook on “Environmentally Oriented Product Design”, published by the Finnish business association for the electronics industry (Kärnä, 1998). The chapter entitled “How can environmental considerations be integrated into the product design process?” starts by observing that if environmental considerations are involved in product development at all, it is typically at a stage when the majority of the design work has been done. By that stage it is difficult and expensive to make dramatic design changes to improve the product's environmental performance. It is similarly observed that product developers are often unaware of the environmental consequences of their decisions, which results in a limited possibility that environmental considerations are properly taken into account in the initial phases of product development.

The design process

Against this background, five aspects are outlined which should be considered with the aim of integrating environmental considerations more fundamentally into the design process:

- ensure motivation and commitment,
- assess the environmental impacts throughout the product's life-cycle,
- specify design goals and indicators for these,
- draw up instructions and guidelines for the various stages in the product design process,
- ensure implementation.

These recommendations have been put forward on the basis of an enterprise viewpoint and emphasise that environmental consideration in product development is largely an organisational issue. Equivalent attention to these organisational aspects can be found in the UNEP journal, which in 1998 had a feature on “Product Development and the Environment”.

Enterprise strategy

Strategic effort

In order for environmental considerations to be integrated into product development, management at all levels must be committed to the implementation of a product-oriented environmental initiative. This will require that management chooses the strategic focus areas for the development work. Based on the guidelines and design criteria which are known from “Design for the Environment”, an auxiliary tool has been developed for facilitating these strategic discussions and prioritisations.

Raising awareness

The tool is called the “Environmental product development strategy wheel” and is based on the life-cycle perspective. This tool can help to raise awareness in the entire organisation about the goal of initiating product development with the environment at the centre. The figure below illustrates an environmental profile of an existing product, which can be compared with the environmental profile for the product the enterprise wants to develop.

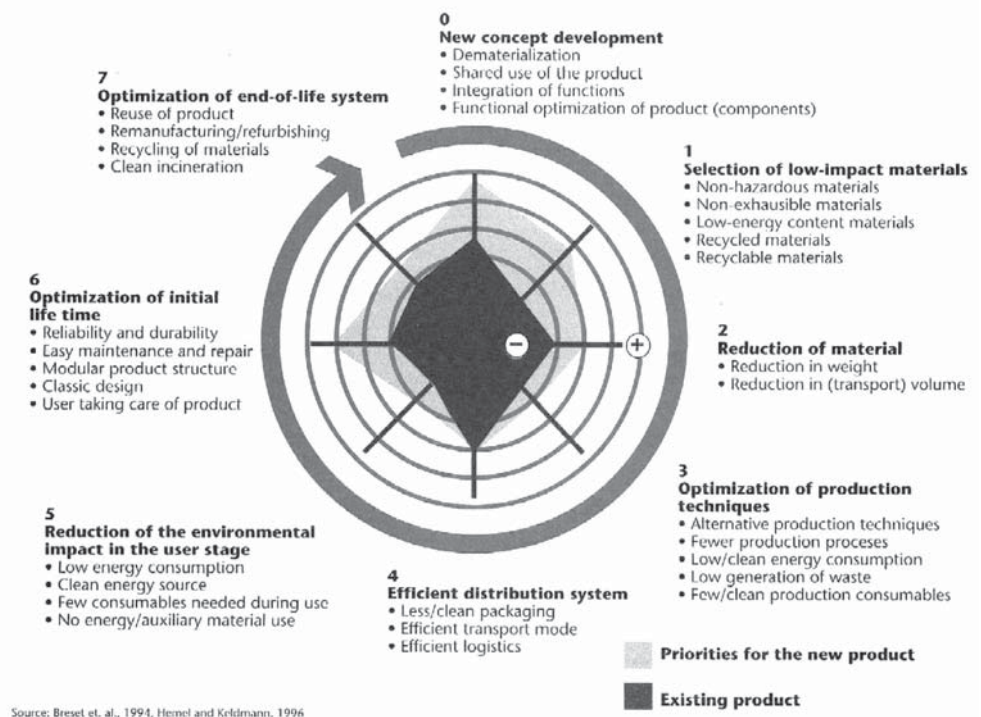


Figure 2.4

Design criteria based on the life-cycle perspective (UNEP, 1998)

It is, of course, not enough to simply get all the development staff interested in the environment. The entire organisation has to be involved and committed, so that the production staff can understand the aim of changing

production to be able to produce the new product and so that the sales staff can see the advantages of the new product and work out a sales strategy for it, using environmental documentation of the advantages – possibly in the form of an environmental product declaration or eco-labelling.

Put another way, it is not enough to simply employ an environmental specialist to be responsible for a product-oriented environmental initiative. This initiative can only be carried out if it permeates the entire organisation. A product-oriented environmental initiative requires at least as much from the organisation as environmental management.

These factors speak for both active participation of the various employee groups, and integrated product development with cooperation between development, production, and marketing (cf. the next two sections).

Employee participation

Employee contribution

It is important to motivate the various employee groups to support a product-oriented environmental initiative, as this can lead to changes in an enterprise's daily routines and organisation of work. Furthermore, there is reason to expect that the employees will be able to make a positive contribution of ideas for product development.

Employees are also consumers out of hours, and are in contact with the enterprise's customers and suppliers. Employees also have extensive knowledge about production, and in a number of enterprises they have been a significant resource both in relation to environmental optimisation of production, and the introduction of environmental management (Lorentzen, et al, 1997). Employees also have an interest in ensuring that consideration is given to the working environment during the development of new processes and products.

Resources

Management must therefore allocate the necessary resources to development work, in the form of time, knowledge (training), and money, and must also ensure that product development is organised in such a way that permits employees to contribute their ideas.

Recommendations – employees

Against this background, it is recommended that projects be initiated with the aim of working out:

- what ideas and contributions do employees have for integrating environmental considerations into product development?
- what types of training could improve the skills of employees in preparation for being involved in product development and what qualifications are necessary to be involved in environmental assessment?
- what internal organisation of the product development process can make room for dialogue between employee groups on environmental considerations?
- can employees, through contact and dialogue with customers and suppliers, create new information channels?

Practical trials involving brain-storming sessions, training courses and experiments with cooperation and experience exchange, both internally and externally, are some of the ways to find answers to these questions.

Integrated product development

Sequential process

Traditionally, product development has been arranged as a sequential process in enterprises. The development department first developed a prototype and then a product, after which the production department made minor adjustments to the product and then produced it, and finally the sales department organised the marketing and sale of the product.

– the problems with this

However, this way of organising product development leads to problems. Development staff have been caricatured as being enthusiastic about new technology, so that the product ends up being more fancy and advanced than originally intended; while the production department has had to make changes to the product in order to have any chance of being able to produce it; and the sales department has been mystified about what happened to the requests and signals they gave the development department 9 months ago, but in the meantime the market has changed anyway, so now ...

Integrated product development

Integrated product development has therefore been launched as a measure for ensuring ongoing cooperation between development, production, and sales departments throughout the development of a product. But what models and experience of this are there when it comes to integrating environmental considerations into product development? What procedures and requirements have to be embedded in the organisation to ensure environmental consideration throughout the development process? This has never been seriously investigated and answered.

Environmental management – eco-labelling

Similarly, it might be important to investigate how the relationship between ISO 14001 and 14040 can be approached in practice. Philips is an enterprise which has some interesting ideas on this point and which has also formulated simple guidelines for how product developers should include environmental consideration in product development (Meinders: Philips EcoDesign Guidelines, 1997).

There is also a need to establish a form of life-cycle-based environmental management whereby enterprises are stimulated to expand their environmental initiatives associated with cleaner production and environmental management to include products based on the life-cycle perspective (cf. chapter 1).

Recommendations – management

Against this background, it is recommended that development projects be initiated which shed light on:

- the strategic process surrounding product development in the enterprise,
- what other tools can support management in integrating environmental considerations into the enterprise's business strategy,
- what new routines and procedures are necessary in order to incorporate environmental considerations into integrated product development?

2.5 Recommendations concerning program administration

Program administration

It has not been the purpose of this sub-evaluation to evaluate the administration of the programme, including organisation, the time taken to perform administrative procedures, etc. However, experience gained from the evaluation still gives rise to some general recommendations for the administration of the programme for cleaner products. The most important of these changes has already been made, since the product programme has become needs and supply driven, instead of being based particularly on the reports of consultants. The recommendations relate to:

- focus areas,
- prioritising communication and network-creating activities,
- the use of evaluations.

Focus areas

As long as there are sufficient resources, it is an advantage to choose focus areas as in the framework programme for the textiles sector. In this way it is possible to focus on selected problem areas, and it can help to disseminate and raise awareness of the initiatives. At the same time, this places greater demands on the program administration and any steering committee not to become “inwardly focused” in their work but to constantly seek new challenges by drawing new aspects and new players into the work. As mentioned in the textiles evaluation, the strength has been the focus, while the weakness has been the limited involvement of other players. A focused effort requires openness and that the steering committee, product panels and similar bodies constantly set new goals for the environmental initiatives each time the earlier goals are achieved: in other words, dynamic follow-up with ongoing adjustment of goals and measures.

Program management

As was stated in connection with the evaluation of the Programme for the Promotion of Environmental Management and Environmental Auditing in Small and Medium-sized Enterprises, the program administration has to let itself be inspired by the systematics of environmental management, by formulating a visionary policy as the long-term guide, by setting specific, measurable targets, by preparing action plans, and by constantly doing follow-up in the form of communicating experience and evaluating initiatives. These “virtues” from environmental management must also form part of the foundation for the work of the appointed product panels. The project’s own self-evaluation and more regular evaluations can provide the basis for making strategic course adjustments, cf. below.

Communication

Communication efforts have generally been strengthened on the part of the Environmental Protection Agency, while the business associations have also played quite a significant role in communication. However, we have not found any particularly clear indications that the communication effort is being given higher priority in the individual projects, or more accurately, it is extremely dependent on the individual project managers. Furthermore, the textiles evaluation in particular provides no evidence that there is a clear link between well-communicated projects and awareness of the projects in the sector.

*Recommendations
– communication*

On this basis, investigation and consideration of several possible measures are recommended:

- Investigation of the differences in information channels and communication patterns in each sector,
- Experiments with various types of communication activities,
- Refinement of the communication requirements for project organisers, specifying as a guideline that about 20 per cent of the project funds should be spent on communication and network-creating activities.

“Ripples in the water”

Last but not least, there is reason to assume that the more enterprises are involved in a project, the more awareness within the sector will spread like ripples in the water. This can be achieved, for example, by having several enterprises take part in a sector network / growth group. This has been successfully employed in the Programme for the Promotion of Environmental Management and Environmental Auditing in Small and Medium-sized Enterprises, and also in the cleaner technology program, for example, in commercial laundries and industrial enamelling (see the evaluation of the product-oriented projects – Environment Project no. 522, the Danish Environmental Protection Agency, 2002).

Rather than just seeing the projects as knowledge-building in the consultant firm or as development in the particular enterprise, there is clearly potential in viewing projects as the beginning of a learning process and shared experience exchange within the product chain or sector.

The use of evaluations

Finally, there is reason to question the way evaluations have been used to date in connection with the cleaner technology programme. In this evaluation, a disproportionately large amount of time has been spent on “archaeological excavations” in terms of finding relevant material on the projects carried out. It was difficult to get the questionnaires back from the enterprises in the textiles sector, despite the fact they have received funds for the projects in question. For this reason, more time-consuming telephone interviews were used in the other sectors, and with these it was similarly extremely difficult to get hold of the person responsible for the project in each enterprise. It was especially difficult to track down information in the electronics industry, because the key people had changed jobs, often several times. Furthermore, it is methodologically problematic to ask informants about motives and events which lie up to five years in the past. It could also be almost impossible to gather relatively simple information about, for example, the number of communication activities carried out, since no record of these had been made.

Recommendations – evaluations These issues give rise to the following recommendations regarding evaluations:

- the projects should perform self-evaluations, with requirements for systematic information on relevant factors as background material for future evaluations, including the requirement that general success and evaluation criteria be defined more closely,
- perform more regular sub and theme evaluations, so the experience is still fresh in the memories of the players involved, and conversely, tone down the documented component of the final evaluations.
- carry out case studies which provide deeper insight into the development processes in the various types of projects,
- strengthen the requirements for the strategic element of the evaluations.

These recommendations have a mutual interdependence. If the self-evaluations can be used to acquire the greater part of the documentation base, case studies of selected projects and theme evaluations can be used much more extensively to assess elements of strategic significance for program execution and for future preventive environmental initiatives.

3 Evaluation of cleaner technology in textiles, electronics, and transport, and of selected product projects

This chapter reproduces the summaries of the four evaluations carried out of cleaner technology in the textiles, electronics, and goods transport sectors, and of selected product-oriented projects.

3.1 Cleaner technology in the textiles and clothing industry Summary of the textiles evaluation

Cleaner technology in textiles

Prevention of environmental problems at source is a fundamental principle in Danish environment policy. 30 cleaner technology projects were commissioned in the textiles and clothing industry between 1990 and the end of 1997, with combined funding of just over DKK 30 million from the support programme for cleaner technology. The great majority of these projects focused on the development of cleaner production technology for textile wet processing; but some of the broader projects have also contributed to refining the approach to cleaner technology.

Developments in cleaner technology perception

Perception of the cleaner technology strategy in the textiles industry has changed gradually over time, and has followed a fairly “classic” path which can also be found in other sectors:

1. the 80's: analysis,
2. from the early 90's: demonstration and development projects,
3. from the mid-90's: general projects and the lead-up to a productoriented approach.

Analysis

The first projects were broadly framed with a primary focus on analysing where environmental problems arose, and outlining how these could be addressed. These analysis activities pointed to wet processing as the primary focus area, partly also to concentrate efforts on the environmental problems which arise in Denmark.

Demonstration and development projects

In the beginning of the 90's, demonstration and development projects were commissioned, combined with a detailed analysis of the dye houses. These initiatives were further strengthened in 1993-94 with the establishment of the framework programme for cleaner technology in the textiles and clothing industry, which focused on the development and optimisation of processes and machines in relation to textile wet processing. The budget for the framework programme was DKK 10 million. In the period up until 1998, over DKK 16 million was spent. In connection with this programme, a steering committee was appointed which consisted of the core interested parties with knowledge about textile wet processing.

General projects

Focus on the development of cleaner production technology for textile wet processing has dominated the strategy right up until today. But since the middle of the 90's, projects of a broader nature have also been carried out which are relevant to the entire sector. The first of these were two environmental management projects, followed by projects with a product-oriented focus. Unlike wet processing, there has not been a unifying idea and

strategy behind the product-oriented projects, but the project on supplier management, for example, has contributed to refining the cleaner technology perspective.

Agreement and close cooperation

There has been a high degree of agreement and close cooperation between the parties involved regarding the cleaner technology strategy. This has had a positive spill-over effect into the other environmental initiatives in the sector, including the development of a chemical assessment system, the work of briefing the sector on cleaner technology, the introduction of environmental management and the preparation of criteria for eco-labelling. The main players in the environmental initiatives and the cleaner technology projects have primarily been the business association (the Federation of Danish Textiles & Clothing), consultants from the Danish Technological Institute (DTI) and the Institute for Product Development (IPU), and the Danish Environmental Protection Agency. The secondary players have been enterprises, trade unions, suppliers, local and regional authorities, and a few other consultants.

The results

From good housekeeping to new technologies

A number of cleaner technologies have been developed in the area of wet processing, with relatively simple process changes or reorganisations of working procedures at one end of the scale and new dye machines and equipment for processing and re-circulating process water at the other end. The focused efforts in all of 13 cleaner technology projects have also contributed to the textile dye houses introducing “good environmental housekeeping” in the form of substitution of chemicals, techniques to reduce chemical usage, energy management, water conservation, etc.

Reduction in resource usage

The cleaner technology strategy in textile wet processing has also led to a total concept for the reduction of environmental problems and has, on a demonstration basis, paved the way for the development of wastewater-free dye houses. In the short term, quite significant reductions in resource consumption have been achieved, and in the longer term the trials in the Dantex project have shown that there is great potential for a 90-per-cent reduction in water usage and a 70-per-cent reduction in energy consumption and in the associated emissions.

Textile dye houses

However, membrane filtering of wastewater and re-circulation will require a “technological quantum leap” and large investments from the dye houses. The dissemination study carried out thus shows that “good environmental housekeeping” with direct economic savings is fairly well known in the sector already, while the more comprehensive water treatment technologies have not broken through – yet.

Textile printing shops

In relation to the printing shops, four cleaner technology projects have been completed which have contributed to reducing energy consumption and wastage and the use of organic solvents and PVC. For the knitting mills there has been just one substitution project.

Product-oriented projects

A few product-oriented projects have developed new tools for environmental initiatives with a general character, relevant to other branches. This is true of the logbook and supplier management project. Conversely, the EDIP-tex project is an example of making use of experience from other sectors in the textiles industry. It is difficult to give an overview of the product-oriented projects, as they have been quite diverse and have almost exclusively had the character of elucidations. Only the project on “washable suits” has resulted in actual product development, although this has not been taken further.

The leaders

A reasonably large group of leading enterprises have introduced cleaner technologies and environmental management systems and these can be expected to be interested in taking the next step to a product-oriented environmental initiative. However, the remaining enterprises are yet to get started on systematic preventative initiatives going beyond direct process optimisations of resource consumption.

The incentives

For the leading enterprises, the incentive to develop environmentally friendly textiles is clearly to gain a competitive advantage on the market. The remaining enterprises can – before that time – be expected to establish systematic preventative initiatives. The incentives for this must come from green taxes, environmental regulation (in the form of the score system, a future sector briefing), an outgoing sector organisation (with an emphasis on information and advice), etc. In other words, there is still much to be done to get cleaner technology and environmental management spread widely to enterprises in the textiles industry.

The textiles industry and the environment

It is worth noting that the elements of the textiles industry with the greatest environmental impacts have not moved abroad, but exclusively the labour-intensive elements. Danish environmental requirements have thus not prevented, for example, the operation of the dye houses, but have rather contributed to initiating an ongoing optimisation of the production process. The textiles industry has been foretold an impending demise in Denmark for several decades, but the reality has been increasing turnover, despite falling employment. This is partly because enterprises have been ready to adapt and they are good at managing cooperation with suppliers, sensing new currents and incorporating new market conditions into product development.

The challenge in the area of the environment has thus been to exploit these characteristics, both in relation to the “leaders” and the other enterprises in the sector.

Recommendations

From cradle to grave

With the introduction of the Product Oriented Environmental Initiative and the appointment of a product panel for textiles, focus has now been placed on the environmental impacts from textiles from the cradle to the grave, and on involving a broader pool of players. This evaluation provides an overview of the earlier cleaner technology strategy as inspiration for the Product Oriented Environmental Initiative in the textiles and clothing industry. The evaluation report contains elaborate sub conclusions which describe strengths and weaknesses of the earlier strategy in more detail.

Cleaner textiles and more involved players

Changing from cleaner production to cleaner products and expanding the earlier pool of players cannot be avoided. But at the same time, there is reason to point out that the earlier projects ought to be pursued to their logical conclusion. Over DKK 15 million has been invested in projects directed towards the use of water, chemicals and energy in the textile dye houses, so the Environmental Protection Agency ought to assess, in cooperation with the other involved parties, how the dissemination and application of these cleaner technologies can be ensured via an increase in information initiatives, the initiation of economic schemes relating to environmental investment and/or via regulatory pressure.

In addition, the following recommendations can be highlighted based on experience from the earlier cleaner technology projects in the textiles industry:

1. Active involvement of enterprises

The projects have to be “owned” by the enterprises rather than the consultants, so that the enterprises are not reduced to data suppliers, and so that the project results find direct practical application. Networks, experience exchange (ERFA) teams, etc., can ensure the exchange of experience along the way between enterprises, and integrate knowledge acquisition with practical application in individual enterprises.

2. Development and dissemination as an integrated process

Rather than first carrying out a development project and then disseminating the results to the rest of the sector afterwards, process and product development should be seen as a distributed process involving a number of different players. There is reason to assume that the more parties who participate actively in dialogue and cooperation in relation to development projects, the better communication, and dissemination throughout the course of the project is ensured.

3. A range of tools

There is a need for a range of tools adapted to each enterprise’s situation and level of ambition. This flexibility must also ensure that each enterprise can easily adapt approaches and tools to their own needs and desires.

4. The balance between good environmental housekeeping and technology development

Projects aimed at good environmental housekeeping and direct results can motivate enterprises to move on to more comprehensive investments in cleaner technology. An appropriate balance between the short and long term can help maintain the interest of enterprises in investing in newly developed cleaner technologies.

5. The balance between environmental improvements and evidence

What type of evidence is actually necessary to motivate enterprises? Rather than detailed scientific evidence, it is actually practical experience from daily operations which carries conviction. The same is true of a product-oriented environmental initiative: a complete life-cycle assessment is particularly necessary if the enterprise wants to praise the product environmentally in its marketing. In many other cases, enterprises can come a long way with environmental improvements of their product in response to environmental assessments based on the life-cycle perspective and an appreciation of the important environmental impacts.

6. Broader pool of players

The earlier strategy focusing on cleaner production has been characterised by engineers and production people. A product-oriented environmental initiative demands that designers, fashion people, retailers, consumers, environment groups, educational institutions, etc. be involved much more actively.

3.2 Cleaner technology in the electronics sector

Summary of the electronics evaluation

This sub-evaluation discusses the course, results, and dissemination of the cleaner technology projects in the electronics sector. The goal of this is to document the results of the earlier strategy and draw out experience with the future Product Oriented Environmental Initiative in mind. The evaluation report has been produced based on literature studies and interviews with relevant enterprises and consultants. Its contents and conclusions are summarised below.

The cleaner technology projects

The problem

In recent years, there has been increased focus on the environmental impacts of electronic products throughout their entire life-cycle, whereas the earlier focus was predominantly on each enterprise's production processes. These products contain a number of different materials, with the result that both choice of materials and disposal are important phases. Many of the frequently used materials are harmful to the environment and health when incinerated or deposited, and several materials are produced from non-renewable and limited resources. Waste management can also be difficult, since electronic products are often constructed in a way that makes it difficult to reclaim materials. Electronic products also have a relatively high environmental impact during the use phase. This is due to the fact that electronic products consume electricity during operation and also have a not insignificant consumption on standby.

Projects in electronics

The cleaner technology strategy in the electronics sector has consisted of seven completed projects, with funding of almost DKK 7.4 million in the period 1993-97. The projects have, on the whole, focused on how environmentally friendly electronics products are – in terms of choice and design, production of printed circuit boards, component mounting and cable production. The seven projects carried out were:

- Setting forth guidelines for producing sustainable electronic products, project phases 1-3 (E1)
- Setting forth guidelines for producing sustainable electronic products, project phases 4-5 (E2)
- Environmentally sound component choices for the realisation of cleaner technology in electronic production (E3)
- A cleaner environment in the electronics sector using conductive adhesives (E4)
- Electrical and electronic products – collection and disposal (E5)
- The development and establishment of an environmental database on cleaner technology, recycling and waste management (E6)
- Optimisation of PVC-free materials for use in cables and associated building installations (E7)

In addition, there are three projects which were commenced in 1997 and which have not yet been completed. These are:

- A cleaner environment in the electronics sector using conductive adhesives. Product consequential analysis of environmentally-optimised adhesive variants (E8)
- Project silver (E9)
- Environmental specifications for electronic, tele, and data products (E10)

Perception of the outcome of the projects

Initiative takers and coordinators

For the completed projects, in all cases, consultants have played a role in taking the initiative for the projects. The motivation on the part of the enterprises has primarily been expectations of government regulations and the opportunity to be on the leading edge of development in the area of the environment. For the projects not yet completed, enterprises have taken the initiative in two of the three projects. Enterprises have co-ordinated the projects in half of the total of ten projects.

Barriers

All enterprises and consultants have had positive perceptions of the projects and there have been few barriers to carrying out the projects. One of the most significant barriers highlighted by the consultants has been uncertainty in the enterprises towards technological changes. In some cases it has been difficult to obtain environmental data for use in environmental assessments, partly due to supplier unwillingness. One of the projects was also affected by the fact that one of the enterprises involved went bankrupt.

The result of the projects

Good results

Several projects have resulted in experiments being done with other materials and processes in the Danish electronics industry. Where this has not been the case, the projects have given enterprises a better basis for product-oriented environmental initiatives, for example, by giving good advice for environmentally friendly design and by establishing a data foundation for the environmental assessment of electronic products. The strategy has predominantly been aimed at trying out environmental assessment as a method, and this has led to the acquisition of quite a lot of experience with the environmental assessment of electronic products. Environmental assessments have been employed in seven of the 10 projects, and in all but one case, the EDIP method has been used.

Lack of interest

While the results of the projects can generally be described as constructive, interest from other enterprises in the electronics sector has not been overwhelming. A seminar on simple guidelines for environmentally friendly electronic products received no support, and there has also only been limited interest in an information database on cleaner technology, recycling and waste management in the electronics sector. This is in a context where disposal is often found to be one of the most important phases in life-cycle assessment of electronic products. It can also be questioned whether enterprises are interested in the results of an environmental assessment if they feel that the environmental impact from their products is so significant that it would lead to bad publicity.

Dissemination to the rest of the sector

Environmental profile of 20 electronics enterprises

In the dissemination study, attitudes towards and knowledge of the environment were investigated in 20 electronics enterprises. The environmental profile of the enterprises can be summed up as follows: only a few had an environment policy, less than a third placed environmental demands on their suppliers, and one quarter had introduced some form of environmental management. There was generally good awareness of cleaner technology among the enterprises, but knowledge of the cleaner technology projects was relatively limited. However, there was widespread knowledge of conductive adhesives. The project on conductive adhesives involved a comprehensive communication effort, but even so it cannot be concluded that the sector's knowledge of this technique is only due to this project. The technology itself has been known for a long time, but there has not been a focus before on the environmental gains of replacing solder with conductive

adhesive, which was the purpose of the project. A Nordic project on conductive adhesives has also been carried out in the same period.

The environment not a competition parameter

The majority of the enterprises did not feel that customers in the electronics sector placed emphasis on the environment, and the environment was therefore not seen as a competition parameter. Two out of five enterprises felt that customers placed absolutely no emphasis on the environment, and a further one quarter described the interest as limited. The environment as a competition parameter in the electronics industry seems therefore, at the time of the investigation, to be relatively far off – which might have contributed to the limited interest in environmental assessment of the enterprises' products.

Conclusions and recommendations

Product-oriented angle

The cleaner technology projects in the electronics sector have been characterised by the fact that most have had a product-oriented angle. Quite a lot of experience has thus already been gained in this area – though primarily in the form of knowledge about the application of environmental assessment methods to electronic products. The most significant experience in this connection has been that data collection is a time-consuming and difficult process for complex electronic products.

Limited dissemination

The investigation into awareness of the cleaner technology projects suggested that there was limited interest in the results of the projects from other enterprises in the electronics sector. This lack of interest can partly be blamed on the limited demand for environmentally friendly products from the electronics industry. The dissemination study also showed that enterprises only see the environment as a competition parameter to a limited extent.

The foundation has to be strengthened

The result of the dissemination study showed that efforts are still required to stimulate enterprises to undertake systematic environmental initiatives based on cleaner technology in production and/or an environmental management system. The question can also be raised about the extent to which the sector is ready to employ the guidelines developed with the aim of integrating environmental considerations into product development. There are enterprises in the sector which are now, or will in the near future, be capable of implementing a product-oriented environmental initiative, but which appear to have reservations about how well new materials, techniques and tools can lead to improvement of their products.

On the basis of the conclusions of the evaluation, the following recommendations can be made:

1. Greater dissemination and broader communication efforts

Communication

The dissemination study showed that the results of the projects were only disseminated to a limited extent, which was partly due to a lack of interest from enterprises in the sector. Experience and results will need be disseminated to an even greater extent in order for the “power of example” to motivate other electronics enterprises to increase their environmental effort. This could, for example, be achieved by initiating a sector project so that increased knowledge is generated about how a product-oriented environmental initiative can be boosted in the electronics industry. After this, a communication project could ensure that tools and experience are disseminated to the right groups of enterprises and players. In this regard it is important that communication is not only aimed at the technical employees in enterprises, but also towards management and other professional groups.

Environmental data

2. Shared environmental data – an essential foundation

Several cleaner technology projects have focused on providing environmental data to the Product Oriented Environmental Initiative, but updating has been suspended due to limited interest from enterprises. It is important to have a common, accessible data foundation available when enterprises are ready for a product-oriented environmental initiative. Time-consuming and labour-intensive data collection must be seen as a significant barrier to using life-cycle assessment, especially in smaller enterprises. There is, therefore, good reason to support updates and extensions to environment databases which can provide a shared foundation for environmental assessments. This is particularly important in an electronics sector characterised by innovation and growth, since this leads to the data foundation becoming relatively quickly obsolete and incomplete.

In this sector there also has to be a focus on the components' environmental impacts. It should be possible to extend the technically oriented component datasheets to include environment data, so that customers can more fully take environmental considerations into account in their choice of suppliers.

3. Test the tools in small and medium-sized enterprises

The needs of small enterprises

The Product Oriented Environmental Initiative in the cleaner technology projects has focused on environmental assessment methods which have been developed and tested by relatively large enterprises. The degree to which the tools developed can be employed by small and medium-sized enterprises needs to be tested; and the tools will need to be adjusted based on this experience.

4. Environment policy, goals, and action plans as a launch platform

A platform

Strengthening the work of electronics enterprises with cleaner technology and environmental management could create better conditions for a product-oriented environmental initiative. The advantages of environmental management are that the environmental initiatives are systematised and focus on ongoing improvements and organisational anchoring in the form of management commitment and employee engagement. However, there are examples of enterprises which have started with a product-oriented environmental initiative and have achieved the same advantages.

Regardless of the angle of approach, environment policy, environment goals, and action plans provide the foundation for a systematic environment strategy and are also the main elements of environmental management. The dissemination study showed that just a handful of the 20 enterprises questioned in the electronics industry had such a foundation. Changing this will require, among other things, a greater communication effort from the business associations, local authorities, etc.

5. Trials of methods in specific development situations

Implementation

The cleaner technology projects in the electronics sector have been based on trials of environmental assessment methods on "test products". This has provided a great deal of useful experience, but future projects must focus on the design and development of environmentally friendly products based on the needs of enterprises. This can be ensured by having enterprises take initiative for the projects and coordinate them. Support must be given to implementation projects in which the methods are employed in enterprises as part of normal product development, and where the environment is considered along with other parameters such as functionality, design, quality, etc.

*Environment project
no. 504, 1999*

Arne Remmen, Brian Dalby Rasmussen & Jette Egelund Holgaard: Cleaner technology in the electronics sector. Environment project 504, the Danish Environmental Protection Agency, the Ministry of the Environment and Energy, 1999.

3.3 Cleaner technology in the transport sector Summary of the transport evaluation

The purpose of this sub-evaluation has been to discuss the course and results of the cleaner technology projects in the area of goods transport, with the aim of documenting the results from the strategy in the area to date and drawing out experience relevant to the future Product Oriented Environmental Initiative. The report has been produced based on literature studies and interviews with relevant enterprises and consultants. It has also been found appropriate to supplement the study with experiences from cleaner technology projects in the area of passenger transport. The report's contents and conclusions are briefly summarised below.

The cleaner technology projects

The problem

Goods are primarily transported by ship, rail, or motor lorry. One of the significant environmental problems associated with transport is CO₂ emissions, with ocean and rail transport often having an advantage over motor lorry transport. However, domestic goods transport in Denmark takes place using motor lorries as the preferred means of transport, since this form of transport is flexible and also often cheaper for an individual enterprise.

Perspectives

There are several initiatives underway in the area of goods transport which seek to reduce the environmental impacts from this sector, for example environmental management handbooks for both buyers and transport providers. The Danish Environmental Protection Agency appointed a product panel for goods transport at the end of 1998. The panel is one of three product panels and aims to initiate a number of activities to promote a reduction in environmental impacts from goods transport. It can therefore be expected in the future that enterprises with external transport activities, carriers and vehicle manufacturers will gain a greater focus on transport in a life-cycle perspective. This will also take place with involvement from sector-oriented organisations such as Railion Denmark, the Danish Shipowners' Association, the Danish Road Haulage Association, and the Association of Danish Export Hauliers.

Projects in the area of goods transport

The cleaner technology strategy in the area of goods transport is part of the earlier environmental strategy in this area. Funding of just over DKK 2 million has been allocated to five cleaner technology projects for goods transport in the period 1993-97. The projects were:

- Eco-labelling and transport
- The environmental advantages of coaster transport compared to land transport
- The environmental impact of moving goods transport from land to sea
- Analysing the air pollution from marine engines with the aim of developing more environmentally-friendly engines
- Development of tools for assessing and choosing ferry types based on a life-cycle perspective

Projects in the area of passenger transport

Only relatively few cleaner technology projects have been carried out in the area of goods transport. In order to be able to make recommendations for the future Product Oriented Environmental Initiative we have therefore supplemented the study with the cleaner technology projects completed for passenger transport in the period 1993-97.

The following six relevant projects were carried out, with funding of just over DKK 2.8 million:

- The development of environmentally friendly oil burners for busses, etc.
- Life-cycle assessment of automobiles (preliminary project)
- Environmental considerations related to the purchase, operation, maintenance and disposal of automobiles (main project)
- Life-cycle assessment of busses (preliminary project)
- Environmental improvements to busses (main project)
- Development and testing of a prototype solar hybrid vehicle

Environmental awareness resulting from the projects

*Environmental awareness
– an important output*

The projects in the area of goods transport have created knowledge focusing on the link between the environment and goods transport. This has contributed to greater environmental awareness in the area. However, this environmental awareness has only been anchored to a limited extent in the enterprises participating in the projects. The only project where enterprises have participated as something more than data suppliers was the project “Analysing the air pollution from marine engines with the aim of developing more environmentally-friendly engines”. This was also the only project where there was actual cooperation with parties outside the enterprise, consultant, and monitoring group. As far as the other projects are concerned, the results and the associated environmental awareness have only been spread via the final report.

In the projects relating to passenger transport, there are more examples of environmental awareness being anchored in the enterprises. In the majority of cases, the environmental work of the enterprises has been in focus, with enterprises having responsibility for most of the projects.

Perception of the outcomes of the projects

*Few enterprises in
goods transport projects*

Generally, both enterprises and consultants consider that the projects in the area of goods transport to have had positive outcomes. The most significant barrier for enterprises was that they were too little involved and for too short a time, and a few consultants point out that it will be a long process to change the environmental awareness of enterprises regarding transport.

*Enterprises active in the area
of passenger transport*

There have not been signs of similar barriers in the projects for passenger transport. This might be because those involved in most of the projects already had a long history of cooperation even before the projects were initiated.

The Product Oriented Environmental Initiative

*Limited product focus in
the goods transport projects*

Product-oriented initiatives have been limited in the projects for goods transport. However the project, “Analysing the air pollution from marine engines with the aim of developing more environmentally-friendly engines” has resulted in more environmentally friendly engines for ferries. The project on “The environmental impact of moving goods transport from land to sea” has also focused on how enterprises can environmentally optimise their external transport activities by choosing other routes and forms of transport.

No projects have focused on how transport providers could provide a more environmentally friendly service. Neither have any projects developed

*General product initiatives
in passenger transport*

guidelines for environmentally friendly purchasing of transport services or environmentally friendly use of transport methods in goods transport.

In the area of passenger transport there has been greater focus on the Product Oriented Environmental Initiative. The projects can basically be divided into three types:

- One preliminary and main project has focused on life-cycle assessment employing a detailed method for the environmental assessment of busses.
- One preliminary and main project has focused on life-cycle assessment employing a short-cut calculation, experience, and relevant literature, with the aim of providing recommendations for public procurement of vehicles.
- Two projects have focused on the direct sources of environmental problems with an existing product, and are developing cleaner products based on this analysis – a solar hybrid vehicle and an oil burner.

In the first project above, participation by the enterprise has been erratic, as the product went out of production during the long process of carrying out a detailed life-cycle assessment. However, the project has resulted in a number of proposals for environmental improvements to busses, jointly prepared by the enterprise and consultant. With reference to the future Product Oriented Environmental Initiative, the other projects are examples of how “common sense” and life-cycle-based “qualified guesses” can provide a basis for the development of more environmentally friendly products or “environmentally sound” purchasing. The projects in the area of passenger transport have thus methodically covered a general approach to the Product Oriented Environmental Initiative, from “common sense” to detailed life-cycle assessments.

Recommendations

On the basis of this report’s conclusions, the following recommendations can be drawn for the ongoing environment work in the area of goods transport:

- Get the enterprises’ environment work into the centre for the Product Oriented Environmental Initiative, and let this provide the basis for general involvement of relevant players in the sector, including transport purchasers, carriers and vehicle manufacturers.
- Support enterprises in the work of analysing the environmental impacts of transport, since neither green accounting, environmental management, nor life-cycle assessments have generally led to greater priority on the environmental impacts from transport in enterprises’ environment work.
- As far as possible, use as a basis products expected to remain in production long term and/or which represent a product family so that the results can be used widely in the sector, including across the division between goods and passenger transport.
- Maintain balance in the Product Oriented Environmental Initiative so that there is still room in future for both common sense and life-cycle based “qualified guesses”, on an equal footing with detailed life-cycle assessments. In each case it is necessary to look at the goal of the assessment and the enterprise’s situation when choosing a specific method.

Environment project 505, 1999 Arne Remmen & Jette Egelund Holgaard: Cleaner technology in the transport sector. Environment project 505, the Danish Environmental Protection Agency, the Ministry of the Environment and Energy, 1999.

3.4 Cleaner technology via product and analysis projects Summary of the product evaluation

The purpose of this sub-evaluation is to present and assess the outcomes and results of 35 projects in the category of product and analysis projects, carried out under the action plan for cleaner technology 1993-97. One primary aim of the report is to gather together experience from the activities carried out with the future Product Oriented Environmental Initiative in mind.

In connection with this evaluation, distinction has been made between enterprise projects, which are typically based on the work of one or more enterprises with specific product development, and elucidation projects in which a consultant firm elucidates the situation relating to a sector or a product.

Data foundation

The background for the report and its conclusions is an analysis of case documents (applications, recommendations and reports) and interviews with relevant enterprises and consultants.

Characteristics of the projects supported

A total of over DKK 36 million has been allocated to support the 35 projects. Most projects received support of less than DKK 1 million (25), while two projects received support of over DKK 5 million. It has been outside the scope of this analysis to assess whether such an allocation of funding, whereby two projects have received about 33 per cent of the total resources, is appropriate from an environment perspective.

Project outcome

Just over one quarter of the projects did not proceed as the interviewed project managers had expected – a common explanation for this being lack of time. One cannot rule out the possibility that more projects would have attained tangible results if there had been greater agreement between the actual workloads and the goals set.

Enterprise projects proceeded

There is a clear relationship between whether the projects were elucidation or enterprise projects, and whether they continued after support ceased. The enterprise projects continued to a much greater extent than the elucidation projects.

Environment funding as business support?

In the assessment of the project managers, six of the enterprise projects completed and one of the elucidation projects, together representing 15 per cent of the total funding allocated, would have been carried out in any case. On the one hand, it can appear to be of concern that the limited funding resources were used on projects which would have been carried out anyway. Such funding, from a narrow perspective, would have to be characterised as business support. On the other hand, such funding can speed up the product development process and mean greater publicity for the results achieved – and hence better opportunities for dissemination of the cleaner technologies/products developed.

From cleaner processes to cleaner products

One of the main aims of the action plan for cleaner technology was to shift the focus from processes to products. This intention is reflected in about half of the projects by the involvement of life-cycle-based elements. The other half of the projects were based on common knowledge of environment factors in the sector. Of these projects, five were enterprise projects which do not mention the incorporation of environmental factors outside the producing enterprise, either in their starting point or during project execution.

Perception of cleaner products One quarter of the project managers interviewed had a narrow perception of cleaner products which was typically defined in relation to a particular problem – e.g. energy or environmentally damaging substances. This implies that in many of the projects there was a genuine lack of awareness of the Product Oriented Environmental Initiative. However, it also needs to be emphasised in this assessment that the projects were not formulated within the framework of what is today called the Product Oriented Environmental Initiative. This perspective was under development during the programme period.

Cooperation in the product chain For both project types, there was widespread lack of cooperation with other players in the product chain. This can be seen by the fact that there is typically cooperation with the early links in the product chain, while consumers, retailers, and consumer organisations are virtually completely absent as cooperation partners. A tentative conclusion is that cooperation on product development has not been expanded from the players with which enterprises normally cooperate: primarily suppliers.

At the same time, a surprising number of enterprises point to increased cooperation in the product chain as a significant result. This must be interpreted as an alarmingly narrow perception of ‘the product chain’.

Exploitation of the market dynamic The participating enterprises can generally be described as environmental leaders. Many name the environment as an important parameter in product development, and even more indicate that they make use of the environment in their marketing. The majority of the enterprises also indicate that they plan to market the results of the projects as environmentally sound products – or already do so. Even though eco-labels only seriously began to be developed during the period of the programme, it is still thought provoking that the enterprises are not more aware of exploiting the opportunities for eco-labelling.

One project has especially led the way, as this project tried out other approaches for the integration of environmental considerations into product development and for raising awareness of a product’s environmental properties.

Results

Implementation in product development Of the projects investigated, over half, or 20 out of 35, resulted in a marketed product (6) or the production of a prototype (14). Of these 20 products, the assessment was that half will have higher production costs than comparable products, while four will have unchanged production costs, and four will have lower production costs.

Of the 14 projects developing a prototype, eight have more or less concrete plans for marketing and two are developing products that are also expected to be marketed. All in all it can thus be expected that at least half of the projects will result in marketed products in the short term.

Only two enterprise projects state that they only resulted in product descriptions. These limited results appear to be due to a combination of the fact that product development is an exploratory, learning process, for which the practical barriers along the way cannot be foreseen, as well as problems related to the actual coordination of the project management.

Environmental results In the environmental arena, most enterprises believe that the projects will have positive consequences in the form of reduced air pollution (13 of 23), while just over half this number believe that the environmental effects will be in relation to waste and wastewater.

If one considers the basis for these environmental improvements, there is an overrepresentation among the enterprises investigated of initiatives in the form of more complex substance substitutions and changes to process technology. This is an indication that the easy environmental gains have already been harvested and that the time has now come for more demanding initiatives – and hence the need for funding.

Anchoring of knowledge

There is a weak tendency for the more general environmental knowledge attained through the projects to be predominantly anchored with the manufacturers. On the one hand this is very good, since it is where the development processes take place, but on the other hand it can also be a barrier to the dissemination of this knowledge since, to a certain extent, these enterprises may keep this knowledge relatively close to their chests, in line with the environment becoming a competition parameter. Conversely, the consultant enterprises, all things being equal, due to their function and their range of contacts would have to be seen as having an interest in serving to disseminate knowledge.

Funding has influenced technological development

The results of the projects have not yet spread to other enterprises. One explanation for this might be that these are technological developments which were not otherwise on the way within the sectors, and that the other enterprises have not yet had time for the adjustment process. Against this background, the funding, in itself, can predominantly be considered to have promoted development, even though many of the projects, as already mentioned, would have been carried out in any case.

Funding was spread across many sectors

It was noted that the individual projects were spread across a relatively large number of individual sectors. As a result there is limited opportunity for synergy effects within the sectors which could contribute to more effective dissemination of the results. However there was one clear exception — two sub-projects which together gathered all or significant parts of a sector's manufacturers. In these cases this cooperation was highlighted as being a very positive result, and in terms of dissemination, almost ideal.

Difficult to evaluate results of the elucidations

It can be difficult to assess the results of the elucidation projects, as their effects will first be felt in the longer term compared to specific product development projects. Those projects, which directly contribute with tools to be used as a basis for making environmental decisions, are an exception.

Recommendations

Based on the evaluation, the following summary recommendations can be made for the future strategy in the product area:

- that in future, projects more explicitly incorporate a life-cycle perspective – either in the form of a full life-cycle assessment/screening or intensified cooperation between players in the product chain.
- that greater efforts be made to ensure that participating enterprises in product projects also understand the fundamental concepts in this strategy.
- that future projects more consciously work in dialogue with the later links in the product chain, such as customers, consumers, and the waste and transport sectors.
- to support projects which work on developing methods for customer and consumer-oriented dialogue and communication.
- to continue to strengthen the work on developing eco-labelling criteria and seek in future to stimulate the supported enterprises to have an active relationship to the official eco-labels.

- that an analysis be made of the relationship between a project's environmental gains in the shorter and longer term and the amount of funding received, for a large group of projects.
- that a more thorough assessment of whether projects can be practically completed within the set framework be undertaken when allocating funding.
- that methods be developed to assess whether or not a given project expresses a development which would have taken place in any event, with the aim of achieving better management of funding resources.

*Environment project
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