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Environmental Assessment of Product Concept for Electronic Products

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Contents

PREFACE 5

SUMMARY AND CONCLUSIONS 7

SAMMENFATNING OG KONKLUSIONER 9

1 INTRODUCTION 11

1.1 BACKGROUND 11
1.2 PURPOSE 11
1.3 TARGET GROUP 12
1.4 PARTICIPANTS 12

2 PROJECT COURSE 13

2.1 PHASE 1: NEEDS ANALYSIS 13
2.2 PHASE 2: DEVELOPING A DRAFT METHOD 13
2.3 PHASE 3: WORKSHOPS 13
2.4 PHASE 4: IMPLEMENTATION OF CHANGES AND INTEGRATION IN THE ECO-DESIGN GUIDE 14
2.5 PHASE 5: DISSEMINATION 14

3 METHOD FOR ASSESSMENT OF PRODUCT CONCEPTS 15

3.1 GOAL DEFINITION 15
3.2 SCOPE DEFINITION 16
3.2.1 Functional unit 17
3.2.2 Analysis of interested parties 17
3.3 INVENTORY ANALYSIS 19
3.3.1 Product Characteristics 19
3.3.2 Evaluation of alternative technology 20
3.3.3 Evaluation of competitor's products 21
3.3.4 Market analysis 21
3.3.5 Legislation 23
3.3.6 End of life 23
3.4 IMPACT ASSESSMENT 23
3.4.1 SWOT analysis 23
3.4.2 Setting up targets and objectives for the product specification 24

4 THE ECO-DESIGN GUIDE 26

4.1 BACKGROUND 26
4.2 PURPOSE AND TARGET GROUP 26
4.3 CONTENT 26
4.3.1 Green Tutorial 26
4.3.2 Implementation of Eco-Design 27
4.3.3 Assessment of product concepts (present project) 27
4.3.4 Eco-Design Guidelines 27
4.3.5 Environmental Calculators 27
4.3.6 Hazardous Chemicals 27

5 REFERENCES 29

Preface

This report summarises the results from the project: ”Environmental Assessment of Product Concept”.

The Institute for Product Development has been project manager and three Danish electronic companies have participated. These are Tellabs Denmark A/S, Sauer-Danfoss ApS and Focon Electronic Systems A/S.

The results from this project have been integrated in the tool ***“A Designer's Guide to Eco-Conscious Design of Electrical & Electronic Equipment”*** (Eco-design Guide) [1], as this tool is already familiar to a great number of Danish electronic companies.

This tool integrates the results of several projects focusing on the environmental aspects of electrical and electronic equipment seen in a life cycle perspective. In addition to the present project, results from the following projects have been reported and disseminated with the Eco-design Guide:

- Design principles and guidelines for environmentally conscious electrical- and electronic equipment [18]
- Environmental Data for electronic components and parts [18]
- Integration of recycling and disposal in the design of electrical- and electronic equipment [19]

The project was funded by the Danish EPA (Miljøstyrelsen) under the “Programme for cleaner products etc”.

Summary and conclusions

A simple method for environmental assessment of electronic products at the very early stage of product development has been developed. This methodology focuses on the concept level since experience has demonstrated that the choice of concept most often has a decisive influence on the environmental impact caused by the product in its life cycle.

It is therefore beneficial to invest some time in evaluating the environmental aspects of different possible alternative concepts bearing in mind that this has to be a rough estimate.

On the basis of several previous projects about environmental assessment of electronic products, it can be concluded that:

- As regards electronic products where energy consumption is based on a central power supply, the energy consumption in the use phase is almost always an important factor in environmental impact during the life cycle.
- Many electronic products consume a considerable amount of energy in standby mode, and that this holds a great potential for improvements that are easy to achieve.
- It is important to avoid sub-optimization. This is especially important for products that act as a part of a large system. For example an automatic valve that controls the energy consumption of a large refrigeration plant can not only be assessed by focusing on the valve itself. If you include the energy consumption of the entire system you will probably conclude that you could accept a higher environmental impact from the valve itself, if you can improve its functionality because this reduces the energy consumption of the overall system.
- For products that spend their "active lives" in some means of transport like an aeroplane, a train, a ship etc., you must include the energy consumption used to transport the product in the entire life span. This contribution to the environmental impact can be quite significant.

Beside the technological and the environmental aspects, marketing aspects are also evaluated. It is not sufficient to develop a product that is good seen from an environmental, technical and economical point of view. If the product does not sell, you will not have any business and society will achieve no environmental improvements.

Following this methodology will result in a number of "hot spots", which form a good foundation for proposing environmentally relevant targets for the product specification and to prioritise.

So as to support the best possible diffusion of the method and the results from this project it has been integrated in the tool ***"A Designer's Guide to Eco-Conscious Design of Electrical & Electronic Equipment"*** (Eco-design Guide), which is available at http://www.ecodesignguide.dk and http://www.elektronikpanelet.dk .

Sammenfatning og konklusioner

Der er udviklet en let tilgængelig metode til at udføre en enkel miljøvurdering af et elektronikprodukt på et tidligt stade i produktudviklingen. Erfaringen viser at valget af koncept ofte har stor betydning for det fremtidige produkts miljøbelastning, og det er derfor relevant at foretage nogle miljømæssige overvejelser omkring dette valg - selv om det i sagens natur kun kan blive på et mere overordnet niveau.

Der tages bl.a. udgangspunkt i de erfaringer, der er indvundet fra tidligere projekter om miljøvurdering af elektronik produkter:

- For produkter, som er tilsluttet det centrale elforsyningsnet, er energiforbruget i brugsfasen ofte en væsentlig miljøbelastning set over hele livscyklus.
- Mange elektriske og elektroniske produkter har et betragteligt energiforbrug i "standby mode".
- Det er vigtigt at undgå sub-optimering. Dette er særligt vigtigt for produkter som indgår som en del af et større system. Fx kan en automatisk ventil, som regulerer energiforbruget af et stort køleanlæg, ikke miljøvurderes ved udelukkende at se på selve ventilen. Hvis man inddrager kølesystemets energiforbrug i det som vurderes vil man opdage at det giver mening at acceptere en større miljøbelastning fra en ventil med en forbedret funktionalitet, hvis dette betyder en forbedret drift af køleanlægget og dermed et mindre energiforbrug af det samlede system.
- For produkter som tilbringer deres "aktive liv" i et transportmiddel (fx et tog, fly, skib el. lign.), skal du indregne det energiforbrug, der medgår til transport af produktet i hele livsforløbet. Dette bidrag til miljøbelastningen kan være ganske betydeligt.

Udover de teknologiske og miljømæssige aspekter inddrages også de markedsrelevante forhold ud fra det synspunkt, at det ikke er tilstrækkeligt at udvikle et produkt, som er godt ud fra et miljømæssigt, teknisk og økonomisk synspunkt. Hvis produktet ikke kan afsættes kommer der ingen forretning ud af det, og der opnås ingen miljøforbedring.

Ved at følge metodikken udpeges en række "hot spots", som kan danne grundlag for at opstille miljømæssige målsætninger i produktets specifikationer og for det videre forløb af produktudviklingen.

For sikre en god spredning og tilgængelighed er metoden integreret som en del af ***"A Designer's Guide to Eco-Conscious Design of Electrical & Electronic Equipment"*** (Eco-design Guiden), som er tilgængelig fra http://www.ecodesignguide.dk og http://www.elektronikpanelet.dk .

1 Introduction

1.1 Background

The developments in the electronics industry have resulted in products that have more and more functions, weigh less and are increasingly smaller, giving users big advantages in the use phase. But as a consequence of the complex composition, an increasing number of new applications, shorter product life, use of hazardous substances and lack of data on the material contents, electronic and electrical equipment (EEE) constitute a threat to both man and the environment.

EEE manufacturers and their suppliers will face a number of important challenges in the near future. These are primarily the new EU directives that deal with the increasing need to design and build products in an environmentally conscious way that at the same time is still profitable, but also a need to cope with the demands and the expectations from customers and society. However it is not enough just to deal with the expectations from the immediate surroundings. You have to focus on the entire lifecycle of the product and the interested parties involved in the success of the product concerned.

Some companies might look upon these challenges as a threat to their well-established business and they might very well be right to do so. The sooner these threats are taken seriously, the greater is the chance of successfully transforming them into something useful.

Environmentally conscious product development should not be considered as a sort of charity but should be seen as a business opportunity.

1.2 Purpose

The purpose of this project is to provide a tool to perform a simple environmental assessment already at the very early stage of product development, when the product concept is being determined. At this stage no decisions have necessarily been taken concerning the physical structure of the product. Product development is often an iterative process. This definitely also applies to the environmental assessment of products. Assessment of the product concept is the first step in this process and aims at establishing the first set of environmentally relevant information about the product category and its life cycle. The life cycle also includes the market to which the product concerned has to adapt.

It is the ambition to get an overview of the environmental issues that bear relevance to the product and to acquire a basic understanding of the environmental aspects of the product and the life the product will lead once it has left the drawing board and the manufacturing facilities. On the basis of this understanding it will also be possible to set up environmental targets and

objectives for the specification of the product and the continuation of the product development process.

When the following steps in the product development process have been taken, it is quite likely that new information has been acquired that will enable adjustment of the conclusions reached from the concept phase. Sometimes it is not possible to apply this new knowledge to improve the present product, however this knowledge can be used to develop future product generations or "sister products" with similar characteristics.

1.3 Target group

The results from this project are primarily targeted at companies developing electrical and electronic equipment, and at educational institutions that teach the engineers of the future and other individuals who will be involved in the design and development of future electrical and electronic equipment.

1.4 Participants

This project has been developed by the Institute for Product Development in cooperation with the Danish companies Tellabs Denmark A/S, Sauer-Danfoss ApS and Focon Electronic Systems A/S. Products from these companies have served as cases in the development of the assessment method. An example of a draft report for a product from Focon Electronic Systems A/S has been made available on the website of the Eco-design Guide [1].

The following persons have been involved in the project:

Ole Willum, Institute for Product Development. (Project manager)
Johan C. Gregersen, Institute for Product Development

Carsten E. Thomsen, Tellabs Denmark A/S
Henrik Hangler, Tellabs Denmark A/S

Gert Lumbye Hansen, Sauer-Danfoss ApS
Lars Althof, Sauer-Danfoss ApS
Thorsten Petersen, Sauer-Danfoss ApS

Kim Petersen, Focon Electronic Systems A/S
Lars Bo Kjøng, Focon Electronic Systems A/S

2 Project course

2.1 Phase 1: Needs analysis

At the beginning of the project the participated companies were interviewed about their expectations regarding the results from the project.

2.2 Phase 2: Developing a draft method

A draft method that can evaluate the environmental issues of an electronic product has been developed. It is not been the ambition to create a new innovative methodology. In the development of this method, focus has been on:

- The needs of the participating companies
- Those circumstances that are specific for electrical and electronic products
- The integration of the methodology in the existing structure of the Eco-design Guide [1].

The objective has been to cover issues that might be quantified at a later stage in the product development procedure as well as issues that are difficult to quantify. Examples of the latter are factors like future legislation, expectations and requirements of customers, investors and other stakeholders who contribute to the success of the company and its products. Questions such as: 'does the product contain harmful materials that might be the object of public attention or in other ways attract negative attention?' and, 'what is the environmental impact of the product compared to products with similar functionality from competitors?' have been asked. The objective has been to develop a systematic approach, which ensures that all the important environmental aspects that might be relevant to the product are addressed.

2.3 Phase 3: Workshops

The draft method was discussed with the companies and the draft was revised. The revised draft was tested on the case products. This was a two-step process:

- A workshop was held at each of the participating companies. Here the initial assessment was started. After the workshop the companies completed the assessment.
- A joint workshop was held where all three companies participated. Each company presented their results and experiences from applying the method. Potential changes were discussed and consensus about the necessary changes was achieved.

2.4 Phase 4: Implementation of changes and integration in the Eco-design Guide

Based on the feedback from the joint workshop, the methodology was amended. The method was integrated into the Eco-design Guide [1] and the necessary adjustments were made.

2.5 Phase 5: Dissemination

The results of the project have been disseminated via:

A presentation for the “ITEK Miljø-ERFA” group of the Confederation of Danish Industries (DI).

An offer to give a presentation has been given to the Danish Electronics Panel (”Elektronikpanelet”).

A presentation has been held at AUC (Aalborg University) and an offer to give a presentation has been given to educational institutes in Sønderborg (University of Southern Denmark and Copenhagen (Technical University of Denmark).

The method was integrated into the Eco-design Guide and made available free of charge from the web [1]. The new Assessment method can be used directly on the web-site or the entire Eco-design Guide can be downloaded with a view to running the application from a single PC or from the company’s intranet.

3 Method for assessment of product concepts

Though this assessment procedure is much simpler to perform than a complete Life Cycle Assessment, it was considered appropriate to apply the same structure as it is specified in the ISO 14040 International Standard [2]. This structure includes:

- Goal definition
- Scope definition
- Inventory analysis
- Impact assessment

Even if the environmental assessment to be carried out is a "light version", it is considered worthwhile to define proper definitions for the goal and scope of the assessment.

This method is developed in html and is available as an interactive tool integrated into the Eco-design Guide [1]. The purpose of the following sections is merely to describe the methodology developed. For full details and reference material, see the Eco-design Guide [1].

3.1 Goal definition

When making an environmental assessment of products or product concepts, it is important to define the goals just as is the case with other projects.

This is done in order to assure that the work described in the following sections is compatible with the goals in terms of relevance and in terms of the extent of the allocated resources. The costs to perform the environmental assessment are (of course) related to the ambition level of the goals. This is illustrated by the examples below (The cost increases as you move down through the table 3.1):

Table 3.1 Different purposes for environmental assessments

Purpose of the environmental assessment	Intended audience
Sound out the situation	Internal
Compare the environmental impacts of new designs to a previous generation of the product	Internal
Use the results for environmental claims for marketing purposes	External
Prepare environmental declarations in accordance with ISO 14021 (Type II) [3]or obtain an ecolabel in accordance with ISO 14024 (Type I) [4]	External
Prepare an environmental declaration in accordance with ISO 14025 /TR (type III) [5] certified by an independent 3rd party.	External

In order to make it easier to set up specific goals, it can be helpful to begin by answering the questions below. Depending on the size of your company, the diversification of its products and its level of experience in integrated product policy, you can choose to deal with the questions covering the entire company, a part of the company or a specific product or type of products.

Task 1.1:
Does the company have an overall environmental policy in which the environmental impact of its products is referred to,, and if so, please explain?

Has the company received any enquires from customers (or potential customers) concerning the environmental performance of its products, and if so, please explain?

Have any targets been set for the environmental performance of products, and if so, please explain? This issue may have been dealt with in relation to coping with section 4.3.1.in the ISO 1400 concerning "Environmental aspects".

ISO 14001:1996 "Environmental management systems - Specification with guidance for use", Sub clause 4.3.1 states:

> The organization shall establish and maintain (a) procedure(s) to identify the environmental aspects of its activities, products or services that it can control and over which it can be expected to have an influence, in order to determine those which have or can have significant impact on the environment. The organization shall ensure that the aspects related to these significant impacts are considered in setting its environmental objectives.
>
> The organization shall keep this information up-to-date.

What is the general purpose of making an environmental assessment of the particular product?

Having dealt with these questions it should (hopefully?) be possible to define the goal by answering this last question:

Task 1.2:
What is the goal of making an environmental assessment specifically of the concept design of this product, and to who will the results be communicated?

3.2 Scope definition

Figures from an environmental assessment are often of little interest seen on their own; they do not make sense until they are used in a comparison. Typically the figures from the assessment of one product are compared to alternatives like:

- Competitors' product
- Next or previous generation product
- Different product concepts

A meaningful comparison requires defining the "functional unit" that the service, the product or the system provides to the customer.

3.2.1 Functional unit

The functional unit must include a qualitative description of the service and quantification. The quantification must specify the duration of use, including the entire life span of the product. Some examples of functional units are given below:

Table 3.2 Examples of functional units for different products

Product	Quantity	Duration	Qualities
TV	Receive and present TV programs in colour on a 28" screen	6 hours pr. day for 10 years	Sharpness of image, Quality of sound, Number of channels, Remote control features
Mobile phone	To enable telephone conversation without any physical connection to the telephone system.	30 minutes of conversation and 23½ hours stand-by pr. day for 3 years.	Low weight and volume, Long stand-by time between recharging of batteries, Indicators in the display. Etc.
Paint	Protection of 1 m^2 of fir surface on an outdoor facade, facing west and exposed to rain and sun.	10 years	Non-dripping, Colour, Durability in closed container.

For some products (especially consumer products) the category "Qualities" can be divided into several sub-categories some of which are essential for the functionality and therefore mandatory and some which are used to attract a certain fragment of the customers. This could be features like trendy design and certain games for a mobile phone.

When quantifying the environmental impact (see section 3.3.1), this should be consistent with the functional unit chosen.

By referring to the functional unit it is possible to compare different products that have different characteristics, e.g. to compare Paint A covering 20m^2/liter requiring maintenance every 5th year with Paint B covering 15m^2/liter and requiring maintenance every 8th year.

Task 2.1:
Define the functional unit for the product as described above!

3.2.2 Analysis of interested parties

The product has several stakeholders. They all have various environmental expectations of the product and they all more or less influence the success the product will achieve on the market. Some of the stakeholders have no specific relation to the product itself, but are stakeholders in the company as such (e.g. stockholders, employees, neighbours, authorities). In this context we will focus on the product/stakeholder relation even though we are fully aware of the fact that some relations are more company/stakeholder relations.

The most important interested parties are listed below. Depending on the type of product, the market situation, the employment situation etc., these parties are of varying importance.

- Internal:
  - Company management
  - Employees
  - Stockholders / Owners

- External:
  - Authorities as legislators
  - Authorities as supervisors/inspectors
  - Authorities as customers
  - Customers and their customers ("the end user")
  - Potential employees
  - Potential investors and banks
  - Insurance companies
  - The public
  - The media / press
  - Suppliers
  - Retail stores
  - Waste management – and recycling companies

The scope of this assessment at concept level is not to make a comprehensive "Product chain survey". The purpose is to spot important environmental impacts or expectations related to the product.

Task 2.2:
Fill out the list below (table 3.3) of the most important stakeholders and their relation to the product in terms of environmental impact or expectations to the environmental performance of the product!

Table 3.3 Stakeholder relations

Stakeholder	*Relation*
Company management	
Employees	
Stockholders / owners	
Authorities as legislators	
Authorities as supervisors/inspectors	
Authorities as customers	
Customers and their customers ("the end user")	
Potential employees	
Potential investors and banks	
Insurance companies	
The public	
The media / press	
Suppliers	
Retail stores	
Waste management – and recycling companies	
Others?	

3.3 Inventory analysis

3.3.1 Product Characteristics

When making a comprehensive Life Cycle Assessment (LCA), the inventory analysis consists of collecting and presenting unambiguous data about the environmental impacts of the activities related to the entire life cycle of the product.

In this case however, it is merely the exercise of establishing a list of "Environmental hot spots" based on experience and simple evaluation methods.

Experience has made it clear that the most important environmental impact from electrical- and electronic equipment can be related to:

- Consumption of energy
- Consumption of scarce resources
- Use of toxic chemical substances

The impact from chemical substances used in manufacturing and/or present in the product can be quite difficult to deal with and cover too many issues even for skilled personnel. This will be dealt with in the section "Legislation".

The consumption of energy and resources can be dealt with in a quantitative way in terms of a Primary Energy and Resource consumption (E- and R-parameter) by using the "Calculator I" in the Eco-design guide [1].

Before we get ourselves completely absorbed in these calculations it might be worth while bearing in mind some important conclusions from previous

studies of electrical- and electronic equipment. These conclusions are listed in the textbox below.

Important conclusions from previous studies of electrical and electronic equipment

- Experience from several studies (Produktfamilie projektet - The Product Family Project[20], Levetids projektet – The Life-Time Project [21], Tele Danmark projektet – The Tele Danmark Project [22]) show that for electronic products where energy consumption is based on a central power supply, the energy consumption in the use phase is nearly always an important source to the environmental impact from the life cycle.

- Many electronic products consume a considerable amount of energy in standby mode, and this holds a great potential for improvements that are easy to achieve.

- It is important to avoid sub-optimization. This is especially important for products that constitute part of a large system. For example an automatic valve that controls the energy consumption of a large refrigeration plant can not only be assessed by focusing on the valve itself. If you include the energy consumption of the entire system you will probably conclude that you could accept a greater environmental impact from the valve itself, if its functionality can be improved as this reduces the energy consumption of the larger system.

- For products that are integrated in some means of transport like an aeroplane, a train, a ship etc., you must include the energy consumption used to transport the product during the entire life span of the respective means of transport. This contribution to the environmental impact can be quite significant, and reducing the weight of the product will in itself release a considerable improvement.

Task 3.1:
Read "Important conclusions…." (above) and answer the question:
What can you conclude from this that bears relevance to the specific product?

Task 3.2:
Fill out the sheet in "Calculator I" (downloadable from [1], Download Page) for the specific product. The most important sections are Materials, Components and Energy. Do not spend time on the other sections unless you have easy access to data or have reason to believe these sections are specifically important to your product characteristics.
What can you conclude from this that bears relevance to the specific product?

3.3.2 Evaluation of alternative technology

As mentioned, at this stage in the development procedure definitive decisions concerning the physical structure of the product have not necessarily been

taken. This also applies to the technologies, materials etc. that provide the basis for product functionality.

The choice of technology most often has a decisive influence on the environmental impact caused by the product in its life cycle.

Most significant environmental improvements have been achieved by applying a “cleaner technology”.

It is therefore important to invest some time in evaluating the environmental aspects of different possible alternative technologies. The environmental impact from a product based on an alternative technology can be assessed in the same way as described above (section 3.3.1).

Task 3.3
Mention at least 3 possible alternative technologies and rank these in terms of environmental improvement potential in terms of:

- ***Energy consumption***
- ***Resource consumption***
- ***Use of toxic chemicals***

3.3.3 Evaluation of competitor’s products

Relevant competitor products can now be evaluated according to the same principles as outlined above.

Task 3.4:
Compare the 2 most significant competitor products to the specific product t in terms of:

- ***Energy consumption***
- ***Resource consumption***
- ***Use of toxic chemicals***

3.3.4 Market analysis

It is just as important to know the market as it is to know the environmental impacts of the product. If you want to develop a product with reduced environmental impact, it is not sufficient that the new and improved product is good seen from an environmental, technical and economical point of view. If the product does not sell, you will not have any business and society will not achieve any environmental improvements.

The objective of the market survey is to benchmark your product on the market focusing in particular on environmental performance.

The position of the product should be determined in relation to the present market situation and to trends for the future. Evaluation of competitor products has already provided us with important information. However, there are several other ways to estimate your position; they will be dealt with in the following sections.

3.3.4.1 Ecolabels

A product can be positioned on the market as being environmentally friendly by achieving an ecolabel. Products that have an ecolabel rank among the top 33 per cent of products on the market within a specific product group with regard to their environmental performance.

The criteria for eco-labelling are thus excellent as general trendsetters.

However, it is problematic that criteria for eco-labelling have only been established for a limited number of products and almost exclusively for consumer products. Having said that it may still be useful to study the criteria for products that have similar characteristics to the product in question.

Information about eco-labelling and which types of product criteria have been established for can be obtained from:

- The Danish Ecolabel web page (in Danish) [7]
- The European Union Eco-label Homepage [8]
- The Global Ecolabelling Network [9]

- A criteria document for eco-labelling of Printed Wiring Boards (PWB) with the Nordic ecolabel "Svanen" was issued in October 2003. In addition to the Criteria document [10] itself, background material [11] is included.

Please note that the ecolabel only applies to the board itself and not the components.

> ***Task 3.5***
> ***Ask your supplier if he/she is able to supply a PWB in accordance with the specification in the criteria document mentioned above!***

3.3.4.2 Environmental Product Declarations (EPD)

While eco-labelling mainly focuses on consumer products, environmental product declarations (EPD) address the OEM customer. The EPD is a standardised way of expressing the environmental impact from the product in its entire life cycle. The content and the applied terminology is more complex, but it is precisely this type of information OEM-manufacturers need to enable them to sum up the environmental profile of the "end-product" in the form of an EPD, as part of the documentation for an ecolabel or a life cycle assessment.

> ***Task 3.6***
> ***Check the website of the Swedish Environmental Management Council (Miljöstyrningsrådet) [12] for EPDs for products with characteristics similar to those of the specific product.***

3.3.4.3 Customer demands

Dealing with precise demands from present customers is usually not very complicated.

However coping with the expectations of potential customers at some point in the future is a somewhat more uncertain exercise.

The different guidelines for green procurement that have already been issued provide an insight into the demands of the future. The Danish Environmental Protection Agency (Miljøstyrelsen) has issued a number of such guidelines specifying their environmental expectations for different product groups.

Guidelines for environment-friendly procurement have been issued at national level [13] as well as at EU level [14].

Task 3.7:
Check the Danish EPA's website [13]for procurement guidelines for a product with characteristics similar to those of the specific product.

Assess your company/your product with regard to compliance of the requirements laid down in the guideline.

3.3.5 Legislation

Electrical and electronic equipment has caught the authorities' attention, primarily because of the rising amounts of waste and the disposal problems linked to these products.

As a consequence of this since the early nineties much attention has been given to legislation in this area, starting in Germany, Denmark, The Netherlands, Sweden and Norway, as well as at EU level.

Regulations are primarily concerned with:

- Establishing collection systems and securing correct handling of waste, i.e. recycling and regaining resources
- Safe separation and disposal of environmental hazardous parts
- Certain hazardous substances which will either be banned or restricted in use.

The regulations also introduce producer responsibility with regard to the disposal of these products and require that the producer provides the recycler with information about e.g. the content of environmentally hazardous parts and possibilities for recycling.

Task 3.8:
Read the WEEE- and RoHS directives [15], [16] & [17] and consider if these trigger any ideas for setting targets for product specification.

3.3.6 End of life

The End-of-life will not be dealt with in any further detail at this stage. End-of-life is dealt with in the Eco-design Guide [1], section "Eco-Design Guidelines /End-of-life".

3.4 Impact Assessment

3.4.1 SWOT analysis

SWOT means Strength, Weaknesses, Opportunities and Threats. This can be related to the existing review in the concept phase. This methodology addresses these four themes in each of the life cycle phases of the product.

Task 4.1:
Use the table below to enter relevant conclusions from the previous sections..

Table 4.1 SWOT analysis matrix

SWOT-screening	*Material phase*	*Manu-facturing phase*	*Use phase*	*End-of-life*	*Transport phase*
Strength					
Weaknesses					
Opportunities					
Threats					

After having done this, consider any other relevant input to each box in the matrix.
Finally check if any important conclusions from the previous sections (that might not fit in the matrix) are missing. If so write them down outside the matrix.

When this task has been completed, you will have identified the "hot spots" for your product!

3.4.2 Setting up targets and objectives for the product specification

By prioritizing the options for possible target settings you should evaluate the individual issues by regarding the significance for the environmental impact and your company's influence on the particular issue. See the figure below.

Task 4.2:
Place each of the "hot spots" from Task 4.1 in the matrix below:

Table 4.2 Significance / Influence matrix

	High significance for the environment	Low significance for the environment
High influence of the company		
Low influence of the company		

By following the procedure described above the product development team will have acquired a basic understanding of the environmental aspects of the product seen over the entire life span. On the basis of this understanding it is possible to set up environmental targets and objectives for the specification of the product and the continuation of the product development process.

This general knowledge and the conclusions summarised in table 4.2 constitute a good foundation for proposing environmentally relevant target settings for the product specification. These proposals for environmentally relevant target settings can form a part of the overall prioritising in the product development procedure.

At this stage one might also have discovered environmental issues that are not sufficiently clarified. Thus the knowledge acquired will also serve as a basis for decisions about e.g. an in-depth environmental assessment of one or more specific issues.

A draft report has been prepared based on this Assessment Procedure for a product from Focon Electronic Systems A/S, Denmark. [1], Download page.

4 The Eco-design Guide

A main objective in the diffusion of the results of the project has been to integrate the method into the tool ***"A Designer's Guide to Eco-Conscious Design of Electrical & Electronic Equipment"*** (Eco-design Guide) [1]. This tool is already familiar to a large number of Danish electronic companies.

4.1 Background

The Eco-design Guide has been developed in Denmark in cooperation between:

- The Institute for Product Development (IPU)
- Danish Toxicology Centre (DTC)
- GN-Teknik

Danish companies in the electronics industry, especially Ericsson Diax A/S, Grundfos A/S, Kamstrup A/S, H.J.Hansen Elektromiljø A/S, Tellabs Denmark A/S, Focon Electronic Systems A/S and Sauer-Danfoss A/S have been involved in both setting up the requirements and the final testing.

The guide integrates the results of several projects focusing on the environmental aspects of electrical- and electronic equipment seen in a life cycle perspective.

4.2 Purpose and target group

It has been the objective to cover all the needs in a company that has decided to make improvements with regard to the environmental aspects of its products, and to have this as an ongoing standard activity in the development process. Such an activity is normally referred to as "Design for Environment (DfE)" or "Eco-conscious Design" or just Eco-design.

This guide is aimed at all individuals involved in the design and development of electrical and electronic equipment, for example:

- Personnel from management and marketing
- Engineers (mechanics, electronics, software etc.)
- Quality/environmental specialists

4.3 Content

4.3.1 Green Tutorial

This section is meant to be the designer's first introduction to environmental issues within electrical and electronic equipment. It provides the reader with a basic understanding of how products in general interact with the environment

and why it is necessary to take environmental issues into account when developing electrical and electronic equipment.

4.3.2 Implementation of Eco-Design

The section outlines the tasks and responsibilities involved in Eco-Design, and it offers some examples of how to choose and measure environmental metrics.

4.3.3 Assessment of product concepts (present project)

The purpose of this section is to provide a tool for simple environmental assessment already at the very early stage of product development, when the product concept is being determined.
It is the ambition to outline in general those environmental issues that bear relevance to the product and to acquire a basic understanding of the environmental aspects of the product and the life the product will lead once it has left the drawing board and the manufacturing facilities.

4.3.4 Eco-Design Guidelines

The guidelines cover all the standard environmental aspects of electrical and electronic equipment (materials, production, use-phase, end-of-life), and give advice on how to minimise the environmental impacts from such equipment. They also contain information about specific requirements in legislation and various environmental labelling schemes.

4.3.5 Environmental Calculators

A core function of the Eco-Design guide is a module of “Environmental Calculators”. These Environmental Calculators enable the designer to compare the environmental impacts from the entire life cycle of different design alternatives. This can be done already in the concept phase, where very few data are available and again before the design is finalised.
These calculations are based on a database where values represent a simplified environmental impact assessment and where no more than two selected parameters are used to describe the impacts. One of the parameters is the Energy parameter, representing the total primary energy used. The other is the Resource parameter, representing the resource depletion involved.

There are three calculators in the tool:

- Calculator I is intended - with a minimum of effort - to give a very rough overview of the environmental aspects of the life cycle of a product.
- Calculator II can be used to make a more detailed assessment and material declarations based on generic life cycle inventory data for electronic components.
- Calculator III can predict the consequences of different end-of-life scenarios based on the design of the electronic product. Key-values for end-of-life can be calculated.

4.3.6 Hazardous Chemicals

This section gives inspiration on how metrics for reduction of dangerous chemicals / substances can be set when developing new products. It contains

"Tools for identification of listed chemicals" and simple tools for prioritising your efforts regarding chemical substances.

The Danish EPA (Miljøstyrelsen) has funded the development of the Eco-design Guide, and it is available free of charge from:

http://www.ecodesignguide.dk or from http://www.elektronikpanelet.dk .

5 References

1 A Designer's Guide to Eco-Conscious Design of Electrical & Electronic Equipment (2004). Web-address: http://www.ecodesignguide.dk or www.elektronikpanelet.dk

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3 ISO 14021:1999, Environmental labels and declarations -- Self-declared environmental claims (Type II environmental labelling)

4 ISO 14024:1999
Environmental labels and declarations -- Type I environmental labelling -- Principles and procedures

5 ISO/TR 14025:2000, Environmental labels and declarations -- Type III environmental declarations

6 ISO 14001:1996, Environmental management systems -- Specification with guidance for use

7 Danish Eco-labelling secretariat (Miljømærkesekretariatet): www.ecolabel.dk

8 European Union Eco-label Homepage (The Flower)
http://europa.eu.int/comm/environment/ecolabel/index.htm

9 Global Ecolabelling Network: www.gen.gr.jp

10 Criteria document for printed wiring board (2003):
http://www.svanen.nu/DocEng/085e.pdf

11 Background for ecolabelling criteria for printing wiring boards (2003):
http://www.ecolabel.dk/pdf/Svanen/85/uk/Background memo for printing wiring boards.pdf

12 The Swedish Environmental Management Council (Det svenske Miljöstyrningsrådet): http://www.environdec.com/

13 Offentlige grønne indkøb (Public Purchasing):
http://www.mst.dk/produkt/05000000.htm (in Danish)

14 Public Procurement in the EU:
http://www.europa.eu.int/comm/internal_market/en/publproc/general/environment.htm

15 Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE): http://europa.eu.int/eur-lex/pri/en/oj/dat/2003/l_037/l_03720030213en00240038.pdf

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