IHOBE
Sociedad Pública Gestión Ambiental

A PRACTICAL MANUAL OF ECODESIGN

Procedure for implementation in 7 steps

EUSKO JAURLARITZA — GOBIERNO VASCO

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DEPARTAMENTO DE
ORDENACIÓN DEL TERRITORIO,
VIVIENDA Y MEDIO AMBIENTE

Experts' opinions on the "Practical Manual of Ecodesign. Implementation in 7 steps".

Este no es un libro para ser guardado, sino un manual fácilmente comprensible desarrollado para ser aplicado en PYMES. Aprovechando el ejemplo de una cafetera, IHOBE explica en 7 etapas como trabajar en Ecodiseño y muestra como, incluso un producto tan conocido, tiene un gran potencial para mejorar su ecoeficiencia.

Hartmut Stiller
(Wuppertal Institute)

The Ecodesign approach looks for opportunities to create competitive advantage for companies by reducing the environmental impact of the life cycle of their products. The IHOBE Ecodesign manual shows a very practical and comprehensive approach for introducing Ecodesign in Basque companies.

Jan Carel Diehl
(TU Delft University)

Tal como está estructurado, el manual resulta práctico para llevar a cabo su propósito. Buena estructuración de la información de todas las consideraciones internas y externas que son necesarias para realizar un proyecto de ecodiseño. El concepto de factores motivantes facilitará el proceso de incorporación del ecodiseño en las políticas de las empresas.
Resulta muy interesante y novedoso la incorporación de ejemplos de ecodiseño reales y adaptados a las características locales. Es de destacar el esfuerzo de sistematización que ofrece la guía sobre el proceso de ecodiseño que puede facilitar su uso por parte de las PYMES.

Joan Rieradevall y Xabier Domenèch
(Escola Superior de Disseny Elisava)

I am impressed by the pragmatism of the manual produced by IHOBE. It is a very good balance between a conceptual and practical approach, using both qualitative and quantitative assessments. I think it is a very good guide for companies that want to improve the environmental quality of their products, and I would really recommend each company to use the manual in at least one test case. The cases described in the manual show how successful such projects can be.

Mark Goedkoop
(PRE Product Ecology Consultants)

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INTRODUCTION

Incorporating the environmental factor into industry, and into Basque society in general is an objective of special importance in the present policy of the Territorial Organisation, Housing and Environment Department of the Basque Government.

Achieving this objective requires a change in the mindset of businesses, as in the near future it will be necessary to think about producing goods while conserving environmental resources and generating the smallest possible quantity of waste.

At present the business world is taking gigantic steps towards contemplating the environmental impacts of its products, not only in their production processes, but in all stages of their life cycle, from the obtainment of materials for later manufacture, to the disposal stage at the end of the useful lifetime of the products.

In this connection the objective set by this Department through its Environmental Management Public-Sector Company IHOBE, S.A. involves developing ECODESIGN methodologies and tools which will help companies to work taking account of the environmental factor throughout the lifetime of their products, thus preventing impacts prevented in one stage from occurring in another.

For this reason I consider that the *"Practical Manual of Ecodesign. Procedure for Implementation in 7 steps"* will successfully familiarise Basque companies, both manufacturing and industrial design companies, with the meaning of Ecodesign.

F.J. Ormazabal

Councillor of the Department of Territorial Organisatioon, Housing and the Environment

INTRODUCTION

One of the objectives of the Department of Territorial Organisation, Housing and the Environment of the Basque Government, through its Environmental Management Public-Sector Company IHOBE, S.A. is to support Basque companies in encouraging cleaner production, and also in the establishment and implementation of Environmental Management Systems.

The IHOBE Public-Sector Company understands that it is necessary for a change of mindset to take place in Basque industry. In fact a major change is already taking place in the industry in this country as end-of-pipe solutions are being abandoned in favour of practices of minimising and preventing waste in the production process. Now the next step is to evolve towards prevention, not only in the process but in all stages of the product life cycle, or in other words, to practice ECODESIGN.

The document presented here is a Practical Manual of Ecodesign which explains in 7 steps a simple method for integrating environmental criteria into the design of industrial products. It is a manual aimed both for large companies and for SMEs, who carry out industrial design, or at least have an influence on the design of their products.

As it is actions which are important, the manual includes four practical cases of Basque companies in which the proposed method has been implemented with excellent results both with regard to the design itself and the environmental advantages achieved (reduction of weight and volume of products or minimisation of energy consumption, for example) to which one would have to add the improvement of the company's image and innovation.

Our Department is convinced that the "*Practical Manual of Ecodesign. Procedure for implementation in 7 steps*" will be a reference for those Basque companies which wish to make the quality of production and respect for the environment their differentiating factor from other companies, and what is more important, for their own clients.

Esther Larrañaga

Vice Councillor for the Environment.

ACKNOWLEDGEMENTS

The preparation of the "Practical Manual of Ecodesign. Procedure for implementation in 7 steps" was carried out by the Environmental Management Public-Sector Company IHOBE, S.A. belonging to the Department of Territorial Organisation, Housing and the Environment of the Basque Government.

Nevertheless the publication now presented is the result of the work of a broad team.

The General Manager of IHOBE, S.A. José Luis Aurrecoechea Urquijo expressly acknowledges the participation in the preparation of this Practical Manual of:

- **IHOBE, S.A.**
  - Ignacio Quintana for the technical and conceptual direction of the document.
  - Ana Rebate for the co-ordination and preparation of the Manual and co-ordination of the pilot project in the companies.
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  - Christine van Wunnik, Lonneke Baas and Laurent Minere for the conceptual support and consulting in the application of the method in companies and preparation of the Manual.
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- **WÜPPERTAL INSTITUTE**
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- **PRE CONSULTANT**
  - Mark Goedkoop for his technical and conceptual contribution and for facilitating the original Eco-indicator '99 document.
- **ELISAVA Higher School of Design of Barcelona Autonomous University**
  - Joan Rieradevall and Xabier Domenèch for their technical and conceptual contribution.
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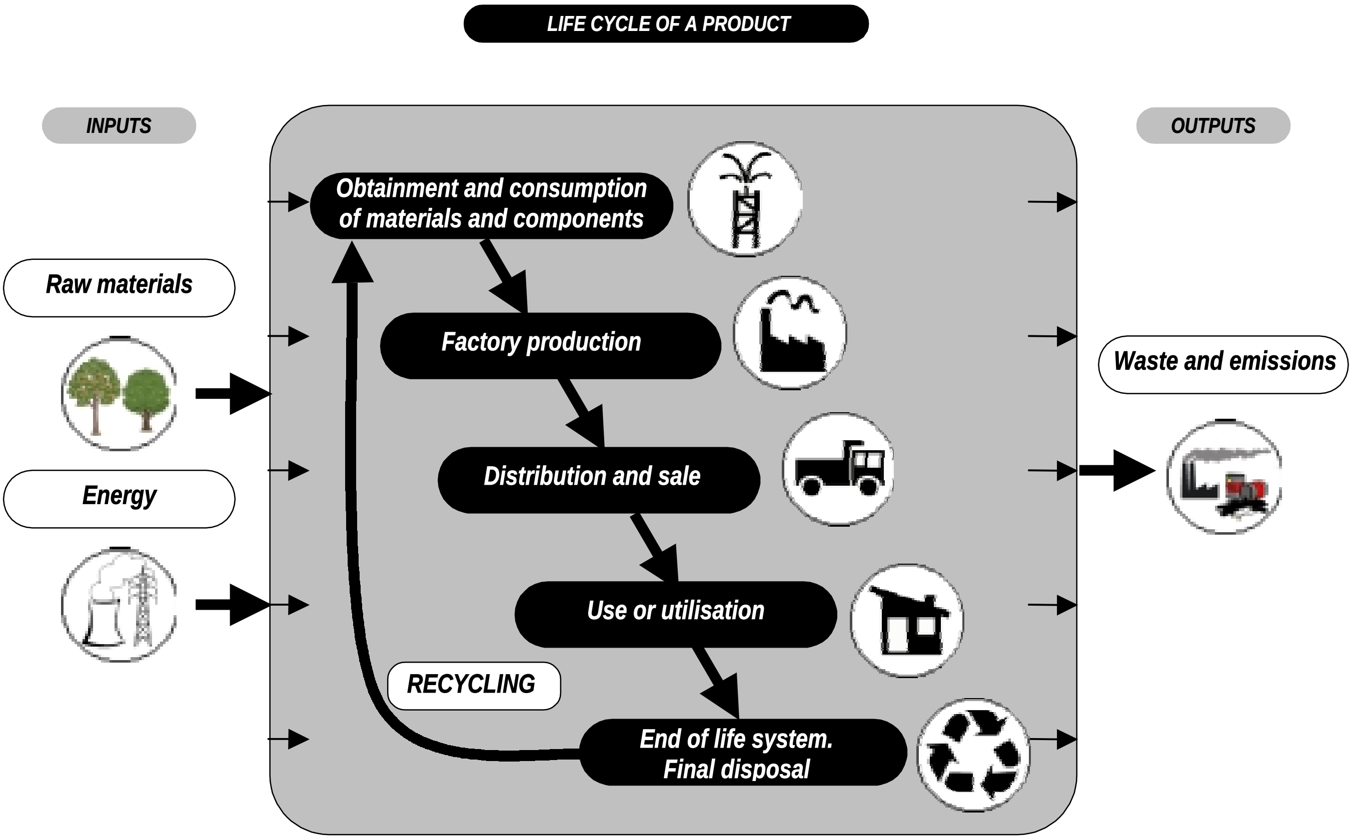
SUMMARY

Summary of the Manual

Introduction

The development of the European and worldwide markets and also environmental legislation and the demands of end customers shows a clear trend towards the integration of the environmental factor, as yet another business factor in the design of industrial products.
This is precisely what Ecodesign is: "Introducing environmental criteria into the design of products, seeking to minimise the main environmental impacts THROUGHOUT the product LIFE CYCLE".

With Ecodesign therefore the focus on improving the LIFE CYCLE of the product takes on importance, as another step towards the approach to the production process itself. The LIFE CYCLE of the product covers all stages of the life of a product, from the extraction of the materials which will form the components of the product, through the production, distribution and use of the product until the treatment or disposal of the said components once the product is thrown away.



As one may see, factory production is only one of the stages and this new approach is important because in many cases the main environmental impacts do not occur in the factory itself, and the producer has the ability to influence the other stages also, thereby improving the environmental characteristics of its product.

Objectives of the manual.

One of the main objectives of IHOBE, S.A. is to encourage environmental improvement and supply companies with tools and methodologies which will help them on their way to CONTINUOUS ENVIRONMENTAL IMPROVEMENT.
In that context the IHOBE "Practical Manual of Ecodesign, Procedure for implementation in 7 steps" has the following specific objectives:

- To raise awareness among Basque companies that have an influence on the design of their product, and also among industrial designers and design offices, of the importance of the LIFE CYCLE concept and the advantages of integrating environmental criteria into the product development process.
- Provide the methodology and simple tools within the reach of any company to work for the first time in Ecodesign.
- Provide directives in order to anchor Ecodesign in the business organisation within the framework of the conventional product development process, within the framework of standard ISO 9001 or within the framework of standard of ISO 14001.

Structure of the manual.

The manual may be structured into 3 clearly differentiated parts:

a) *The methodology, with the 7 correlative stages to develop the first Ecodesign pilot project in a company.* In this part the methodology of Ecodesign is explained step by step clearly and simply, also each of these steps is illustrated by its application in the design of a coffee-maker of the fictitious company CAFETERAS ENSUEÑO, S.L. This example provides an understanding of the methodology and gives it an even more practical character if possible.

b) *Practical experiences, results of the application of the methodology in products of 4 Basque companies.* The methodology presented here has been based on the PROMISE Manual, developed by VROM and O2 and which has been implemented in over 150 SMEs in Holland. Nevertheless we have worked on a pilot project with 4 Basque companies: Daisalux, S.A., Fagor Electrodomésticos – Minidomésticos, S. Coop.; Ofita S.A.M.M. and Fagor Electrodomésticos – Lavadoras, S. Coop., implementing the methodology and adapting it not only to the particular features of local companies but also to their real demand and needs.
In the practical experience section the whole process of application of the methodology in each of the 4 companies is presented, showing the differences between them which presented themselves and the various directions which the project has taken in each case.

c) *Annexes containing tools of interest: forms,* recommendations, bibliography … to be used throughout each stage of the manual (in the ***Tools*** sections and the annex ***Eco-indicator '99***).

Each of these is described in greater detail below:

a. *La methodology:*

The table below indicates in summary the keys of each stage of the methodology, that is the objectives in each stage and the planning or approximate time which each stage may require from the company:

Stage	OBJECTIVES	PLANNING
Stage 0.- INTRODUCTION	Give a general view and basic information on what Ecodesign is and its benefit for the company.	-
Stage 1.- PREPARATION OF THE PROJECT	Organisation of the project: - Selection of the work team. - Selection of the product to be ecodesigned. - Investigation of Motivating Factors to carry out Ecodesign.	10 - 20 hours
Stage 2.- ENVIROMENTAL ASPECTS	Analysis of the main environmental aspects of the product THROUGHOUT its LIFE CYCLE.	20 - 50 hours
Stage 3.- IDEAS FOR IMPROVEMENT	Generate and prioritise ideas for improving the product.	20 - 80 hours
Stage 4.- DEVELOP CONCEPTS	Develop a TECHNICAL AND ENVIRONMENTAL specification and generation of conceptual alternatives of the product on the basis of this specification.	50 - 80 hours
Stage 5.- PRODUCT IN DETAIL	Definition of the product in detail	280 - 480 hours
Stage 6.- ACTION PLAN	- Establish an action plan for all outstanding measures of environmental improvement for the product in the medium and long term. - Finally integrate Ecodesign into the design tools, and also into the company management tools.	10 - 50 hours
Stage 7.- EVALUATION	Evaluate the results of the project to draw conclusions and learn to transmit the results regularly internally and externally	40 - 60 hours
	Total:	430 – 820 hours

As may be observed, stages 1, 2, 3 and 7 have quite a standard duration for all companies. The planning of stages 4, 5 and 6 may vary according to the product and design process in each company. The values offered are the ranges of time spent in companies participating in the IHOBE pilot project.

The total number of hours spent therefore could be between 430 – 820 hours, always taking into account that we refer to a pilot project and that the anchoring of the methodology in the global reckoning is included, so subsequently this extra time will be minimised.
It is important to bear in mind that the first time Ecodesign is carried out it is recommended to have an expert in the field who can advise and guide us in each stage. In this way the results and the time spent internally on the process will be optimised.
Lastly, although the methodology is not intended to be strict, it is recommended to follow each and every one of the steps, at least in the first project, so that each company can subsequently adapt the methodology to its needs and ways of working.

b. *Practical experiences* ( ):

The practical experiences of the application of the methodology in the design of products in the 4 Basque companies mentioned: Daisalux, S.A., Fagor Electrodomésticos – Minidomésticos, S. Coop.; Ofita S.A.M.M. and Fagor Electrodomésticos – Lavadoras, S. Coop are included.
The table below shows the keys of the application of the project in these companies:

COMPANY	PRODUCT	MAIN ENVIRONMENTAL ASPECTS / REDUCTION	MAIN BENEFITS AND RESULTS
1 **Daisalux, S.A.** **Electronic sector** **Vitoria – Gasteiz**	Emergency luminaire	- Batteries with heavy metals. - Energy consumption. - Fluorescent lamps with mercury.	- Environmental improvements: more environmentally friendly batteries, 50% reduction in energy consumption etc. - Reduction of user costs in energy consumption. - Innovative product - Environmental motivation: in the process of ISO 14001.
2 **Fagor Electrodomésticos S. Coop. (Small Appliances)** **Household sector** **Eskoriatza**	Pressure Cooker	- Energy losses in cooking. - Use of stainless steel.	- Environmental improvements: 14% reduction in weight, 15% reduction in volume, etc. - Innovative image. - Anchoring of Ecodesign in procedures of ISO 9001 in the whole Fagor group.
3 **Ofita, S.A.M.M.** **Metal furniture sector** **Vitoria – Gasteiz**	Office desk	- Transport. - Use of steel. - Use of wood and particle board.	- Environmental improvements: 52% reduction in volume, etc. - Innovative image. - Greater interconnection between the various departments of the company and suppliers.
4 **Fagor Electrodomésticos S. Coop. (Washing Machines)** **Domestic appliances sector – white goods** **Arrasate**	Washing machine	- Use of energy, water and detergents during the phase of use. - Use of steel.	- Environmental improvements: elimination of Hg, Pb, Cd, Cr, VI, elimination of bromated retardants, facilitate recyclability of the product etc - Anticipate the fulfilment of many requirements of the WEEE Directive on the end of life. - Innovative environmental advantages compared to competitors. - Anchoring of Ecodesign in the procedures of ISO 9001 of the whole Fagor group.

As may be deduced from the "main benefits and results" column, all the companies have improved the environmental characteristics of their products but in addition to that they have ALL managed to give an INNOVATIVE image and 50% of these have reduced costs with the measures applied.

c. *Annexes containing tools of interest (y A):*

The annexes include practical tools which have been mentioned throughout the various stages of the methodology:

Tools.- includes all the forms shown throughout the manual so that they may be used by the companies (also included in electronic version on the diskette accompanying the manual) to facilitate handling.

Eco-indicator '99.- is a document which includes the Eco-indicators (stage 2) which were used in the project, and also the explanation of the methodology used for their obtainment.

Final conclusion

This Practical Manual has been developed within the framework of the Ecodesign Pilot Project from May 1999 to May 2000, in collaboration with the leading organisations GAIA (Association of Industries of Electronics and Information Technologies of the Basque Country) and MCC (Mondragón Corporación Cooperativa), belonging to the Environmental Network for Competitiveness (COANET network).
In this pilot project, in addition to being able to document four practical experiences in companies, the methodology has been optimised for the real needs of the companies. Therefore we consider that the manual constitutes a suitable point of departure in order to promote the sustainability of industrial products. The practical experiences of the four companies (several of which already manufacture the ecodesigned product), the training and practical experience in Ecodesign of industrial design experts and the public promotion of Ecodesign by IHOBE in collaboration with other organisations (DZ Centro de Diseño, MCC, GAIA, etc.) has reinforced the practical sense of this Practical Manual of Ecodesign.

0

INTRODUCTION

Objectives and preliminary definitions

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0 INTRODUCTION

Objectives and preliminary definitions

0.1.- Objective and content of the manual

The objective of this manual is to GIVE GUIDELINES to companies so that they can learn to integrate environmental criteria into the design of their products and PROVIDE THEM WITH SIMPLE TOOLS which will allow them to act in this direction. In this way an improvement in the environmental aspects associated with the products throughout their LIFE CYCLE will be achieved.

It must be borne in mind that neither the methodology (based on and adapted from the PROMISE1 Manual) nor the tools are unique, but on the basis of the experience in four Basque companies it has been proved that these tools are simple and useful to begin to work in ECODESIGN (in both large companies and SMEs) and that it is the companies themselves which must now adapt these tools to their own needs and methods of working.

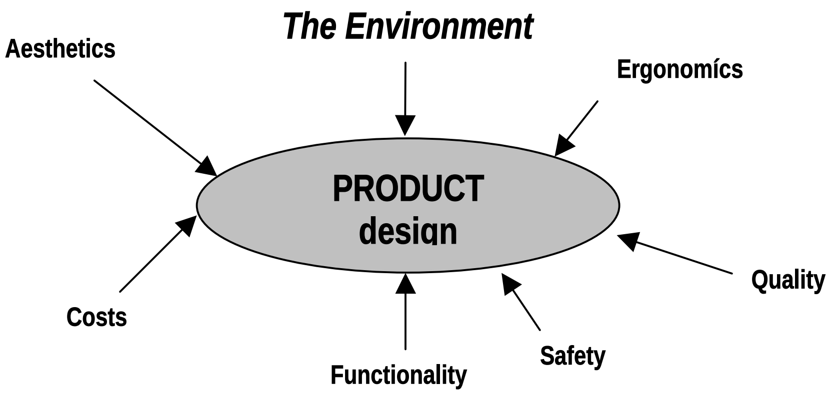
This manual describes the 7 stages to be followed to Ecodesign a product. The bar at the bottom of the page shows the stage we are in at each time. In order to give a more practical aspect to the methodology and to make it easier to understand, the example has been used of the company Cafeteras Ensueño, S.L. throughout the manual, showing by way of example the use of the various tools and the follow-up of the methodology by that company (2).

It is important to stress that in the use of this methodology and tools it is recommended to follow each and every one of the stages of the manual and not to skip any, as they are all interrelated and their importance for the correct and most successful implementation of the methodology has been proven.

0.2.- What is Ecodesign?

0.2.1.- Definition

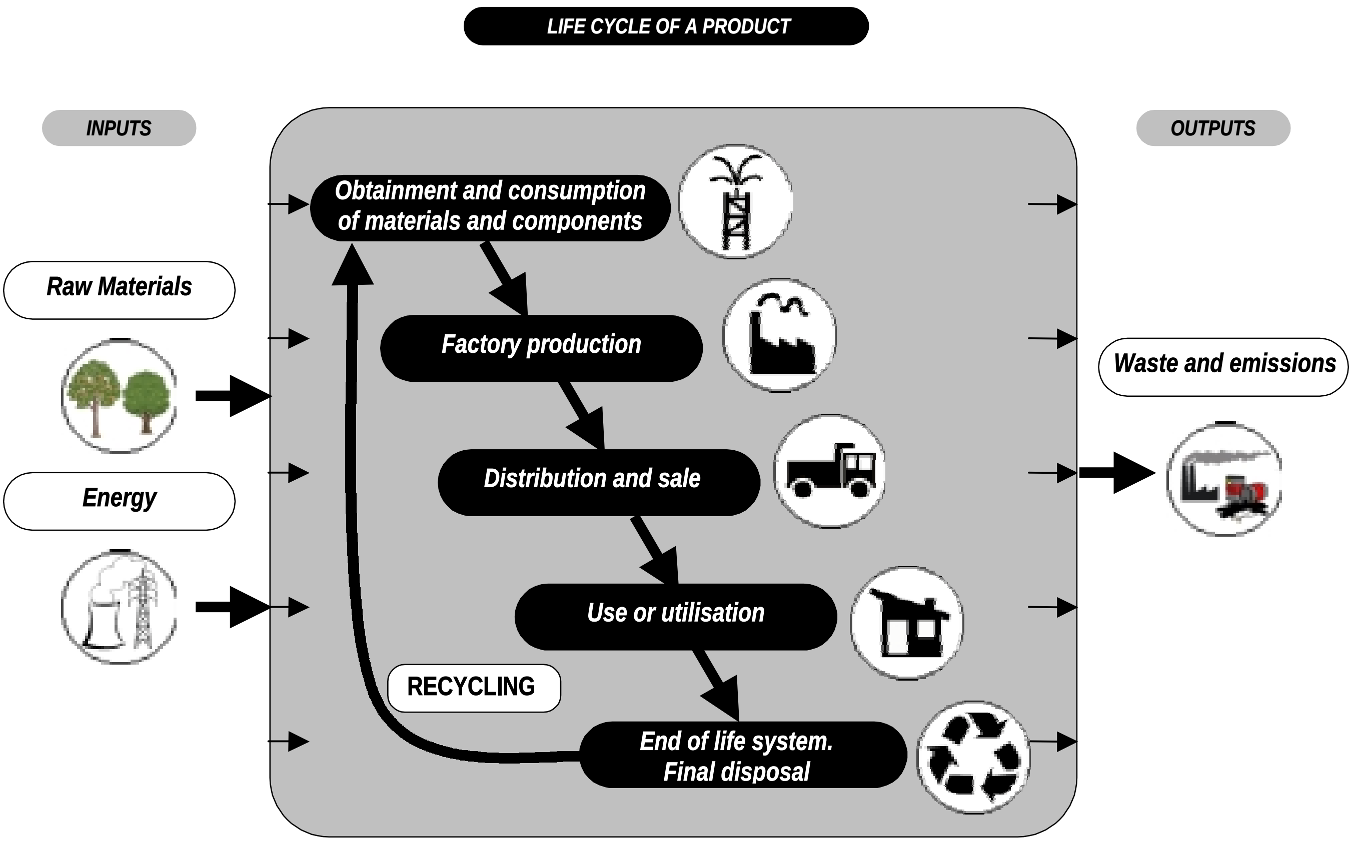
Ecodesign means that account is taken of the Environment when taking decisions during the product development process, as an additional factor to those which have traditionally been taken into account (costs, quality, etc.).



(1).- Source: Brezet, J.C., C. van Hemel, Ecodesign, A Promising Approach to Sustainable Production and Consumption, UNEP, 1997
(2).-' For the formulation of examples relating to the fictitious company Cafeteras Ensueño, S.L. information on coffee-makers from O2 Nederland and Pre Consultants was used.

0.2.2.- Product Life Cycle

The objective of Ecodesign is to reduce the environmental impact of the product throughout its LIFE CYCLE. Life cycle is understood to mean all the stages of the life of a product, from the production of the components and raw materials necessary for its obtainment to the disposal of the product once it is thrown away. The Life Cycle of the product therefore comprises different phases which follow the logical order of the figure:



The importance of considering the WHOLE Life Cycle of the product is that it allows one to identify clearly all the inputs and outputs of the process which entail an ENVIRONMENTAL IMPACT (not only those produced in the factory itself or in a specific stage of the Cycle). The next step will be to reduce to a minimum the quantity and toxicity of the inputs (materials and energy) and the outputs (emissions and waste) in each phase of the said Life Cycle of the product, or what is better, seek the appropriate balance in order to minimise the overall impact of the product throughout its Life Cycle.

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0.2.3.- Relation of Ecodesign with product development.

Ecodesign is based on the general stages of the traditional product development process. The basic structure of the process does not change. It is a question of giving this process a new approach taking account of environmental criteria in addition to other criteria.

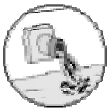
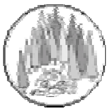
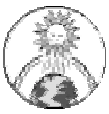
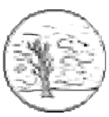
TRADITIONAL PRODUCT DEVELOPMENT PHASES	NEW APPROACHES INTRODUCED BY ECODESIGN
Preparation of the new design / redesign: select product, determine demand,... ***(ESTRATEGY)***	Selection of the project team also taking account of environmental criteria and determination of the Motivating Factors to perform Ecodesign (Chap. 1) Determination of environmental aspects of the product (Chap. 2)
Generation and selection of ideas. ***(NEW IDEAS)***	Ideas of environmental improvement (generation, evaluation and selection). (Chap. 3)
Propose conceptual solutions of product design. ***(PRODUCT CONCEPTS)***	Environmental requirements in the Specification (Chap. 4)
Selection and development of the best concept. ***(PRODUCT DESIGN)***	Environmental requirements in the functional assessment of the alternatives (Chap. 5)
Product production, distribution, marketing and sales plan. ***(PRODUCT IN THE MARKET)***	Plan of new environmental improvements to the product in the medium and long term. New tools derived from this new approach, anchoring of Ecodesign ... (Chap. 6)
Project evaluation.	Analysis of the environmental results, green marketing, internal and external environmental training and information. (Chap. 7)

0.3.- Benefits of Ecodesign for Basque companies.

0.3.1.- Reduction of environmental impact.

The first and most direct benefit from designing products taking account of the Environment is the reduction of the environmental impacts of the product.

The main environmental impacts, how they affect various products and possible improvements which can be made are shown below.

MAIN IMPACTS	BRIEF DESCRIPTION	PRODUCTS INVOLVED	EXAMPLES OF POSSIBLE IMPROVEMENTS
Water pollution 	Spillage of toxic substances or excessive organic matter generates high mortality of fish, alters aquatic fauna and flora (biodiversity) and endangers human health.	Toxic substances (oils, ammonias, cyanides, solvents ...) and sewage. Products which generate uncontrolled pollutant waste in their manufacture.	- Avoid the use of surfactants and problem products (NPE, EDTA, etc.) - Use of batteries and lamps without heavy metals
Pollution of the soil and uncontrolled waste dumping 	Pollution due to uncontrolled waste dumping, leaks and accidents compromises the utilisation of the soil for multiple uses (parks, farming, and so forth) endangers human health through ground water and bioaccumulation and alters the flora and fauna.	Products with toxic substances (mercury, oils, and so forth), where their end of life cycle is not correctly managed. Products in the Life Cycle of which waste is generated and dumped in an uncontrolled manner.	- Thermometers and appliances without mercury - Electric cables without PVC - Non-chlorinated metal degreasers.
Depletion of natural resources 	Excessive use and ineffective management of fossil fuels and other basic goods (water, minerals, wood, and so forth) which exhaust natural resources.	Use of scarce, threatened or non-renewable natural resources.	-Minimisation of the use of containers and packaging. -Energy cogeneration of excess biomass -Utilisation of environmentally friendly wood -Utilisation of recycled and recyclable materials (PET, PVC etc.).
Greenhouse effect 	Emissions into the atmosphere of certain gases (CO_2, CH_4, N_2O) act as a filter causing the global warming of our planet	Transport of products. Use of materials requiring a great expenditure of energy (aluminium, ceramics and noble metals). High energy consumption during the use of the product.	- Optimisation of mileage or means of transport in distribution. - Design of electrical domestic appliances with low energy consumption.
Reduction of the Ozone Layer 	Certain human activities are damaging the stratospheric ozone layer which protects the Earth from ultraviolet radiation.	Chlorine compounds such as CFCs, HFCs, halons, trichloroethylene etc.	- Elimination of chlorine compounds by non-halogenated refrigerants in the design of refrigerators.
Acid rain 	Acid rain is produced by the emission of SO_2, NO_x and NH_3 into the atmosphere, which are absorbed into the rain, generating major damage to nature.	Use of energy sources with a high sulphur content. Lack of catalysers in cars.	- Replacement of cupola furnaces (fossil fuels) by electric furnaces in the iron and steel products casting process.
Smog 	Smog is both an increase in the concentration of dust and SO_2 in the atmosphere (winter smog) and the increase in ozone, but at stratospheric level (summer smog).	Emissions from the product and production.	-Design for the reduction of emissions from domestic boilers during their useful lifetime. - Design of hybrid engines for the open road and the city.

In the Territorial Unit where an environmental policy is going to be applied it becomes necessary to consider which of these matters or environmental impacts is of major importance and identify whether other more specific ones exist

with a local effect. In the European space other environmental impacts have been considered, in addition to those already mentioned:
toxic and hazardous pollutants; erosion; damage to the urban environment; natural and technological risks; genetically modified organisms; human health; marine and coastal areas; and rural areas.

0.3.2.- Other benefits.

In addition to the benefits of environmental improvement there are other possible benefits deriving from Ecodesign which may be of great interest to companies.
These benefits correspond with some of the Motivating Factors which the company may have to perform Ecodesign and as such are:

Reduction of costs

By carrying out Ecodesign the costs of the company and also of the end user may be reduced.

EXAMPLE

To reduce the main impact of a pan, a manufacturing company reduced the thickness of the steel to the minimum necessary to maintain the technical performance of the product. Thus it managed to reduce the costs of raw materials and energy consumption in the stamping process.
Furthermore, by improving the design of a coffee-maker, for example, energy consumption in the phase of use may be reduced and this will have a positive effect on the costs of consumption for the user.

Innovation

As Ecodesign is not a very widespread subject at present, the fact of designing a product with Ecodesign criteria grants this product an innovative nature. Furthermore the introduction of new aspects into the habitual design methodology may contribute new ideas on aesthetics, functionality and so forth which otherwise would not have arisen, thus making the process richer.

EXAMPLE

The Smart is a car manufactured in co-operation between Swatch and Mercedes with Ecodesign criteria. The automotive market is a very advanced market in which innovation is very important. Being one of the first ecodesigned cars, together with the avant-garde image of the model (also a result of the utilisation of two materials in the bodywork: steel and glass fibre) has given the product that undeniably innovative character.
Furthermore, the most important environmental aspect of energy consumption has been optimised by consuming 3 litres of diesel fuel per 100 km in the diesel version.

Comply with enviromental legislation

In introducing environmental criteria one may achieve compliance with the requirements of environmental legislation both in the Basque Country and in the countries to which the product is exported with all the derived benefits which this entails for the company.

EXAMPLE

When eliminating the utilisation of hazardous substances (oils with additives) in the pressing of domestic appliances and replacing them with biodegradable oils, the toxicity of waste from washing water is eliminated and the parameters required by the Water Law are complied with.

Comply better with customers' demands

When designing a product with environmental criteria, other demands of customers may be met.

EXAMPLE

When designing a car to minimise fuel consumption, the manufacturer is not only minimising the "fuel consumption" environmental aspect of the car but is meeting one of the most important demands of customers for the product.

Increase in the product quality

When introducing environmental criteria into the design of a product, the quality of that product may be increased.

EXAMPLE

In the design of an item of furniture, by introducing environmental criteria (performing Ecodesign), it has been studied how to reduce materials and in order to maintain the technical characteristics of the furniture the design of the fixings or anchorings has been improved; these are now much better and safer than the previous ones.

Improvement of the image of the product and company

By performing Ecodesign, a company can improve its damaged image or that of its product by the environmental improvements made in the product and the projection of a green image of the company and product.

EXAMPLE

The image of a manufacturer of fruit bowls has been damaged owing to a series of products with over-fragile handles. When performing Ecodesign, a material was found which, in addition to being more environmentally friendly, is stronger. The company's image has therefore been doubly improved, owing to the improvement in the quality of the handle and the product as a whole, as it is also one of the first ecodesigned fruit bowls.

These benefits, analysed in greater depth in the next chapter, coincide with some of the Motivating Factors which lead companies to perform Ecodesign. The Motivating Factors constitute the challenges and opportunities which the demand for total quality offers the market.

Their study will indicate the reasons why Ecodesign is important for our company in relation to a specific product.

1

1

PREPARATION OF AN ECODESIGN PROJECT

Selection of the project team and determination of the Motivating Factors

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1 PREPARATION OF AN ECODESIGN PROJECT

Selection of the project team and determination of the Motivating Factors.

Outline of the stage

OBJECTIVES	Organisation of the project: - Selection of the work team. - Selection of the product to be Ecodesigned. - Investigation of the Motivating Factors to perform Ecodesign.
PERSONS OR DEPARTMENTS INVOLVED	- ***General Management*** - ***Product Development Manager*** - Other departments - Outside agents
TOOLS	- Table of criteria for product selection. - EXTERNAL MOTIVATING FACTORS Worksheet. - INTERNAL MOTIVATING FACTORS Worksheet.
PLANNING	10-20 hours

1.1.- Composition of the team.

The first phase in the development of an Ecodesign project consists of the formation of a team. This team will be responsible for the correction functioning of the project. The basic characteristics which this team must present are as follows:

- **Small, well organised team.-** The group must be operational, therefore it must not be formed by too many people. One of the members of the group (preferably the Product Development Department Manager) will be in charge of directing the stages of the project and will act as the co-ordinator.

- **With decision-making capacity.-** Any decision at strategic level of the company must be able to be taken by the working group. This involves the need to involve the management in the work team, and persons with decision making capacity.

- **Multidisciplinary team.-** In the Ecodesign project all types of aspects will have to be considered (take account of the requirements of product quality, see how modifications affect the product's costs, contact suppliers in order to find out about possible alternatives of better materials from the environmental point of view, and so forth). Therefore there must be persons from different departments, in order that the information may be gathered first hand.

The inclusion of the following departments will be considered as a priority:

- ***Management:***

Its presence makes it possible to define the importance of the environment in the company's business and take decisions relating to the integration of Ecodesign criteria.

- ***Product Development Manager:***

The objective of Ecodesign is the development of new products, so the presence of the Product Development Manager is key. He will preferably act as the leader of the group and involve the various departments throughout the project. He will also be in charge of defining the training and information needs within the company with regard to Ecodesign.

- ***Other departments:***

Their incorporation into the group is considered to be important for the analysis of the Motivating Factors, and the contribution of information on these and other matters arising throughout the project. Among departments of interest to be involved we may indicate the following:

- ***Purchasing.-*** Detects and checks the information received or existing information relating to materials and alternative technologies which are more respectful of the environment. Studies their feasibility.
- ***Quality and the Environment.-***
  - Report on aspects relating to regulations existing in relation to the product (safety regulations, quality, the Environment, …) and also the existing environmental programmes or initiatives in the company itself.
  - Provide any other necessary information about the quality of the processes used or proposed.
  - Assess the alternatives of improvement on the basis of fulfilment of the requirements of product quality and (where appropriate) the environmental management system.
- ***Marketing.-***
  - Detects environmental demand in relation to products (with regard to the end customer and industrial customer).
  - Contributes ideas in decision taking in relation to customers' preferences..

  - Designs and develops the marketing campaign on the basis of the results of the project and detected environmental demand.
  - If the marketing is carried out by an outside company, it must also be involved, and for this purpose it will be duly informed about this matter.
- ***Human Resources/Personnel.-***
  - Analyses the motivation of employees with regard to the environment.
  - Introduces workers into the use of good operating practices.
  - Encourages suggestions by employees with regard to improving production processes, thereby achieving continuous improvement.
  - Manages or channels training and information in the company on the basis of the needs of Ecodesign.

Often it may be interesting to involve outside persons in the project team such as:

- ***Environmental expert:***

To advise us about the environmental appropriateness of the various alternatives arising throughout the project.

- ***Outside designer or design engineering company:***

If the company works with outside engineering companies, it is essential to transmit to them the company's interest in this connection and environmental demands. Of course, training in Ecodesign of these outside agents will facilitate and enrich the process.

EXAMPLE

The company CAFETERAS ENSUEÑO, S.L. is a company situated in Orio with 18 employees and it decided to integrate the Ecodesign methodology as a factor of innovation in his company. Accordingly it formed the following work team:

- **Manager:** He gave the initiative and took the decision to participate in a project of this type, supporting the decisions which will be taken within the framework of the project.
- **Product Development Manager:** led the project involving the various persons of the company in the various stages of the project.
- **Environmental consultant expert in Ecodesign:** directed the company in the application of the methodology and in the assessment of environmental criteria.
- Other: Purchasing, sub-contracted marketing company, and so forth participated occasionally, providing or receiving key information for its work.

1.2.- Product selection.

The criteria for the selection of a product are specific to each company, but as a general rule they must follow the following guidelines:

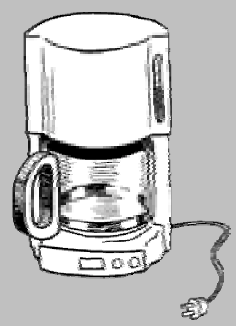
- ***The product must have a sufficient number of degrees of freedom to allow its modification.***
  (E.g. – The polyethylene (PE) plastic bag product does not have any degrees of freedom either with regard to its form or the material used, so it is of no interest to perform Ecodesign).
- ***The product must preferably be the one which is greatly affected by the Motivating Factors of Ecodesign for the company,*** as this is related with the potential benefits which the company will obtain with the project.
  (E.g. – If the introduction of environmental criteria into the design of product A may favour compliance with environmental legislation, improve its marketing and give the product the innovative character it needs, it will be more interesting to perform Ecodesign with product A than with another product B which is not affected by any of these factors when environmental criteria are introduced into its design).

- ***Additionally, in the case where it is the first product in which Ecodesign criteria are introduced, it is of interest that the product or part thereof to be modified should be relatively simple,*** as this favours the obtainment of rapid results, and with this the motivation to continue working on Ecodesign.

EXAMPLE

The product selected by the company CAFETERAS ENSUEÑO, S.L. was a low range coffee-maker which was about to be redesigned to supply a young market with high purchasing power and which presented specific demands for the product.

It was the company's simplest coffee-maker in terms of its design, which facilitated acquaintance with the methodology.



Selected model

1.3.- Investigation of Motivating Factors for Ecodesign.

The reasons for the application of Ecodesign will arise from the analysis of the strengths and weaknesses of the company and the opportunities and threats present in the market. These reasons may be divided into:

- *External Motivating Factors.*
- *Internal Motivating Factors.*

1.3.1.- External Motivating Factors for Ecodesign.

These are classified according to the following categories:

ADMINISTRATION: legislation and regulation

The European Union is developing environmental directives, the centre of attention of which is shifting towards "extended liability of the manufacturer" or the "obligation to collect". A large part of this legislation will probably become State legislation in European countries in the near future. In order to avoid unpleasant surprises, companies should anticipate these obligations to collect, by starting to design now their products with the possibility of dismantling and recycling.
An example of this type of legislation is Law 11/1997 of 24 April of packaging and waste packaging or the ELV (End-of-Life Vehicle Directive) and WEEE (European Directive on Waste Electrical and Electronic Equipment) Directives which affect the automotive and electrical/electronic sectors respectively. These directives require among other things the MODIFICATION OF THE DESIGN OF PRODUCTS towards the elimination of some heavy metals, the increase in the percentage of recyclability of products at the end of their useful lifetime and so forth.

In addition, state governments all over Europe, in the United States and Japan are developing their own environmental legislation.
Furthermore, the promotion of more environmentally friendly products is also a part of the policies of various countries of the European Union. For this it grants the ecolabel to a growing number of groups of products and stimulates Ecodesign by means of subsidies.

MARKET: demand by customers (industrial and end customers)

Public opinion is increasingly aware of the environmental quality of products.
In turn industrial customers in general have greater capacity to influence a company than end customers. At present there is a growing number of industrial companies which expect their suppliers to report on their environmental characteristics both in terms of production (by means of ISO 14001 certification) and in products or their packaging (by presenting environmental improvements to these products or packaging). Section 6 of the Tools chapter of this practical manual gives a table showing the relationship between ISO 14001 and Ecodesign and its possible anchoring.
If clients require from the company environmental characteristics of a particular product, the company may greatly benefit from the integration of Ecodesign into the development of the said product.
Furthermore, the number of ecolabels existing for different products is increasing. The products affected by these regulations may favour compliance with the requirements applied by these by introducing environmental criteria into their design (Ecodesign).

SOME OF THE MOST IMPORTANT ECOLABELS

GERMANY	*Blue Angel – Angel Azul* *(http://www.blauer-engel.de)*
AUSTRIA	*Austrian Eco-Label* *http://www.bmu.gv.at/u_kennzeich_auszeich/oe_umweltzeichen/uwzenglisch.htm*
CANADA	*Environmental Choice* *http://www.terrachoice.ca/*
U.S.A.	*Energy Star* *http://www.epa.gov/office.html*
	Green Seal *http://www.greenseal.org/*
SPAIN	*AENOR Medio Ambiente* *http://www.aenor.es/medioamb/Medioa.htm*
E.U.	*EU Ecolabel* *http://europa.eu.int/comm/environment/ecolabel/prodgr.htm*
FRANCE	*NF - Environmental* *http://www.afnor.fr/activities/certification/page9.htm*
HOLLAND	*Stichting - Milieukeur* *http://www.milieukeur.nl/english/*
SCANDINAVIA	*Nordic Swan* *http://www.svanen.un/Nordic/Swanindex.htm*

COMPETITORS

Environmental aspects are a part of product quality. Many leading companies in the market are aware of this and act accordingly.

Another point of interest is the possibility of using the environment as an exclusive selling point. It is increasingly important to be distinguished from the competition by means of differentiating aspects and Ecodesign may provide the company with that differentiation.
Furthermore, the environmental actions of competitors may serve as a source of inspiration when performing Ecodesign.

SOCIAL ENVIRONMENT: responsibility to the Environment

If our social environment is environmentally aware, Ecodesign may be a form of improving the company's image in that social environment.

SECTORAL ORGANISATIONS: environmental pressure on the company

Many sectoral organisations motivate, or occasionally require, companies to take account of the environment in their processes and products. Ecodesign may be a way of responding to these requirements.

SUPPLIERS: technological innovations

Each day new technologies and products appear which improve their relation with the environment. When materials or technologies exist which can improve the environmental characteristics of a product, it will be positively affected by the Ecodesign at the probability of obtaining good results from the project will be very high. In that case it may be of interest to analyse the possibility of performing Ecodesign with that product.

1.3.2.- Internal Motivating Factors for Ecodesign.

These will be the following:

Increased product quality

The constant search for quality in products is a priority task for any company. By means of Ecodesign we will manage to increase the environmental quality of the product by means of factors such as functionality, reliability in operation, durability or the possibility of repair.

Improvement in the product and company image

Once the improvements in the product have been obtained, they must be notified correctly to the user. With Ecodesign, the environmental quality of the product will be publicised with the help for example of Ecolabels, green marketing and so forth, improving the image of the product and the company.

Reduction of costs

The application of Ecodesign in companies allows costs to be reduced in two ways:
- *Immediately*, by means of direct improvements to the product such as reduction of weight or change of materials, and improvements in the production process, stage of transport and so forth, with reductions in the consumption of auxiliary materials and fuel.
- *In the long term*, by means of the implementation of environmental criteria of operation in the company such as for example more efficient production which minimises the volume of waste and optimises energy consumption.

Costs to the client may also be reduced by reducing for example the energy consumption of the product or improving the design with a view to repairs.

Innovative power

With Ecodesign we can introduce the concept of new product or innovative product and thus enter new sectors of the market or new markets (countries which require environmental requirements).
Ecodesign may also enrich the design process by contributing new approaches which favour innovation of the product and its production.

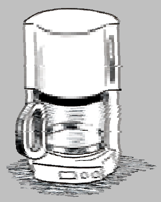
The Manager's sense of environmental responsibility

The awareness of the importance of sustainable development among executives and persons in charge of product development often leads companies to start an Ecodesign pilot project.

Motivation of employees

Ecodesign may help to improve industrial health and safety, aspects which directly affect the employees of the company, and also increase the pride of belonging to a company "which works taking account of the Environment".

EXAMPLE



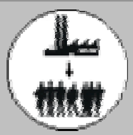
We see below the motivating factors which the company CAFETERAS ENSUEÑO, S.L. has identified as relevant for the introduction of Ecodesign in the development of the coffee-maker.

EXTERNAL Motivating Factors for the application of Ecodesign

ADMINISTRATION: legislation y regulation

This product will be affected by the WEEE Directive (elimination of hazardous substances and heavy metals, increase in recyclability, marking of plastics, collection system – recycling of the product at the end of its useful lifetime and so forth).

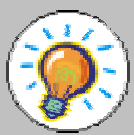
MARKET:* Demand by customers (ind. & *end customers)



Demands and queries by clients start to be received relating to the recyclability of the jug when it is broken or damaged. Other demands are along the lines of ease of handling and cleaning, speed of operation, keeping the coffee hot and so forth.

INTERNAL Motivating Factors for the application of Ecodesign in the coffee-maker

Innovative power



The main client is "young people" and for this market the possibilities of regular modification of the product and innovation in design are very important. Also it is a product which is well known among the public and the differentiating aspect is significant.

NOTE.- Full tables for the identification of Motivating Factors may be found in the  tools chapter of this manual.

2

ENVIRONMENTAL ASPECTS

Their determination for our product

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2 ENVIRONMENTAL ASPECTS

Their determination for our product

Outline of the stage

OBJECTIVES

Analysis of the main environmental aspects of the product THROUGHOUT its LIFE CYCLE.

PERSONS OR DEPARTMENTS INVOLVED

- ***Product Development Manager:*** To lead the evaluation-prioritisation. Transmit the keys to the outside designer, where he exists and the importance of this stage. Co-ordinate the team.
- ***General Management:*** Will be informed of the results (important for understanding the process and taking decisions).
- ***Other departments:*** Supply information (countries of sales and purchases, calculations of transport, weights of raw materials etc.).
- ***Outside environmental expert:*** Support with his knowledge in the evaluation-prioritisation of environmental aspects.
- ***Outside designer (where he exists):*** His participation in the process of determination and prioritisation of environmental aspects is recommended.

TOOLS

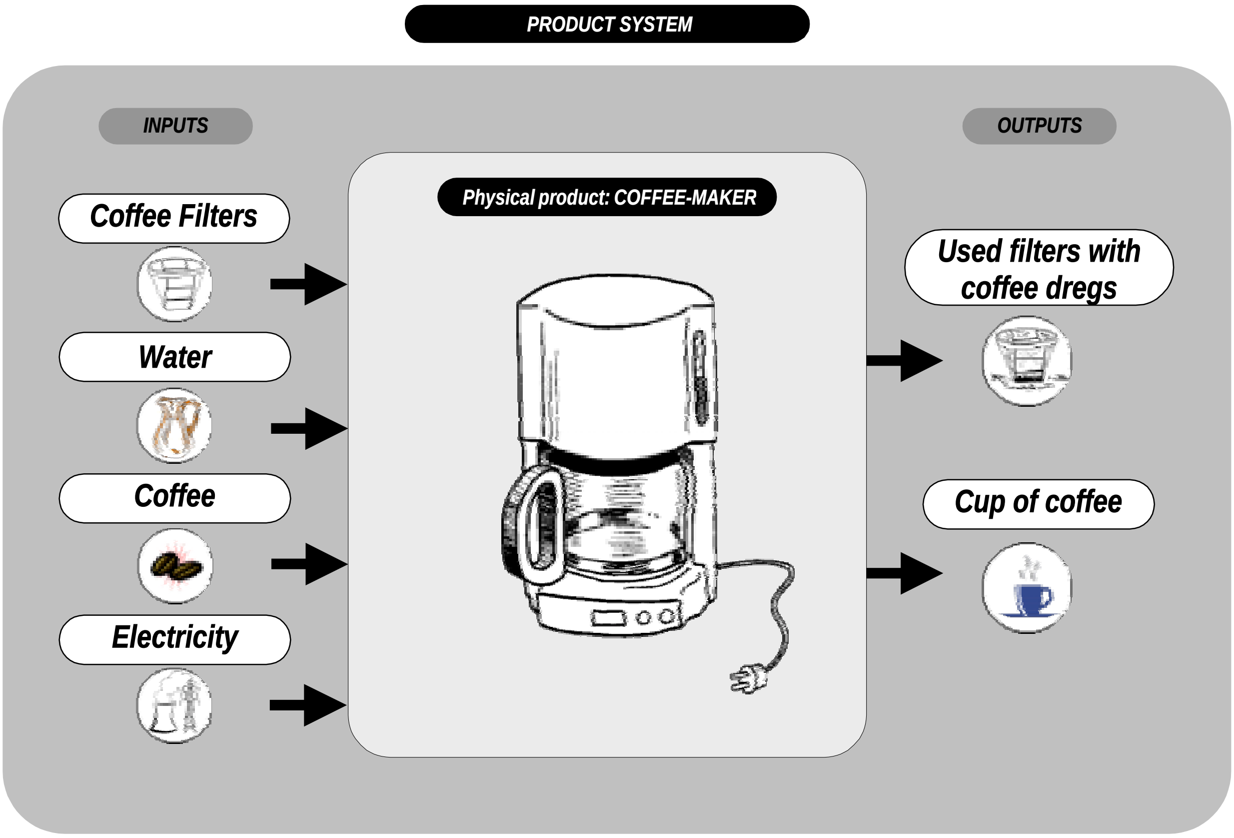
- MET Matrix.
- Eco - indicators.
- Software tools for Life Cycle Analysis.

PLANNING

20-50 hours

2.1.- Set the limits of the product system.

When an Ecodesign project is commenced, it is important to obtain a general perspective of the aspects of the product which cause the greatest environmental impacts, in order thus to identify the priorities for the making of improvements.
In order to obtain this general perspective it is not sufficient to study only the physical product, but a vision of the system of the product as a whole is required. This means, for example, that in the analysis of the environmental aspects of a coffee-maker, account must also be taken of the filters, water, electricity and coffee. See the figure below for a graphic explanation of a product system.

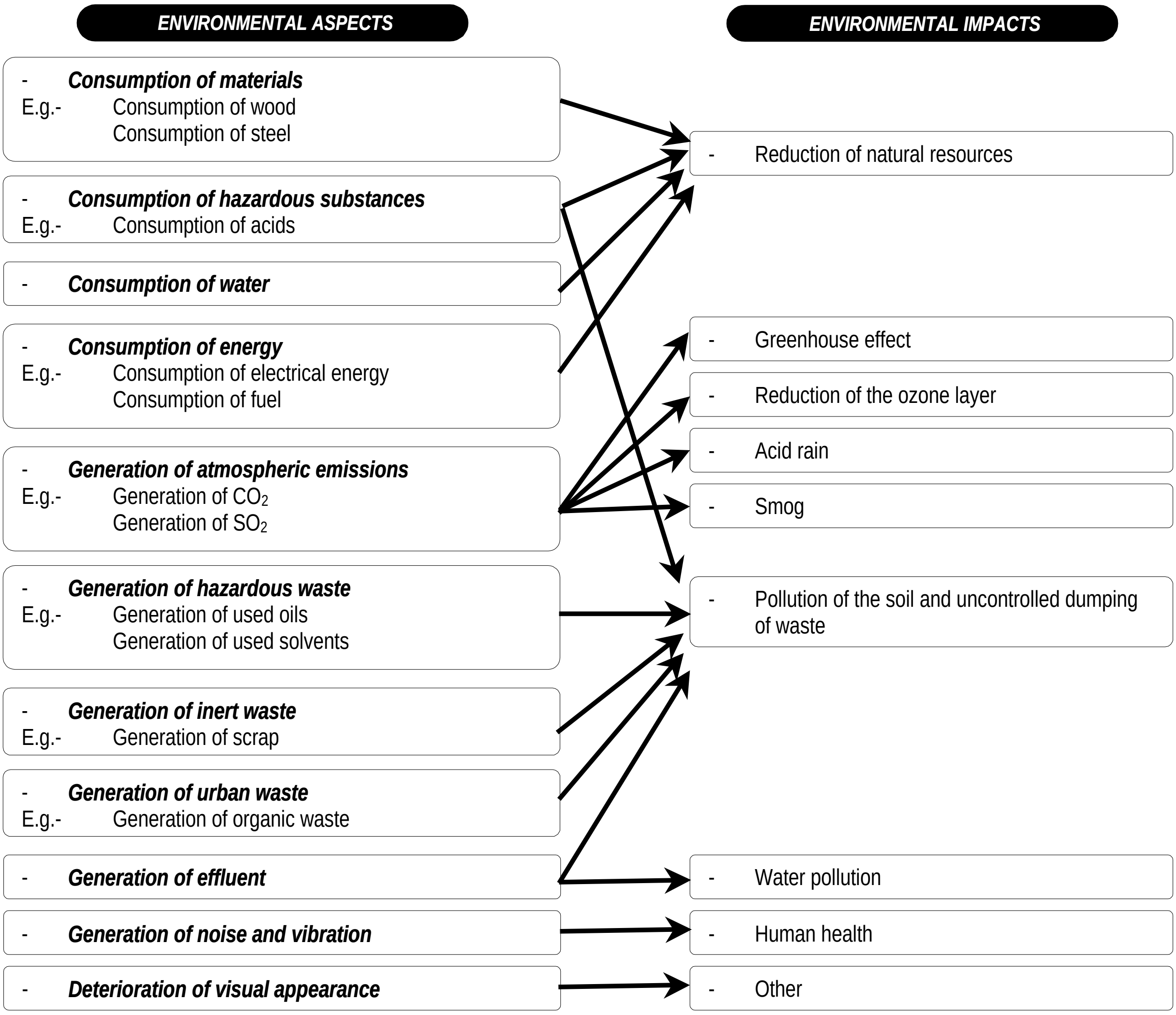


An important criterion for defining the product system consists of including the elements external to the product which may be affected when the design is modified.
Thus, for example, in a pressure cooker there may be the doubt as to whether to include the energy consumption in the system of the cooker or not, as the cooker is not an electrical product and does not consume energy directly. Nevertheless, an improvement in the design of the pressure cooker may reduce the energy consumption of the heat source, so it is interesting to include it, as may be seen in Practical Experience 2 of this Manual, of Fagor Electrodomésticos S. Coop (minidomésticos).

2.2.- What are the environmental aspects of the product and why it is important to identify and prioritise them?

- ***Environmental aspect***: according to standard ISO 14001 this is: "element of the activities, products or services of an organisation which can interact with the Environment". It is therefore directly associated with the PRODUCT.
- ***Environmental impact:*** this is "any change in the Environment, whether adverse of beneficial, resulting wholly or partly from the activities, products and services of an organisation". It is therefore directly associated with the GLOBAL ENVIRONMENT.

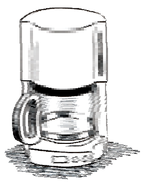
We have already seen in the introduction to this manual what the main environmental impacts are (global changes in the Environment), which give us an idea of how important it is to preserve environment quality.
Now, concentrating on our product in order to perform Ecodesign, we are interested in identifying the specific environmental aspects of this product in order to seek to optimise them.



EXAMPLE

In order to understand better the difference between both concepts, we shall see the main environmental aspects of the coffee-maker (which will be precisely identified and prioritised throughout this chapter) and how they affect the global environmental impacts.

ENVIRONMENTAL ASPECTS	ENVIRONMENTAL IMPACTS
- Consumption of electric energy.	- Reduction of natural resources (consumption of natural gas in combined gas cycle power stations).
- Consumption of natural resource filter paper.	- Reduction of natural resources.



2.3.- Methods of analysis of the environmental aspects of the product and setting priorities.

There are various methods, qualitative and quantitative, for analysing the environmental profile of the product and establishing environmental priorities. All the methods are based on Life Cycle Analysis, which means that these methods analyse all phases of the Life Cycle of the product with regard to the environmental aspects of the product in each. The objectives of the utilisation of these methods are:

– To obtain a general perspective of the main environmental aspects of the product throughout its Life Cycle.
– To identify the environmental priorities which will be dealt with during the Ecodesign process.

Although all the methods are aimed at the fulfilment of these objectives, they vary in their complexity, economic cost, consumption of time for their utilisation and necessary information. The methods which we consider to be most interesting are briefly analysed below.

2.3.1.- METM Matrix.

- ***WHAT IS the MET Matriz?***

The MET matrix is a qualitative or semi-qualitative method which serves to obtain a global view of the inputs and outputs in each stage of the product Life Cycle. It also provides a first indication of aspects for which additional information is required.

This is a qualitative or semi-qualitative tool because despite the fact that it handles quantities, the prioritisation of environmental aspects proper is qualitative and is based on environmental knowledge and golden rules (which we shall see below) and not on figures or results.

- ***HOW THE MET Matrix is USED.***

The MET Matrix includes:

- ***M – Utilisation of Materials in each stage of the Life Cycle.*** This refers to all the inputs (consumption) in each stage of the Life Cycle. This provides a view of what the priority inputs are by their **greater quantity**, **toxicity or because they are scarce materials (such as copper).**
- ***E – Utilisation of Energy.*** This refers to the impact of the processes of transport in each stage of the Life Cycle (those which consume much energy mainly). This provides a view of what the **processes or transport of greatest impact** are throughout the product Life Cycle.
- ***T – Toxic Emissions*** (all outputs: emissions, effluent or toxic waste). This refers to all outputs produced in the process. This gives an idea of which are the **most important outputs by their toxicity.**

These aspects are included in the MET matrix in a simplified way and organised according to the stages of the product Life Cycle.

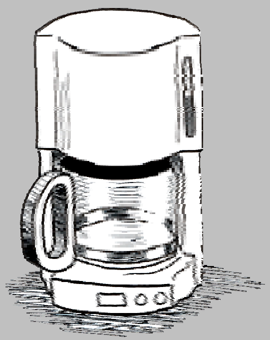
In order to understand a little better how the MET matrix is used, it is shown below what type of information is gathered in each section.
Also the practical example of the application of the MET matrix is included for the coffee-maker of CAFETERAS ENSUEÑO, S.L.
It is very important to complete the MET matrix in a work team in which each person supplies the information which he knows best. So, for example, purchasing: details of materials; logistics: details of transport; sales: details of useful lifetime; outside environmental expert (if participating): greater contribution in the prioritisation of aspects and support in the scope of the necessary information.

	Use of MATERIALS (Inputs) **M**	Use of ENERGY (Inputs) **E**	TOXIC EMISSIONS (Outputs: emissions,effluent, waste) **T**
Obtainment & consumption of materials and components	- All the necessary materials, parts and components which are bought as such.	- Necessary energy consumption for the obtainment in raw condition of the materials purchased. - The necessary energy to obtain the materials in the state in which they are acquired (laminated, surface treatment, etc.). - Energy consumption for the transport of the purchased materials to the factory.	- Toxic waste generated in the obtainment and transformation of the materials acquired before their arrival at the company.
Factory production	- Auxiliary materials bought as such (screws, electrical items, etc.). - Auxiliary substances which are used in the production process and not included in the previous stage (items for welding, painting, glass fibre moulding, etc.).	- Energy consumption in the processes employed in the factory.	- Toxic waste produced in the factory. - Remainder of materials: offcuts, rejects, etc.
Distribution	- Product packaging. - Elements of repackaging used for transport and distribution.	- Energy consumption in packaging and packing (where significant). - Transport from the factory to the final distributors.	- Waste from combustion produced during transport. - Waste packing.
Use or utilisation	- Consumables. - Estimated spare parts.	- Energy consumed by the product throughout its estimated useful lifetime.	- Waste from consumables. - Waste from spare parts.
End of life system. Final disposal	- Consumption of raw materials and auxiliary materials for the end of life treatment.	- Energy used in any of the end of life systems of materials or parts (incineration, dismantling, recycling, etc.). - Energy for transport to the end of life systems.	- Toxic waste generated by the product and which is destined to an authorised manager. - Materials to tip. - Recycling of materials. - Waste from combustion.

Let us see below the example of an MET matrix for a coffee-maker.

EXAMPLE

We shall analyse the main environmental aspects of the selected coffee-maker to perform Ecodesign by the company CAFETERAS ENSUEÑO S.L. For this we have the following information:



Technical information

- The body of the appliance (including the water tank) is of polystyrene, weighs 1 kg and is produced by moulding.
- The hotplate is steel and weighs 0.3 kg.
- The water vapour discharge tube is aluminium, weighs 0.3 kg and is produced by extrusion.
- The glass jug weighs 0.4 kg.
- The cable is PVC and weighs 100 g and contains copper wire weighing 50 g.
- The coffee-makers are packed in a polyethylene bag (the weight of which is 10 g) and the assembly is then inserted into a cardboard box weighing 300 g.
- 8 coffee-makers are packed in a large cardboard case weighing 800 g.
- Each coffee-maker includes a small instruction manual containing 30 pages and weighing 40 g.
- Transport for distribution of the product throughout Europe is by means of lorries.
- It includes a printed circuit which is brought from Asia (100 g).

Assumptions relating to operation

The coffee-maker has a power of 1000 W. It is used twice a day at half power (10 minutes to make coffee, 20 minutes to keep it warm).
In the coffee-maker the water is evaporated so it rises to the filter chamber where it then condenses.
The useful lifetime of this coffee-maker is 5 years on average. After this the glass jug is placed in the glass collection container and the appliance is thrown into general domestic refuse for collection by municipal services.
Each time coffee is prepared a paper filter weighing 2 g is necessary and 300 cl of water are consumed for cleaning.
Throughout the useful lifetime of the appliance, filters full of coffee dregs are thrown away into the municipal refuse collection.

On the basis of all these data we developed the MET matrix of the appliance, obtaining the following:

	Use of MATERIALS (Inputs) M	Use of ENERGY (Inputs) E	TOXIC EMISSIONS (Outputs: emissions, effluent, waste) T
Obtainment & consumption of materials and components	- Copper (exhaustible material) (0,05 kg). - Steel (0,3 kg) - Aluminium (0,3 kg) - Polystyrene (PS) (1 kg) - PVC (0,1 kg) - Glass (0,4 kg) - Printed circuits (0,1 kg)	- High energy content in materials (Al, Cu) - Transport of ready assembled printed circuits from Asia (0.03 kWh)	- Fire retardants in printed circuit boards (↓) - Liquefiers for injection moulding (↓) - PS: Benzene emissions (↓) - PUR: Isocyanate (↓) - Emissions due to painting and gluing (↓)
Factory production	- Auxiliary materials (welding materials, degreasers and lubricants for the machines of the production system of the company, etc.) (↓)	- Energy in miscellaneous processes (Polystyrene moulding, aluminium extrusion, welding etc.) (↓)	- Metallic and plastic waste (offcuts and rejects) (↓) - Remainder of lubricants and degreasers for machines. (↓)
Distribution	- Product packaging. (polyethylene bag: 0.3 kg and cardboard: 0.1 kg) - Cardboard for repacking (↓) - Instruction manual (0,04 kg).	- Diesel fuel for transport (lorries) (0.3 kWh)	- Emissions from diesel fuel combustion (↓). - Remainder of packing: - Polyethylene bag (recyclable) (0.3 kg) - Cardboard (recyclable) (0.1 kg)
Use or utilisation	- ***OPERATION*** - Paper filters (7,3 kg) - Coffee used (65 kg)* - Cleaning materials (↓) - Water for cleaning (10.950 l)	- Energy consumption (375 kwh) a.- Heating: 281,25 kwh b.- Maintenance: 93,75 kwh **	- Waste from consumables (filter with coffee dregs, etc.) (72,3 kg) - Waste water from cleaning (10.950 l). - Emissions deriving from energy consumption (2305 kg CO_2).
	MAINTENANCE - Parts which are easily breakable (↓).	- Transport of maintenance providers (↓)	- Remainder of replaced parts (↓).
End of life system. Final disposal			***RECYCLING*** - Glass (0,4 kg) - Plastics (1,1kg) - Instruction manual (0,04 kg) ***DISPOSAL*** - Printed circuit board (0,1 kg) - Copper (0,05 kg) - Aluminium (0,3 kg) - Steel (0,3 kg)

[grey box] Priority impacts (detected with the aid of environmental consultant expert in Ecodesign).

* Consumption of coffee is allowed for at one 250 g packet per week throughout the 5 years of estimated lifetime. Despite the fact that the coffee is quantitatively one of the highest figures, it is the only one which cannot be minimised, so it has not been considered to be a priority.

** This breakdown may facilitate the generation of ideas for improvement on this environmental aspect.

- ***HOW TO PRIORITISE the main environmental aspects using the MET matrix.***

In order to prioritise with the MET matrix it is convenient to follow the golden rules, a series of rules which give guidance about the main sources of environmental impact. they are the following:

- In products with plugs, energy consumption is a point of interest.
- The weight (in kg) is an indication of the importance of the environmental aspect. Special care must be taken with materials with a high energy content necessary for their obtainment (for example Al) and heavy metals (Cd, Zn, Pb, Cu, Cr, etc.). In both cases the weight will be multiplied by 10 in order to make the comparison and prioritisation.
- Pay attention to the consumption of auxiliary materials during the utilisation phase of the product.

Other recommendations:

- Once the priorities have been defined, mark them with a different colour on the MET.
- Receive assistance from an environmental consultant (expert in Ecodesign) for in order to establish priorities.

- ***WHEN the utilisation of the MET matrix is recommended.***

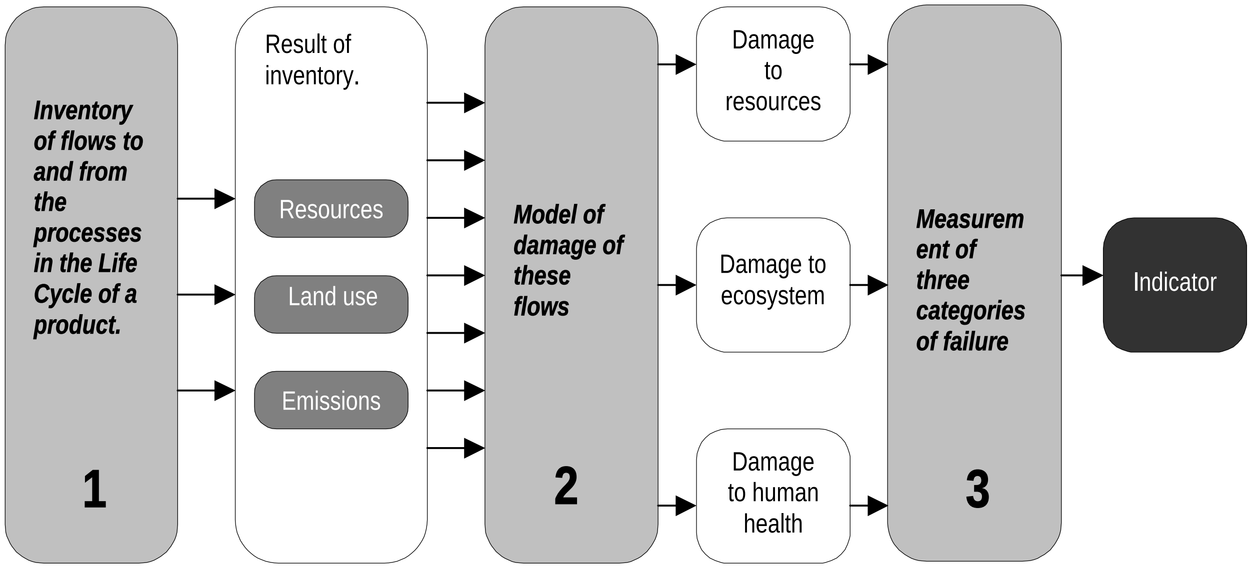
- When one starts working in Ecodesign, as it facilitates an understanding of the whole process and the importance of optimising each environmental aspect.
- When there is support from an expert in Ecodesign or environmental consultant.
- To gather data before using the Eco-indicators or a Life Cycle Analysis software tool (allows all the information for each stage of the product's Life Cycle to be very well organised).
- When it is of interest to have quickly an overall view of the environmental priorities and great accuracy is not required.
- When there are no relevant Eco-indicators for materials or processes of the product.

2.3.2.- Eco-indicators.

- ***WHAT are Eco-indicators?***

The Eco-indicator is an easy to use quantitative tool for product designers. It is more precise than the MET matrix when prioritising the main environmental aspects of the product in its Life Cycle. It is quantitative because the prioritisation is based on the numerical calculations.

Eco-indicators are the result of a project developed by a multi-disciplinary team formed by leading edge industries in different sectors, scientists from independent research centres and the Dutch Government. Their objective was to try to evaluate the environmental impact on the Environment exercised by industrial activity, concentrating on the impact on the ecosystem, resources and human health at European level. Accordingly impacts such as the following were taken into account: the greenhouse effect, the reduction of the ozone layer, acid rain, the reduction of natural resources, the reduction of biodiversity and smog (these aspects analysed in the introduction chapter of this manual). The model presented here is only one of the existing models, its accuracy is not yet precisely known (the same as the rest of the models). It is however the most widely used model with regard to the use of Eco-indicators for Life Cycle Analysis.



As a result, tables of numeric values were obtained which express the environmental impact according to the quantity or volume of each material or process. These values are expressed in their own units which are called millipoints (mPt) which are not comparable with any other traditional unit of measurement.
The full listing of the available Eco-indicators '99, and also further information relating to these may be consulted in Annex A ***Eco-indicator ‘99*** of this manual.

- ***HOW Eco-indicators are USED.***

For the application of Eco-indicators to our product, there are sheets to be filled in which are of the type shown below. Also brief instructions are given regarding their use. This is explained in greater detail in the Annex A ***Eco-indicator ’99.***

Product or component	***Project***
Date	***Author***
Notes and conclusions	

Production ***(Materials, processes and transport).***

Material or process	***Quantity***	***Indicator***	***Result***
Total			

Use ***(Transport, energy and auxiliary materials).***

Material or process	***Quantity***	***Indicator***	***Result***
Total			

Waste ***(For each type of material).***

Material and type of process	***Quantity***	***Indicator***	***Result***
Total			

TOTAL (all phases)	

The Life Cycle of the product on this sheet is divided into three stages:

- ***Production.-*** This includes both the obtainment of the necessary materials and factory production of our product. Each aspect will be listed separately (materials, processes, transport of materials, waste, etc.) and their corresponding quantity (in the units determined in the lists of Eco-indicators – see Annex A ***Eco-indicator '99***, at the end of this manual) and the corresponding Eco-indicator, obtaining as a result the product of both. The Eco-indicators of materials will be used for materials which form part of the product and auxiliary materials; those of process for the various operations undergone by the components before they reach the factory and in the factory; and waste ones for waste in each process according to their destination. Also transport Eco-indicators will be used for the transport of the components or materials from the suppliers to the factory.
  The partial sum of these values in this phase will give us an idea of the impact of the product in the production phase compared to the use and final disposal phases of the product.

- ***Use.-*** This includes both the transport of the product from the factory to the final distributors and consumers, and also the consumption of energy and consumables of the product throughout its useful lifetime (for which one must define what the useful life time of the product approximately is), and the packaging which the product carries (indicators of materials).

- ***Waste.*** This refers to the final destination of the product and its components once its useful lifetime has been completed. According to the destination given to each part or the whole, a different Eco-indicator will correspond to it (recycling, tip, incineration etc.)

Finally everything is added together, with which we obtain a quantitative value of the impact of our product throughout the whole of its Life Cycle.

– ***HOW TO PRIORITISE the main environmental aspects using Eco-indicators.***

Once all the materials, processes, transport etc. have been quantified with the Eco-indicators, one may:

- see which aspects have the greatest numerical result.
- identify in which phase those main environmental aspects are produced (production, use, waste, etc.).

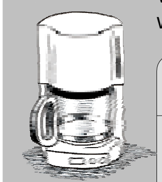
This may help the company to identify and prioritise actions for the environmental improvement of the product.

– ***WHEN the utilisation of Eco-indicators is recommended.***

- In combination with the MET matrix when working in Ecodesign for the first time. This facilitates an understanding of the calculations and their importance.
- When it is wished to prioritise the main environmental aspects of the product without having an outside consultant and where it is not wished to use a software tool; and data exists of relevant Eco-indicators for the products and processes necessary in the lists published in the Annex.
- When it is wished to base the environmental prioritisation on figures (quantitatively).

LIMITATIONS OF THE TOOL.- Eco-indicators are figures which require a laborious process for their obtainment. At the present time there are lists included in the Annex Eco-indicator '99, however new Eco-indicators are in continuous development. Therefore sometimes it may happen that the indicator we need has not yet been defined.
For example in the company Daisalux, S.A. of Vitoria-Gasteiz there was no indicator for NiCd batteries (used until that time in its product and highly toxic as they have heavy metals) so the improvement obtained with their replacement by a battery with less impact such as NiMH is not reflected in the total calculation of Eco-indicators.
This will therefore be a case where the availability of the most relevant Eco-indicators for the product does not allow one to observe the environmental improvements obtained. In these cases the use of Eco-indicators will not be recommended.

EXAMPLE



We shall now perform the calculation of the environmental impact of the coffee-maker, the characteristics of which we have analysed in the section corresponding to the MET matrix.

Product	***Author***
Coffee-maker	CAFETERAS ENSUEÑO, S.L.

Notes and conclusions
Analysis of the coffee-maker of the company CAFETERAS ENSUEÑO, S.L., the technical characteristics of which we have described previously.

Production ***(Materials, processes y transport).***

Material or process	Quantity	Indicator	Result
Expanded polystyrene – EPS	1 kg	360	360
Injection moulding - 1 (PS)	1 kg	21	21
Aluminium 0% rec. (Al)	0,1 kg	780	78
Extrusion - aluminium	0,1 kg	72	7,2
Steel	0,3 kg	86	25,8
Glass (white)	0,4 kg	58	23,2
Heat from gas (moulding)	4 MJ	5,3	21,2
Flexible PVC	0,1 kg	240	24
Copper (Cu)	0,05 kg	1400	70
Transport of printed circuit	0,9tkm	72	64,8
Total			695,2

Use ***(Transport, energy and auxiliary materials).***

Material or process	Quantity	Indicator	Result
Transport (28 t lorry)	10 tkm	22	220
Cardboard (packaging)	0,4 kg	69	27,6
Polyethylene bag (PET)	0,01 kg	380	3,8
Paper (Instruction manual)	0,04 kg	96	3,84
Low voltage electricity	375 kwh	37	13.875
Paper (filter)	7,3kg	96	700,8
Total			14.831

Waste ***(For each type of material).***

Material and type of process	Quantity	Indicator	Result
Urban waste, PS.	1 kg	2	2
Urban waste, steel.	0,4 kg	-5,9	-2,4
Urban waste, paper.	7,3 kg	0,71	5,2
Urban waste, PVC	0,1 kg	10	1
Urban waste, aluminium	0,1 kg	-23	-2,3
Domestic refuse, glass	0,4 kg	-6,9	-2,76
Total			0,74

TOTAL (all phases)	***15526,94***

From the analysis carried out by means of using the Eco-indicators we may observe how energy consumption in the product utilisation phase represents the greatest value, and therefore the greatest environmental load. This is followed in importance by the consumption of paper owing to the use of paper filters and the use of Polystyrene (PS).

2.3.3.- Software tools for Life Cycle Analysis (LCA)

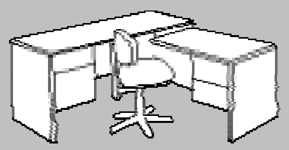
– ***WHAT is LCA?***

Although all the tools we have described so far (MET matrix and Eco-indicators) serve to make the analysis of the Life Cycle of the product, the **software tools** used for this same purpose are generically called LCA.
There are many detailed software programs to carry out Life Cycle Analysis.
Below is a table with the most important software tools arranged according to their ease or simplicity of operation (from the simplest to the most complex). Fuller information, with the internet addresses of the demo versions available of these and other additional characteristics are to be found in the tools chapter of this manual.

	Description	Users	Operation
Eco-it	Simple tool for Life Cycle Analysis. Evaluation on the basis of the Eco-indicator '95 method. Provides values for guidance, not absolute values. Will soon include standard values of Eco-indicator '99.	Product design teams. No special environmental knowledge required.	Simple. Does not require advanced knowledge of the methodology.
Ecoscan	Simple tool for Life Cycle Analysis. Evaluation based on the Eco-indicator '95 method, although it is adaptable to others (makes it possible to increase the starting data base).	Product design teams. No special environmental knowledge required.	Simple. Does not require advanced knowledge of the methodology.
Simapro	Complete Life Cycle Analysis tool. Evaluation on the basis of various methodologies. Will soon include standard values of Eco-indicator '99.	Design department or R&D.	May be complex. Requires knowledge of the methodology, and entering a large number of data into the system.
Team	Complete Life Cycle Analysis tool. Evaluation based on various methodologies.	Experts in Life Cycle Analysis.	Complex. Requires knowledge of the methodology.
Idemat	Simple tool based on environmental evaluation oriented to the selection of materials and processes.	Design department or R&D.	Quite simple.

- ***HOW TO PRIORITISE the main environmental aspects with a software tool..***

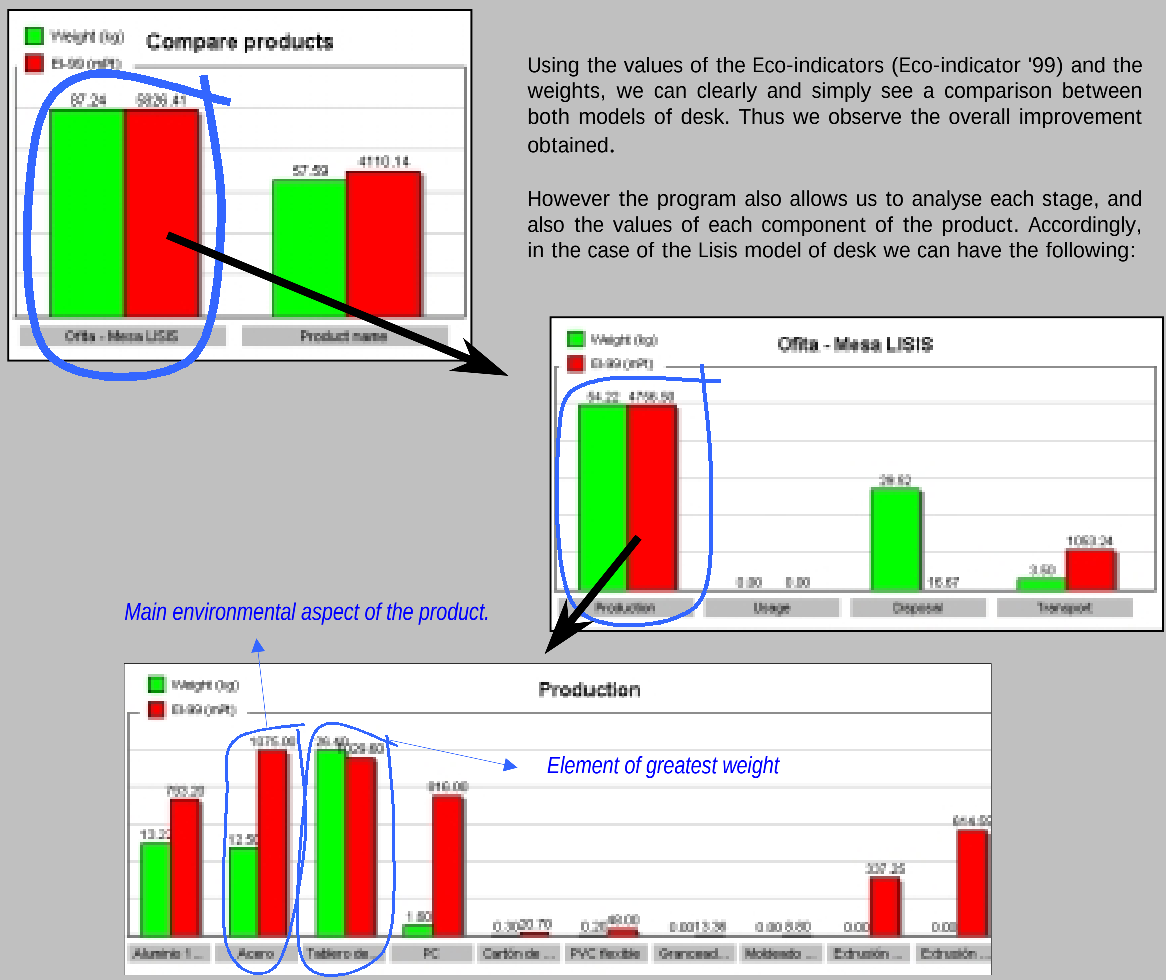
EXAMPLE



The office furniture company OFITA, S.A.M.M., situated in Vitoria-Gasteiz with 94 employees, developed a model of desk with Ecodesign criteria (Genius Model), on the basis of a previous model (Lisis Table). We shall analyse this case with the help of a software tool (in this case Ecoscan 2.0).

Using the values of the Eco-indicators (Eco-indicator '99) and the weights, we can clearly and simply see a comparison between both models of desk. Thus we observe the overall improvement obtained.

However the program also allows us to analyse each stage, and also the values of each component of the product. Accordingly, in the case of the Lisis model of desk we can have the following:



– ***WHEN the utilisation of a software tool is recommended.***

- When it is wished to base the environmental prioritisation on figures (quantitatively).
- When it is wished to compare the environmental aspects of various alternatives of the same product.
- When we analyse excessively complex products (in which case the use of Eco-indicators would require many operations) or formed by sub-systems common to several products.
- When valuations are going to be made of the environmental aspects periodically, as entering the data is more complicated but once it has been carried out, the calculations are much quicker and safer.

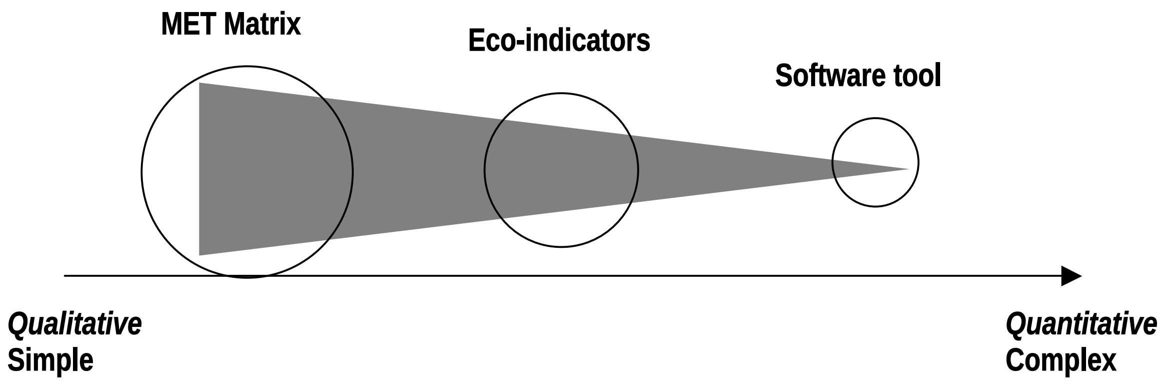
2.4.- Differences between the three types of tools for Life Cycle Analysis.

	ADVANTAGES	DISADVANTAGES
MET Matrix	- It is the simplest and quickest. - It provides an overall view of the Life Cycle of the product (inputs and outputs in each stage). - It allows us to analyse environmental priorities even though relevant Eco-indicators for the product do not exist. - It allows all the information to be well organised for each stage of the Life Cycle **(mainly if working in Ecodesign for the first time).**	- It does not provide a numeric quantification of either the main impacts or the critical stage of the Life Cycle (it is for guidance). - It requires ample environmental knowledge or the collaboration of an environmental expert capable of analysing the results.
Eco-indicators	- It allows one to understand better the methodology and results **(mainly if one is working in Ecodesign for the first time).** - Numeric valuation of the environmental impact of products and processes without using a software tool. - It does need any environmental expert, as it is known how to use the tool.	- Lists of Eco-indicators not yet well developed and some of them not fully adapted to the real situation in each territory/country. - Difficult numerical operations in the case of complex products.
LCA Software	- Facility of calculation and iteration. - Possibility of adaptation to the company itself with the inclusion of its own valuation parameters. - They make it possible to compare simply alternatives to a same product.	- Hinders understanding and internalisation of the results and the methodology the first time one works with Ecodesign if the MET matrix and Eco-indicators are not used in parallel. - The acquisition of the software program requires an economic outlay, although normally this is not usually very large. It may vary between 240 and 3,200 Euros, according to the tool used (1). - Not all programs have a version in Spanish. - The available data bases are not very extensive for the moment. - Data entry into the tool may take some time depending on the tool in question (see table of software tools).

(1).- Figures at September 2000.

The above table shows the advantages and disadvantages of each tool. Each company will be responsible for evaluating which is the most appropriate tool on the basis of the characteristics and needs of the company itself.
Nevertheless we recommend the following:

- To use the MET matrix and the Eco-indicators the first time you work in Ecodesign and with support from an outside environmental expert.
- Use a software tool (the one which is best adapted to the company's needs) on subsequent occasions. This prevent errors of calculation and once the data have been entered it facilitates the periodic utilisation and valuation of various alternatives for the product.
- It is important to use these tools within the framework of the whole methodology without missing out the rest of the stages, in which case the Ecodesign process would be partial and incomplete.


MET Matrix
Eco-indicators
Software tool
Qualitative
Simple
Quantitative
Complex

3

IDEAS FOR IMPROVEMENT

Their generation, selection and evaluation

IHOBE
Sociedad Pública Gestión Ambiental

3

3 IDEAS FOR IMPROVEMENT

Their generation, selection and evaluation.

Outline of the stage

OBJECTIVES	To generate and prioritise ideas for improvement of the product.
PERSONS OR DEPARTAMENTS INVOLVED	- ***Technical or design department:*** lead and participate in the generation, selection and evaluation of the ideas for improvement. - ***Other departments:*** support in the generation, selection and evaluation of ideas for improvement on the basis of their particular knowledge. - ***Management:*** approval of the selected measures for improvement. - ***Outside environmental expert (if participating in the project):*** his participation in the process of generation, selection and evaluation of the ideas for improvement is recommended, as he may give ideas and information about measures and improvements from an environmental viewpoint. - ***Outside designer (where he exists):*** his participation in the process of generation, selection and evaluation of the ideas for improvement is recommended.
TOOLS	- Tools for the generation of ideas for improvement: - The 8 strategies of Ecodesign. - El Brainstorming. - Tools for assessing ideas for improvement: - Prioritisation matrix.
PLANNING	20-80 hours

3.1.- Introduction to the generation of ideas for improvement.

In the previous chapter we learned about the main environmental aspects of our product. Now we shall deal with their optimisation by generating ideas for improvement.
Throughout this process, all types of ideas for improvement will arise. Therefore, once they have all been obtained, we shall proceed with their selection, analysis and prioritisation, as the objective is to concentrate on the improvements which refer to principal environmental aspects or are aimed at the fulfilment of the Motivating Factors of the company to perform Ecodesign.
For the generation of ideas for environmental improvement it is appropriate to use the table of the 8 strategies shown in section 3.1.1. as any type of idea for environmental improvement may be classified on the basis of one of the 8 strategies. It makes for a good starting point and it may serve to guide and inspire us.
Additionally the generation of ideas is a creative process for which different techniques exist.
In section 3.1.2. we propose one of these, brainstorming, owing to its simplicity, because it is already used in many companies of CAPV and the possibility of achieving one of the most important requirements in the matter of Ecodesign: *involvement and connection of different departments of the company.*

3.1.1.- The 8 strategies of Ecodesign.

During the performance of the Life Cycle Analysis with any of the tools described in the previous chapter, we have known which are the main environmental aspects of the product. Accordingly, some ideas for environmental improvement of the product will have arisen spontaneously. Nevertheless, they will not be the only possible ones. Therefore, for the generation of ideas we shall not concentrate on the main environmental aspects, but we shall take account again of all phases of the product Life Cycle. This will give us greater freedom and greater possibilities.

Knowing which the main environmental aspects (Chap. 2) are, and also the Motivating Factors of the company for Ecodesign (Chap. 1) will serve us when it comes to assessing and prioritising the ideas to be developed (second stage of this chapter) and when it comes to developing them and implementing them in the new product (Chaps. 4 and 5).

There are various strategies into which all ideas for the environmental improvement of a product may be classified. A total of 8 strategies may be adopted and these are shown in the table below and which are related in turn with the various stages of the product Life Cycle.
As an exception to this comment, the last of these (strategy number eight "optimising the function") is a strategy of "radical" change which means changing the concept of the product or service. Taking a bird's eye view of the product, we analyse the various needs which it meets and we think of other ways in which we could provide or meet these needs.

Throughout this process we must bear in mind the Motivating Factors analysed in the first chapter of the manual (demands of customers, legislative requirements and so forth) as they will help us to direct our work.

	Strategies for improvement	Types of Associated Measures	Comments
Obtainment & consumption of material and components	***1.- Select low impact materials.***	- Cleaner materials. - Renewable materials. - Materials with a lower energy content. - Recycled materials. - Recyclable materials.	- On the basis of the materials used and the processes necessary for their obtainment, we shall analyse the possibility of other alternative materials which have a smaller environmental impact, maintaining identical technical features or even improving on them.
	2.- Reduce the use of the material.	- Reduction of weight. - Reduction of volume (of transport).	- Reducing the use of materials means at the same time a reduction in the environmental aspect of the product and the reduction of costs for the company. Thus, we shall try to ensure that the volume is as small as possible, so it will occupy less space and will allow transport and storage to be optimised, which will entail another reduction of costs.
Factory Production	***3.- Select environmentally efficient production techniques.***	- Alternative production techniques. - Fewer stages of production. - Lower/cleaner energy consumption. - Less production of waste. - Production consumables: fewer/cleaner.	It is a question of obtaining "cleaner production" by means of improvements in production techniques, that is for example: - improvements in auxiliary materials. - good operating practices in production. - re-use in factory. - technological changes.
Distribution	***4.- Select environmentally efficient forms of distribution.***	- Packaging: less/cleaner/reusable. - Energy efficient mode of transport.	The aim is for the transport from the factory to the retailer or end user to be as efficient as possible. Aspects such as packaging, the means of transport and logistics will be dealt with.
Use or utilisation	***5.- Reduce the environmental impact in the utilisation phase.***	- Lower energy consumption.. - Cleaner energy sources - Less need for consumables. - Cleaner consumables. - Avoid wasting energy/ consumables.	The products for their operation need all types of consumables (energy, water, detergent, filters and so forth). This also applies to maintenance, cleaning and repair. In this stage we shall therefore attempt to think up ways of designing the product in such a way as to optimise the use of consumables or we may even eliminate some of these.
End of life system. Final disposal	***6.- Optimise the life cycle.***	- Reliability and durability. - Easier maintenance and repair. - Modular structure of the product. - Classic design. - Strong product – user relation.	We may distinguish the following in the life cycle of a product: - Technical Life Cycle – Time during which the product works well. - Aesthetic Life Cycle – Time during which the user finds the product attractive. The ideal situation would be for both to coincide. Nevertheless, it is not usually so and offer a product which works correctly is thrown away because we no longer find it attractive. Therefore, in this stage we shall seek to prolong and equal both cycles. For example, by means of a classic design, we will prevent the user becoming tired of the product, and also create a strong product – user relation.
	7.- Optimizar el sistema de fin de vida.	- Re-utilisation of the product. - Remanufacture/ modernisation. - Recycling of materials. - Safer incineration.	This strategy is intended to reuse the valuable components of the product and to guarantee adequate waste management. The goodness of the measures is in descending order, that is to say one must tend towards reuse and if this is not possible, remanufacture, recycling or incineration in this order.
New product ideas	***8.- Optimise the function.***	- Shared use of the product. - Integration of functions. - Functional optimisation of the product. - Replacement of the product by a service.	In this strategy the attention will not be fixed on our physical product, but on the function it satisfies. For this we shall research the needs of users, analysing: What need or needs does the present product satisfy? How could the features of the product be optimised? Can an alternative system which better satisfies the same need be developed?

The company may use the table of the eight strategies of Ecodesign in the ***Tools*** section of the manual as a model for generating ideas.

3.1.2.- Brainstorming

To help us to generate ideas it is recommended to use a brainstorming session. This consists of getting together various persons from different departments of the company around the eight existing strategies, in such a way that they may all express the ideas which occur to them in relation to the said strategies.
In this brainstorming the participation of different departments of the company is important, as each one has a different point of view and this may give greater richness to the process and favour all relevant matters to be taken into account.
For this same reason the presence of the management is also very important, as it will understand the conclusions more easily and that will facilitate their approval.
There are basic rules of the operation of brainstorming which must be explained to the participants at the beginning of the session.

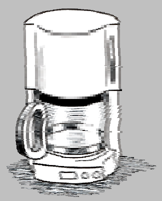
Rules of operation of brainstorming

- *State all ideas.*
- *No criticism is allowed.*
- *Say the first thing that comes into your head.*
- *It is the quantity and not the quality of ideas which is important (the quality will be taken into account in the selection).*
- *Combinations may be made with other ideas. The idea is of the group and not individual.*

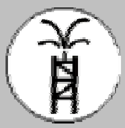
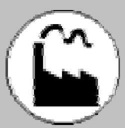
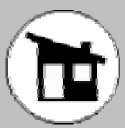
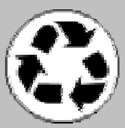
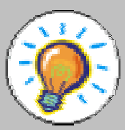
There will be one person who leads the brainstorming. This person will preferably be from the technical or product development department and will act as the natural leader of the whole project. His functions will be to:
- Convene all the participants.
- Explain the objective of the meeting.
- Explain the rules of brainstorming.
- Present the eight strategies in order that they may serve as an inspiration for the participants. It is not necessary to follow the order of the eight strategies. Structuring the meeting too much may reduce creativity.
- Make the meeting dynamic: for it to be active and for there to be no moments of silence. In order to prevent this it is appropriate for the leader himself to throw some new ideas in which will make it dynamic, or if there is evidence that creativity has been exhausted, it is preferable to end this phase of the meeting and go on to the selection of the best ideas which will be discussed. The leader must seek to remain neutral and not direct the attendees towards his own opinions.
- Facilitate the selection of ideas.

Once the brainstorming session has ended, the selection of ideas will take place. For this each participant will choose those which are the best in his opinion. All the votes will be counted and the 10 to 15 preferred ones will be chosen.
This process does not have to be developed from a technical or financial point of view, but from the perspective of which are, in the opinion of each, the most interesting ideas for the product, as this assessment will be made subsequently.
In some cases it may be recommended to comment on all the ideas arising, group those which in the opinion of the group represent the same improvement, and define them in a practical way with a view to their inclusion in the set of conditions.
In any case, it will be in a subsequent phase when each of the ideas selected is assessed in greater detail and prioritised.

EXAMPLE



With the environmental aspects defined and bearing in mind the Motivating Factors for Ecodesign, the company CAFETERAS ENSUEÑO, S.L. carried out a brainstorming session, from which the following ideas for improving the product arose:

	Strategies for Improvement	Measures generated in brainstorming
Obtainment & consumption of material and components 	1.- Select low impact materials.	- Use of biodegradable plastics. - Use of recycled plastic in internal parts. - Use of recycled aluminium. - Use of cables without PVC.
	2.- Reduce the use of material.	- Less thickness and weight of the coffee maker body. - Eliminate the jug (cup holder).
Factory Production 	3.- Select environmentally efficient production techniques.	- Degreasing with water based products (instead of solvents). - Moulding machines with high efficiency in energy consumption. - Elimination of electrostatic printing and painting of parts.
Distribution 	4.- Select environmentally efficient forms of distribution.	- Reduce thickness of packaging carton. - Use of recycled cardboard. - Insert graphics to encourage recycling of cardboard packaging among consumers. - Instruction manual in only 1 or 2 languages.
Use or utilisation 	5.- Reduce the environmental impact in the utilisation phase.	- Better insulation of the jug. - Supply hot water to the coffee maker direct. - Use of permanent filter. - Automatic switch-off system of the coffee maker after a certain time. - Use renewable energy sources. - Use of gravity for water – without evaporation.-.
End of life system. Final disposal 	6.- Optimise the Life Cycle.	- More durable glass jug – unbreakable material.-. - Offer a repair service
	7.- Optimise the end-of-life system.	- Easily demountable electrical part. - Product collection system (Renove plan). - Marking of plastic pieces to facilitate their subsequent recycling.
New product ideas 	8.- Optimise the function.	- Napolitan coffee maker (without filters, gas heated). - Supply and sale of coffee tablets. - Machines which serve each cup of coffee cold. - Machines which serve coffee, tea and other hot drinks (several functions in one machine). - Create a system for home delivery of coffee.

After generation, the selection and grouping of the ideas which the group considered to pursue the same objective took place. Thus finally the following final strategies for improvement were reached:

Selected Measures

Obtainment & consumption of materials & components

a.- Use of recycled plastic in internal parts
b.- Use of recycled aluminium

c.- Less thickness – weight of the coffee-maker body

Factory production

d.- Elimination of electrostatic printing and painting of parts

Distribution

e.- Use of recycled cardboard.
f.- Insert graphics to encourage recycling of cardboard packaging among consumers

Use or utilisation

g.- Better insulation of the jug.

h.- Use of permanent filter
i.- System of automatic switching off of the coffee-maker after a certain time

j.- Use of gravity for water – not evaporated -

End of life system. Final disposal.

k.- More durable glass jug – unbreakable material -.

l.- Electrical part easily demountable.

m.- Marking of plastic parts to facilitate later recycling.

New product ideas

n.- Neapolitan coffee-maker (without filters, heated by gas)

Grouping and practical definition of the measures

Obtainment & consumption of materials & components

- Unification in the use of materials, using those of recycled origin where possible *(grouping of measures a and b)*

- Less thickness – weight of the coffee-maker body *(measure c)*

Factory production

- Elimination of electrostatic printing and painting of parts (*measure d)*

Distribution

- Use of recycled cardboard (measure e).
- Insert graphics to encourage recycling of cardboard packaging among consumers (measure f)

Use or utilisation

- Reduction of the energy consumption of the appliance (grouping of meaures g, i and j)
- Use of permanent filter (measure h)

End of life system. Final disposal.

- More durable glass jug – unbreakable material (measure k)

- Electrical part easily demountable (measure l).
- Marking of plastic parts to facilitate later recycling. (measure m)

New product ideas

n.- Neapolitan coffee-maker (without filters, heated by gas)

These measures for improvement must then be assessed in greater detail and prioritised.

3.2.- Assessment and prioritisation of the selected ideas/measures.

At this point of the process we are now left with the ideas which obtain the highest number of votes. Now we shall assess in a little greater detail and prioritise each of these. Study among others the following criteria for prioritisation:

- ***Technical feasibility***.- This refers to the possibility of applying the proposed idea with the available technical resources of the company.
- ***Financial viability.-*** This evaluates the economic viability of the improvement. Can the necessary economic cost for the proposed idea be met? It will therefore be necessary to study the costs which entail the application of the idea both in preliminary studies and in practical application in the production chain.
- ***Expected benefits for the Environment.-*** Assesses the importance which the selected idea will entail for the environment specifically.
- ***Positive response to the main Motivating Factors.-*** If it positively affects the Motivating Factors which led the company to perform Ecodesign it is an idea of greater value.

Each of these may be assessed for example according to the following criteria:

2	Very positive score/very feasible
1	Positive score/feasible
0	Neutral score
-1	Negative score/almost unfeasible
-2	Very negative score/completely unfeasible

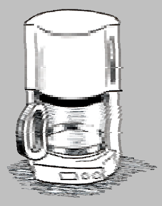
Apart from the criteria indicated here, each company may define new ones according to their own characteristics or needs (quality and so forth) or give greater weight to some criteria rather than to others.
For the assessment other departments which have not yet intervened in the process must be involved, such as the financial department of the company.

When all the selected measurements for improvement have been assessed, we shall proceed to prioritise them, deciding whether each of these is effectively interesting and applicable in principle in the short (ST), medium (MT) or long term (LT). This will be shown in the **prioritisation** column.

In this phase the prioritisation matrix included in the tools section of the manual may be used as a tool.

The whole of this process must be developed, carefully evaluating each of the relevant criteria for the company which are involved as, as a result of this, there will come the improvements which in subsequent stages we shall apply to the product.
Therefore, supervision by the management will be an essential aspect on this point.

EXAMPLE



Let us see below the prioritisation matrix which the company CAFETERAS ENSUEÑO, S.L. carried out on the basis of the ideas which arose in the brainstorming session.:

Prioritisation Matrix

Selected measures	Technical feasibility	Financial viability	Benefits to the environment	Positive response to the main Motivating Factors	Prioritisation
Obtainment and consumption of materials & components					
- Unification and the use of materials, using those of recycled origin where possible(grouping of measures a & b).	-1	1	2	1	ST/MT/LT (1)
- Less thickness and weight of the coffee maker body (measure c).	-2	-1	1	1	MT
Factory production					
- Elimination of electrostatic printing and painting of parts (measure d)	1	1	1	1	ST
Distribution					
- Use of recycled cardboard (measure e)	2	1	1	1	ST
- Insert graphics to encourage recycling of cardboard packaging among consumers (measure f)	2	2	1	1	ST
Use or utilisation					
- Reduction of energy consumption of the device (grouping of measures g, i and j).	1	-1	2	2	ST/MT/LT (2)
- Use of permanent filter (measure h)	1	-1	2	2	ST
End of life system. Final disposal.					
- More durable and glass jug – unbreakable material (measure k)	-1	-2	1	2	LT
- Easily demountable electrical part (measure l)	1	-1	1	1	MT
- Marking of plastic parts to facilitate their subsequent recycling (measure m)	2	1	1	1	ST
New product ideas					
- Neapolitan coffee maker (no filter, gas heated) (measure n)	-1	-1	1	-1	Ruled out (3)

2	Very positive score/very feasible
1	Positive score/feasible
0	Neutral score
-1	Negative score/almost unfeasible
-2	Very negative score/ completely unfeasible

ST:	Short Term
MT:	Medium Term
LT:	Log Term

(1).- In the short term the use of recycled material for internal (not visible) plastic parts is proposed. In the medium term it will be attempted to replace the aluminium tube by the same type of plastic as the body of the coffee-maker. In the long term and according to progress in technology it will be attempted to develop the whole product with recycled material.

(2).- It is thought possible to reduce the energy consumption of the appliance in the short term. In any case, this is considered to be a priority task and of continuous improvement, so it is proposed that this continue in constant research throughout time, adapting to new technological progress.

(3).- It is of no interest to the young market, it does not respond to the main Motivating Factors. The rest of the valuation criteria are not even of interest. The measure is RULED OUT now that it has been discussed in a little greater detail.

4

DEVELOPING CONCEPTS

Development of different concepts for the product

IHOBE
Sociedad Pública Gestión Ambiental

4

4 DEVELOPING CONCEPTS

Development of different concepts for the product

Outline of the stage

OBJECTIVES

Development of a technical environmental specification and generation of conceptual alternatives of the product on the basis of the said specification.

PERSONS OR DEPARTMENTS INVOLVED

- ***Quality department:*** Establishment of quality requirements, regulations, etc. for the specification.
- ***Technical or design department:***
  - Establishment of environmental requirements for the specification based on the idea selected in stage 3.
  - Development of concepts.
  - Study of the environmental aspects of the different concepts and selection.
  - Give criteria to the ***outside designer***, where there is one (in which case the two above tasks will correspond to him).
- ***Purchasing department:*** information on new alternatives to materials, technologies etc.
- ***Marketing department:*** information on specific demands of consumers for the establishment of the specification or the appraisal of concepts, and also of materials with good or poor image in the market, etc.

TOOLS

- Creative techniques.
- Selection tools.
- Tools selected by the company for studying the environmental aspects of the product (Eco-indictors, software tools).

PLANNING

50-80 hours

4.1.- Introduction to the development of concepts.

In stage 3 the ideas of environmental improvement were generated and the most relevant options in the short, medium and long term were selected on the basis, among other things, of the Motivating Factors of Ecodesign and the expected environmental benefits.

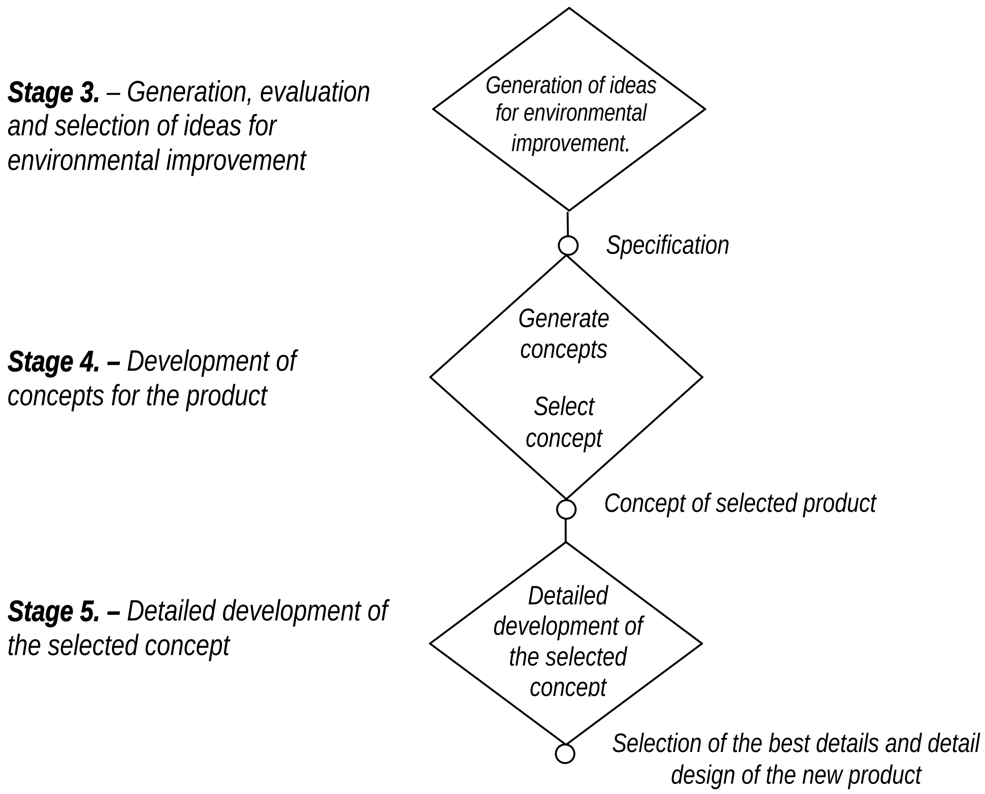
This stage is the beginning of the development phase proper, which will finally lead to a new product.

As the design activity does not follow a step by step method, but is an iterative process (in other words, a process of moving forward and backwards), this part of the manual provides some approaches or practical examples, with the intention of structuring the process.

The ideas for environmental improvement generated in stage 3 define in some way the new requirements in the design. One of these new requirements is, for example, to design a product which uses less energy. These environmental requirements will be included in the specification to be developed in this stage 4 and later translated to specific ideas about the product, therefore providing product concepts, even though without going into details.

The aim of this stage is the obtainment of many solutions for the product or parts of the product which fulfil the requirements of the specification. Alternative concepts must be generated which lead us to a search for the best one. This means that a divergent process takes place.

The development of all concepts signifies an explosion of the number of possibilities to be studied. Therefore convergence is required, and this is achieved by evaluating and selecting the best concepts. In this selection environmental criteria will also be included. The selected concept will subsequently be developed (stage 5) at detailed level, which will again involve a divergent – convergent process.

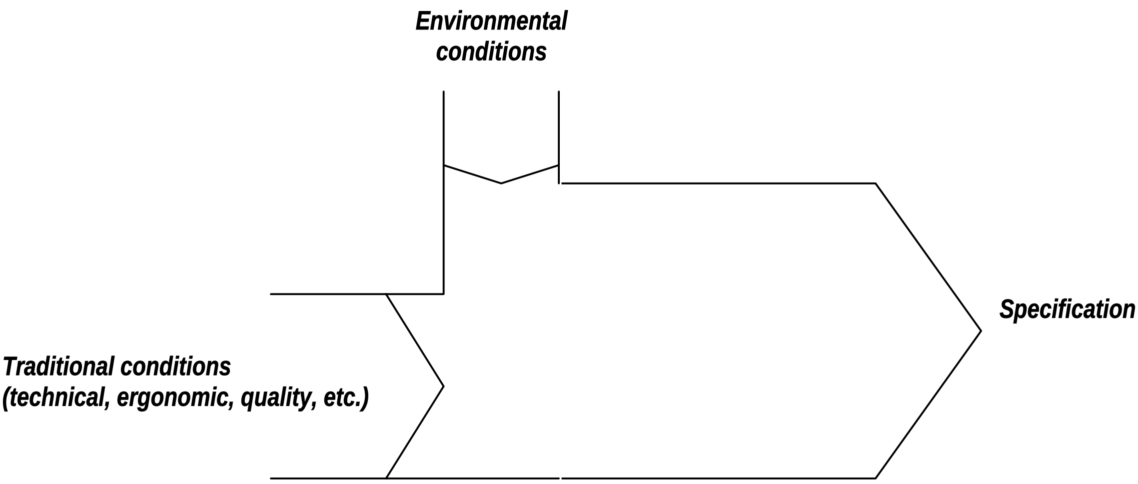


The differences in this stage for an Ecodesign project compared to conventional product development are:

- ***The starting point: environmental requirements in the specification.***
- ***The process of evaluation and selection of the best concept: account will be taken of environmental criteria and tools will be used such as Eco-indicators, software tools for Life Cycle Analysis, or the golden rules for the said selection.***

4.2.- Drafting of the specification.

As a result of the above stages a specification must be established. In this, all the product specification will be taken into account, not only environmental but also technical, ergonomic, commercial and economic specifications.



The above stages concentrated on the Environment, however in the next two stages the Environment is ONE of the requirements of the product, as for the company there is another series of requirements which are just as important or more important than the environmental requirements: technical, economic and quality requirements etc. which we cannot overlook at any time.

If the designer is outside the company, the Ecodesign team must pass on to him clearly the environmental requirements included in the specification for their correct interpretation. This will be simpler if the designer has environmental or Ecodesign knowledge.

4.3.- Generation of new product concepts.

As has been mentioned earlier, the objective of this stage is to develop product concepts. This stage pursues the preliminary design, where the composition, form and material of the product is provisionally defined.
As has been mentioned earlier, the objective of this stage is to develop product concepts. This stage pursues the preliminary design, where the composition, form and material of the product is provisionally defined.
For this purpose, all this information must be collected periodically, informing the technical or product development department about the conclusions.
In the case where the company collaborates with an outside designer, he must meet with the various departments of the company at the beginning of this stage in order to bear in mind all this information detected.

Several developments of conceptual solutions must be considered in parallel in order to find the solution which best meets the requirements of the specification.

There are many ways of (re)designing the product, most of them beginning with a sketch. Each designer has his own method and way of doing it.

When the selected ideas for improvement (stage 3 of the project) are very ambiguous, it may be necessary to investigate or develop them a little more and see what consequences they can have on the product. For example if the selected measure is to "design a coffee-maker which uses less energy" it may be necessary to investigate what possible sources of energy can be used and how each one affects the product.

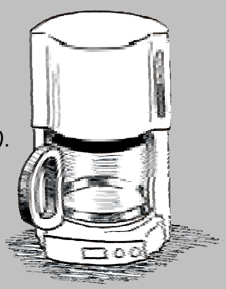
Also the original idea selected in the brainstorming which led to the establishment of the specification may be used.

EXAMPLE

DEVELOPMENT OF CONCEPTS FOR A COFFEE-MAKER

The company CAFETERAS ENSUEÑO, S.L. intends to develop a new model of coffee-maker. For this, it will carry out the design of concepts of coffee-maker on the basis of an analysis of the environmental aspects of the product and the ideas for improvement generated in the previous stages. First it will define the specification of the new product which, in this case, will take the following form:

Technical requirements:



- *Improved fulfilment of the function by keeping the coffee hot.*
- *Innovative image. It is wished to differentiate this coffee-maker from the rest of the products of the competition, achieving a novel product.*
- *Reduction of costs as far as possible (this will not be considered to be a priority aspect).*
- *Reduce the number of necessary spares.*
- *Facilitate as far as possible the handling of the new appliance.*
- *Easy to clean.*
- *Increased speed for fulfilment of the function.*

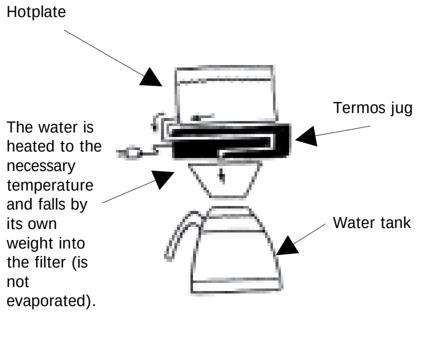
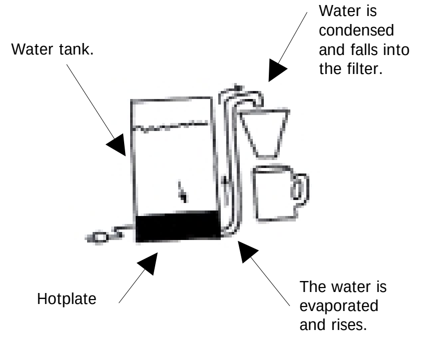
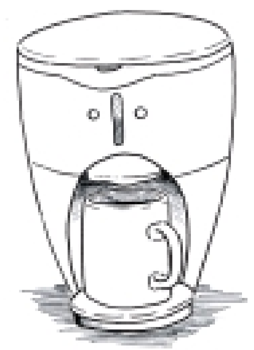
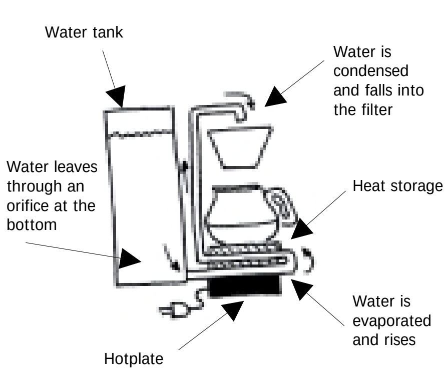
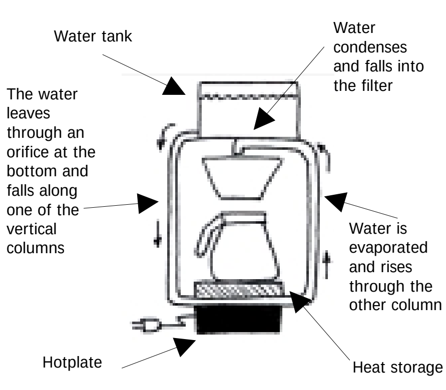
Technical and environmental requirements:

- *Unify as far as possible the use of materials, using materials of recycled origin where possible (measures a and b).*
- *Reduce as far as possible the weight of the coffee-maker body (measure c).*
- *Elimination of electrostatic printing and painting of parts (measure d).*
- *Use of recycled cardboard for packaging (measure e).*
- *Insert logo to encourage recycling of cardboard packaging among consumers (measure f).*
- *Reduction as far as possible of energy consumption of the appliance (measures g, i and j).*
- *Elimination of disposable filters, by adopting a permanent and easily washable filter system (measure h).*
- *More durable jug (measure k).*
- *Develop a product which facilitates the dismantling of the various materials and components both in order to facilitate repairability of the product and to permit adequate treatment at the end of its useful lifetime (measure l).*
- *Marking of plastic parts to facilitate subsequent recycling (measure m).*

On the basis of all these requirements, various product concepts are then developed. Requirements such as the use of recycled plastic in internal parts, reduction of the thickness of the coffee-maker body, elimination of electrostatic printing, use of recycled cardboard, use of a permanent filter and insertion of graphics on the box and on plastic parts (according to ISO 11469) facilitating recycling, which verify all concepts at the same level. The main differences between these are in the way the reduction in energy consumption is responded to.

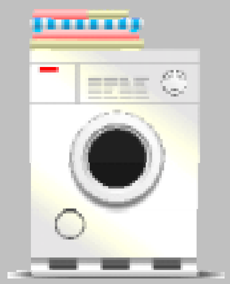
Therefore different concepts are proposed with different functional characteristics, as shown in the graph below:

Development of concepts on the basis of the Specification

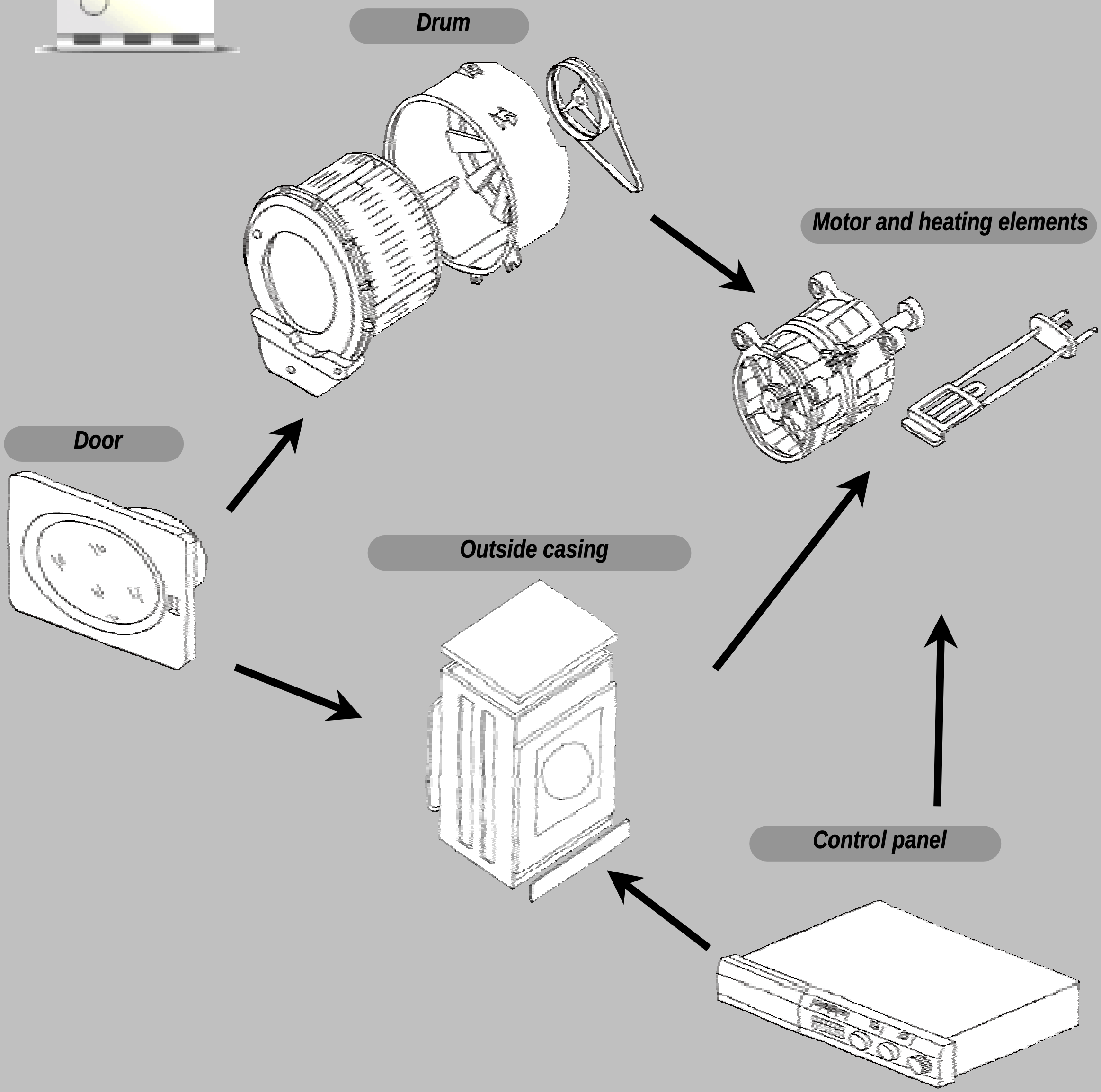
Proposed action	Structure of the new product	Concept of the new product
Thermos jug and no evaporation of water		 A
Elimination of the jug (platform for cups)		 B
Heat storage plate		 C
		 D

When we have a complex product, which we know will have many components (the detailed determination of these will be made in the following stage), we may divide it into various functional sub-systems, all interrelated, forming the product. In turn each one will have different parts but for the present we can consider generally only the sub-systems of the product.
The relation between the various sub-systems may be represented by flow charts.

EXAMPLE



A washing machine may be considered as a complex product in which we shall have various sub-systems, each of which will be formed in turn from a large number of parts. In a case such as this one, the design in stage 4 will be quite general, and having only initial estimates of the number and shape of the parts of each sub-system and also the relations existing between them.



4.4.- Selection of the product concept.

Not all concepts developed in this stage are equally useful. Before going on to the following stage, an evaluation and selection of these concepts is needed. Account must be taken of the possibility of combining the best characteristics of each concept into a single one.

In order to select between the existing concepts we shall make an assessment table of these. For this we shall take into account the requirements contained in the specification. As all the designs have been made considering this document as a basis, they must all fulfil the requirements contained in this. Nevertheless, we will observe that some fulfil functions better than others. Therefore we shall proceed to appraise each of the existing concepts on the basis of the fulfilment of these requirements of the specification.
We can establish various modes of appraisal (good, fair, poor, or scores 1-10). With all those values a global estimate will be made of each of the concepts developed.

So far, the only way this stage differs from a conventional design is that the fulfilment of the ENVIRONMENTAL requirements of the specification is appraised.

For the appraisal of the environmental improvement of the various concepts, the tools used in stage 2 for the analysis of the environmental aspects may be useful. From estimates which would result from each of the concepts referring to materials and their quantities, processes etc., we can obtain an approximation to the expected environmental improvement.
Thus we can have an idea not only of which is the best concept from an environmental point of view, but also whether it is better than the previous design (in the case of redesign) or the existing products in the market.

As we are still at a preliminary phase, the available information on each concept is not exhaustive. The appraisal will therefore have a subjective nature in many aspects. Here therefore the experience of the technical or product design department of the company will be of great importance, and also of the outside designer, where appropriate.
In the latter case it will be of great help for him to have knowledge of Ecodesign. Despite everything, in the end it will be the company which decides and selects the final concept. It will be interesting for the environmental criteria to be discussed and justified by both parties in order to ensure that the objectives and requirements understood by both parties are the same.

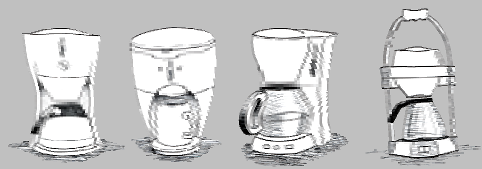
Therefore this stage will end with the selection of one of the concepts. In the next stage we will develop it in detail (and according to this selected concept one may begin to take account of the manufacture and marketing plans).

In this phase, some of the ideas selected in the previous phase which have been the basis of environmental requirements of the specification may be replaced or complemented by better ideas which have arisen during the development of concepts.

EXAMPLE

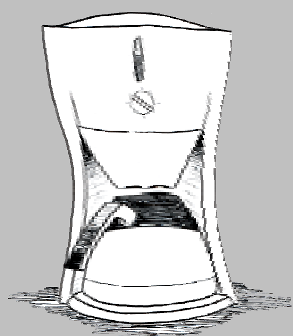
In the case of the company CAFETERAS ENSUEÑO, S.L. they had four developed coffee-maker concepts, of which they had to choose one. For this, each concept was appraised according to its better or worse fulfilment of the requirements of the specification, giving scores between 1 and 5. For the sake of simplicity, the same weight was given to each one, although in other cases, some requirements may carry greater weight than others.

Appraisal of the various concepts



Valuation criteria =Requirements of the specification	Concept A	Concept B	Concept C	Concept D
Improved fulfilment of the function by keeping the coffee hot	3	3	3	3
Innovative image	3	2	3	5
Reduction of costs (NOT KEY)	2	4	2	4
Reduction of number of spares	4	3	2	4
Easy to operate	2	4	3	4
Easy to clean	4	4	3	3
Greater speed for fulfilling its function	3	3	3	5
Unified materials	4	3	5	3
Recyclable materials	4	3	3	3
Reduction of weight of body	3	2	3	4
Elimination of painting and electrostatic printing	3	2	2	3
Utilisation of recycled cardboard in packaging	4	3	2	3
Insertion of logos of recyclable material	3	3	3	3
Reduction of energy consumption	5	3	3	3
Elimination of disposable filters	4	3	3	3
More durable jug	4	5	2	2
Easy to dismantle	4	3	3	4
Marking of plastic parts	3	3	3	3
TOTAL SCORE	**62**	**56**	**51**	**62**

After the appraisal we see that we have a tie between the best two scores. In this case we shall consider which of these obtains the best score in environmental aspects, that is those in the second group of criteria. Accordingly in this example we see that concept A gets a better score than model D in almost all these aspects. Therefore ***we shall choose concept A.*** In the next stage we must define at detailed level each of the necessary parts with their dimensions, finishes, material etc.



Model A.- selected model

5

PRODUCT IN DETAIL

In depth development of the selected product

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5

5 PRODUCT IN DETAIL

In depth development of the selected concept

Outline of the stage

OBJECTIVES

To define the product in detail.

PERSONS OR DEPARTMENTS INVOLVED

- ***Technical or design department:***
  - Develop the product in detail.
  - Evaluate the various alternatives and select materials, processes etc. on the basis of environmental criteria.
  - Give criteria to the ***outside designer*** (if there is one, he will be responsible for the above tasks. The technical or design department will be in charge of indicating the necessary criteria and also any other information required)
- ***Quality department:*** supply specific information on the fulfilment of the quality requirements of the developments of the technical department.
- ***Purchasing and marketing department:*** supply specific information requested by the technical department or outside designer and report on possible problems of the new product etc.

TOOLS

- Tools selected by the company for the study of the environmental aspects (Eco-indicators, software tools).

PLANNING

280-480 hours

5.1.- Introduction to the definition of the new product in detail.

After product concepts have been generated (stage 4), this stage has the object of the detailed definition of the selected concept to obtain a final design. The exact dimensions, materials and production techniques must be determined.

As in the previous stage, the process will be iterative and quite chaotic. The definition of the product will evolve from a stage of rough definition to reaching the level of detail.

In this stage, and in the previous one, the Environment is not the only aspect to be borne in mind as in the first three stages. Nevertheless, unlike conventional product development processes, the Environment is yet another aspect to be assessed and taken into account among others: economic, technical, aesthetic, ergonomic etc.

5.2.- Define the product in detail.

The result of this stage will be a final design of the product, almost ready for its manufacture and introduction into the market.

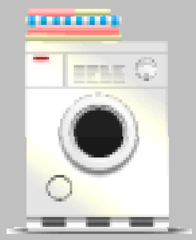
Despite the fact the designer/design team will detail the product as a whole, sketches will probably be made of parts of this. This means that in practice the differentiation between stages 4 and 5 is not as strict as is presented in this manual (as design is an iterative process, it is normal to work in several stages at the same time).

- In a first step, the characteristics of the concept selected in stage 4 are defined in greater depth. The main decisions are taken about the form and construction of the product. The environmental aspect, functionality, reliability, possibility of its manufacture and costs may then be determined. As a result we shall obtain general layout plans made to scale showing the main dimensions and lists of preliminary materials.

- The second step will be the exact definition of the number of parts, the geometrical shape of each, their dimensions, tolerances, surface properties and material. The design must be represented on layout plans, detailed plans and lists of materials and, where appropriate, prototypes.

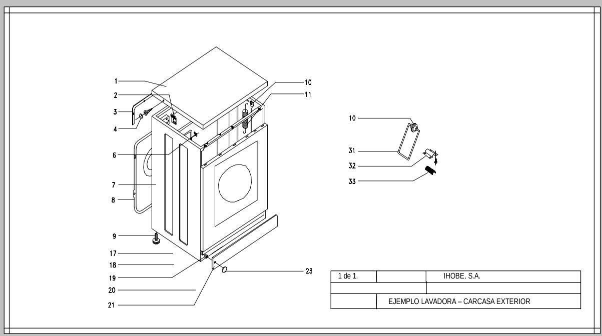
See example of the detailed definition of the coffee-maker of CAFETERAS ENSUEÑO, S.L. at the end of this stage.

EXAMPLE

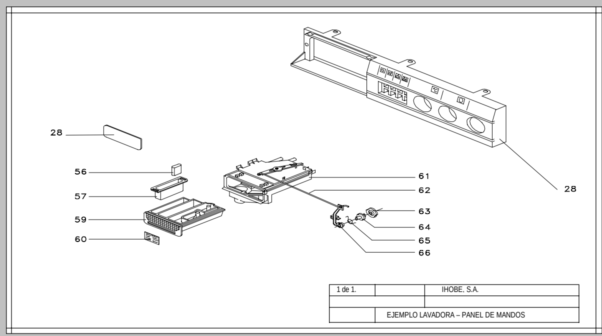


If we take the case of a complex product, which is the case of the washing machine in the previous stage, in this stage we must be capable of defining the various sub-systems exactly. We shall see how in addition to reaching a complete definition, we can define some new sub-system, such as in this case the water conduction sub-system. We will therefore arrive at definition plans as follows:

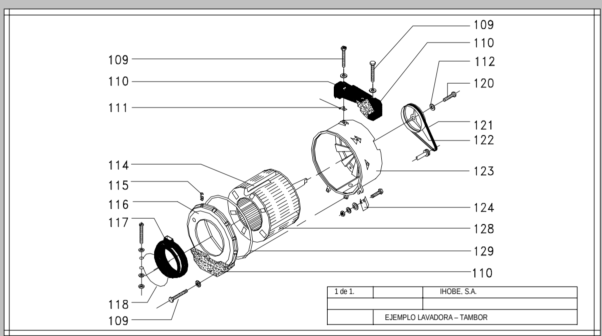
Outer casing



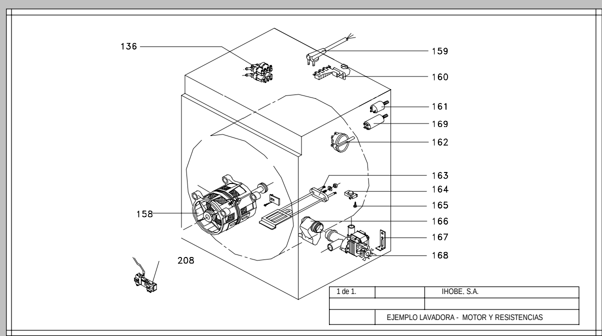
Control panel



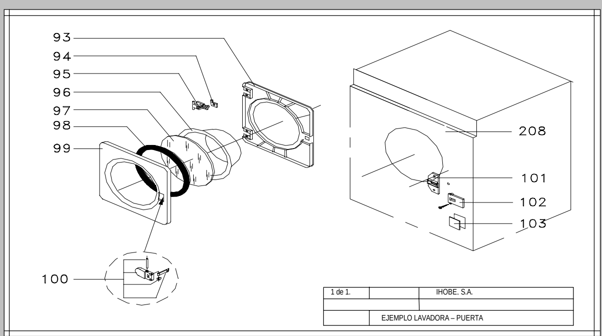
Drum



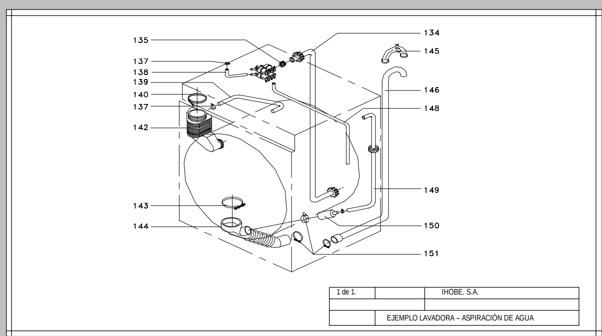
Motor and heating elements



Door



Water conduction system



In this stage the designer must take all types of specifications into account. Part of these will be environmental. In order to define the product, it may be useful to contact suppliers in order to identify alternatives of more environmentally friendly materials or components, with a lower cost or which have a better functionality.

At the same time, in order to help in the selection of materials and processes from an environmental point of view, the Eco-indictors or some of the software tools analysed in chapter 2 may be useful. Accordingly we can appraise for example different materials or alternative processes.

Production of non-ferrous metals (in millipoints per kg.)

Material	Quantity	Indicator	Total	Description
0% recycled Aliminium	0,075	780	58,5	Blocks of material which only contain primary materials
Polypropylene (PP)	0,100	330	33	

Processing of plastics (in millipoints)

Material	Quantity	Indicator	Total	Description
Extrusion - aluminium	0,075	72	5,4	Per kg
Injection moulding-1	0,100	21	2,1	Per kg de PE; PP; PS and granulated ABS, but without production of material.

Eco-indicators for metal production and plastics processing (Eco-indicator '99 Annex).

If one is designing a tea cup, the choice of the material could be made between non-recycled aluminium or plastic (PP). On the basis of the result of multiplying the quantities by their respective Eco-indicators, the best option will be polypropylene PP (35.1 millipoints including the material and its processing), followed by 0% recycled Aluminium (63.9 millipoints), despite the fact that a smaller quantity of material is required to make the cup from aluminium. This is a very simple example, but in practice the choice is more difficult owing to the fact that many of the requirements conflict with each other. So, for example, the use of one material or another will be associated with certain technical characteristics, so the weight for the same part may be different and therefore the final numerical result of the part also.
Also it could affect other associated Eco-indicators, such as those of transport: a material with greater weight or volume will adversely affect the numerical result of the transport in the recalculation of the Eco-indicators. Therefore it is appropriate to analyse whether the change of material also affects other Eco-indicators and recalculate these numerical results before selecting one or the other.
Also see the following example relating to the choice of material for a wind deflector.

EXAMPLE

A wind deflector is a useful item for reducing aerodynamic drag on lorries. However the weight of the deflector itself contributes to increased fuel consumption. Therefore the reduction of the weight of the deflector is an important environmental requirement. A comparison has been made between the applications of deflectors manufactured from steel and deflectors manufactured from expanded polypropylene PP. Expanded polypropylene PP has a higher intrinsic Eco-indicator value than the Eco-indicator of steel. However if one considers the useful lifetime, the deflector manufactured from PP polypropylene has less impact on the environment owing to its lower weight and therefore lower energy consumption in the phase of use. (Source: Collignon M., Leeuwen van A., Geschuimde kunststoffen, Journal 02).

5.3.- Selection of the product concept details.

Several solutions may be generated in the process of design in detail for a particular aspect. After analysing them, the designer or design team must select the best of these.

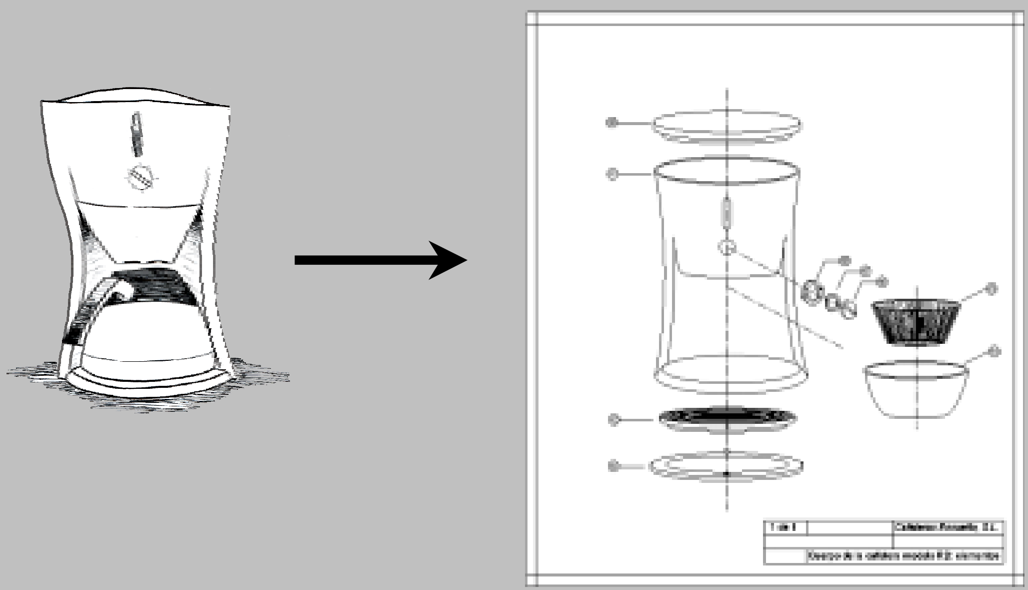
In each of these cases a comparative table may be made of the various possible alternatives similar to that seen in the previous chapter in which different functional aspects will be assessed.
On this occasion the aspects to be appraised will be more specific than in the previous chapter. The methodology to be followed will be similar.

When it comes to obtaining data for the appraisal of the details of the concept it may be useful to do the following:

- **Calculate the cost price of the end product.**
- **Prepare questionnaires aimed at the group of users to find out how the new (re)design fits in with their needs (this could be a task of the marketing department).**
- **Use the Eco-indicators or analysis tools of the main environmental aspects.**
- **Carry out tests or make prototypes to observe the feasibility of each of the details defined.**

EXAMPLE

As the end result of this stage for the example of the company CAFETERAS ENSUEÑO, S.L. we reach a complete definition of the new model chosen, with detailed plans of the assembly and the various components of the product.



6

ACTION PLAN

Medium and long term plan based on the project conclusions

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6 ACTION PLAN

Medium and long term action plan based on the project conclusions

Outline of the stage

OBJECTIVES

- To establish a medium and long term action plan for all measures of environmental improvement of the product **(MEASURES FOR IMPROVEMENT OF THE PRODUCT PRIORITISED for implementation IN THE SHORT TERM are not included in this action plan as it is assumed that they have already been carried out).**
- Permanently integrate Ecodesign into the design tools (at the level of product development department), and also into the management tools (ISO 9001, ISO 14001, marketing plans, etc.) at the level of the whole company.

PERSONS OR DEPARTMENTS INVOLVED

- ***Product development manager:*** leadership and proposal of the initial action plan.
- ***Rest of team:*** Checking and consensus of the final action plan.
- ***Management:*** Approval of the action plans in terms of the product and the company.

TOOLS

- Medium and long term product action plan.
- Action plan at the level of the company for anchoring Ecodesign with the product development procedures.
- Action plan at the level of the company for anchoring Ecodesign into ISO 9001.
- Action plan at the level of the company for anchoring Ecodesign in ISO 14001.

PLANNING

10-50 hours

6.1.- Introduction to the establishment of an action plan.

Once the methodology has been implemented and the Ecodesign tools have been used, one arrives at a series of selected measures for improvement which will be implemented in the medium and long term in the designed product (it is assumed that the short term ones have already been implemented or are in the process of being implemented). As this is a novel experience in the company, if everything is not properly organised it may happen that some of the measures will never be implemented.
The same can happen with the Ecodesign methodology itself, which owing to the inertia of the usual methods of working, may never again be used in the development of new products, unless it is linked with other management tools in the company.
In order to avoid this situation and obtain the greatest benefit from the experience obtained, it is an indispensable requirement to establish an action plan at the level of the product and at the level of the whole company with a view to the future.

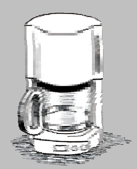
By establishing an ***action plan at the level of the product*** we guarantee that interesting measures for the product are not forgotten and can be finally implemented.

By establishing an ***action plan at the level of the company***, we will manage to involve the product development department and other affected departments of the company, thus guaranteeing that products continue to be developed, taking account of the environment, that is to say, by internalising the Ecodesign methodology.
Furthermore, the fact of establishing a general action plan at the level of the company, co-ordinating various departments, will make it possible to obtain other benefits deriving from the utilisation of Ecodesign: marketing of environmental improvements (green marketing), co-ordination between quality and environmental requirements, etc.

6.2.- Medium and long term product action plan.

According to the environmental improvement measures generated and prioritised in phase 3 and the actions carried out and described in chapters 4 and 5 of this manual (relating to the development of the new product) we can now have a vision of the times for implementation of the various selected measures for environmental improvement. Now would be the time to establish an action plan which clearly contains all the selected measures for improvement not yet implemented (those in the medium and long term) with their time limit for implementation, necessary actions, person responsible and persons in charge of the said actions.

EXAMPLE



In the Ecodesign project of the coffee-maker of the company CAFETERAS ENSUEÑO, S.L. for those measures which were postponed, the following action plan was established at product level:

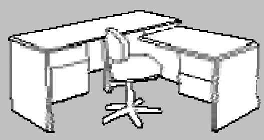
Medium and long term product action plan

Measures for improvement	Time scale	Actions	Responsible	Time limit & frequency
- Unification in the use of materials, using materials of recycled origin where possible.	MT/LT	- Studies for the replacement of the aluminium tube. - Check progress in the use of recycled materials.	Technical Dpart. Quality Dpart.	- Time limit of one year. - Half yearly checks.
- Less thickness and weight of the coffee-maker body.	MT	- Carry out strength tests on prototypes.	Technical Dpart.	- Time limit of one year.
- Reduction of energy consumption of the appliance.	MT/LT	- Be au fait with the appearance of new electronic components with lower power consumption.	Purchasing Dpart.	- Quarterly checks.
- More durable glass jug – unbreakable material.	LT	- Look for new alternative materials or progress in glass technology.	Purchasing Dpart.	- Half yearly searches.
- Electrical part easily demountable.	MT	- Internal redesign, tests and prototypes.	Technical Dpart.	- Time limit of one year.

Also presented as an example are action plans for each company participating in the IHOBE Ecodesign pilot project: Daisalux, S.A.; Fagor Electrodomésticos – Minidomésticos, S. Coop.; Ofita S.A.M.M. and Fagor Electrodomésticos – Lavadoras, S. Coop. in the annexes of ***Practical Experiences***.

The form included in the ***Tools*** chapter of the manual may be used for establishing the medium and long term product action plan.

EXAMPLE



A measure for the environmental improvement of the desk of the company OFITA S.A.M.M. is the utilisation of alternative boards without formaldehyde, which at the moment are not available in the market, but apparently will be shortly.

The derived actions may be:
1.- Call various suppliers periodically to check availability of these materials.
2.- When they become available, make a feasibility analysis.
3.- According to the result of the feasibility analysis, go ahead with the use of the new material if the analysis is positive.
If these tasks have not been established in an action plan, the measure (very useful owing to its highly innovative nature) would probably have been forgotten until other companies in the sector had implemented it.

6.3.- Ecodesign action plan at the level of the company.

Once the Ecodesign methodology and tools have been used for the first time in the product development department, conclusions may be drawn as to which of those tools are of interest for the company and how we can integrate them into the design process of new products.
For this the following steps are proposed:

1.- Hold a meeting in the Product Development Department at which the methodology of Ecodesign and all the stages of the product development process in the company are analysed in parallel (including other actions performed by other departments: exchange of information between the Marketing Department and the Product Development Department etc.) and trying to see how both methodologies can be integrated.
Also an attempt will be made to integrate all this with other management tools of the company (ISO 9001, ISO 14001).

2.- As a result of this analysis, establish an action plan at this time at the level of the company, to include the necessary changes in the product development plan, ISO 9001 or ISO 14001; the responsible department; the necessary tasks and their frequency.

3.- As the last step the development or adaptation of the necessary tools will be performed.

It should be indicated that, even though the tools can and should be adapted to the specific needs of the company, it is important not to miss out any of the stages of the Ecodesign methodology, because although some appear to be more interesting or important than others, they are all related and they all have their importance.
As a basis it is proposed to use the Ecodesign action plan form at the level of the company in the Tools chapter of the manual.

EXAMPLE

During the Ecodesign pilot project of IHOBE, it was observed that the companies did not show great interest in the phase of the study of Motivating Factors. On the contrary, they found the study of the environmental aspects of the product to be very important.
When the project was completed and the marketing campaigns started to be carried out for each product, the importance of the first analysis of Motivating Factors was understood a lot better and it was observed how that prior information about customers, competitors etc. had been very useful for designing a product in the right direction, not only for respect for the environment but also with a view to the introduction of the new production in the market.

It is advisable to fix and anchor in the company the experience and knowledge obtained after the first Ecodesign project has been carried out. When this anchoring is made seriously, continuous improvement of the environmental aspects of products will be achieved. The control and systematic improvement of the environmental aspects of products within an organisation is called Product Oriented Environmental Management Systems (POEMS).
The way to ensure continuous attention to the environmental aspects of products is by means of the integration of the results of the Ecodesign project (with regard to knowledge and experience), within the environmental management system, or within the quality system of a company.

Guidance is offered below on how Ecodesign may be integrated with ISO 9001 and ISO 14001 systems on the basis of the points of those standards.

6.3.1.- Anchoring Ecodesign in standard ISO 9001.

ISO 9001 is a world-wide accepted standard for quality management. The system is based on a cycle on which the policies, objectives and tasks are formulated, and on the this basis the programs are prepared and implemented. Subsequently it is evaluated whether those objectives and tasks have been achieved and corrective actions are determined.
Like standard ISO 14001, standard ISO 9001 offers the opportunity of anchoring product oriented environmental management (elements of this). Within the ISO 9001 standard, companies may integrate environmental aspects in the development of their products, including environmental demands, into the criteria on which they base their products at present. One of the specific possibilities is, for example, implementing environmental aspects in purchasing procedures.

In the ***Tools*** chapter there is a table in which guidance is given about anchoring Ecodesign in the ISO 9001 system (of 94 and 2000), in relation to each point of the standard.

6.3.2.- Anchoring Ecodesign in standard ISO 14001.

Strictly speaking, the international standard ISO 14001 already assumes that companies, in the implementation of this standard, must take account of the environmental impact of their products. According to this, the coverage of the system is extended: instead of controlling and improving only the environmental impact of production processes, the objective of companies is to control and improve the environmental impact of the product throughout its Life Cycle. This implies that attention to the environmental impact must also be concentrated in the production plant itself, but not only this.

At present, this part of the standard ISO 14001 requires further investigation and explanation. Especially with regard to the following points:

- Determination of the environmental aspects of products.
- Formulation of an environmental policy for the product.
- Measures to reduce the environmental impact of a product.

For these points we may base ourselves on the Ecodesign methodology presented in this practical manual of Ecodesign.

In the ***Tools*** chapter there is a table which gives guidance about anchoring Ecodesign with the ISO 14001 system in relation to each point of the standard.

It is recommended to take as an example the integration of the phases of Ecodesign and the product development process in companies participating in the Ecodesign pilot project. As an illustration it stresses the scheme used by OFITA S.A.M.M. for the integration of the design manual with the Ecodesign manual and the integration of Ecodesign into the procedures of ISO 9001 of the Fagor S. Coop. group and into the pressure cooker manual in Fagor Electrodomésticos – Minidomésticos S. Coop.
As one may see, this phase is specific to each company. The documents and resulting actions must be tailor made, so that each company familiarises itself with Ecodesign and adapts it to its own tools and needs.

7

EVALUATION

How to evaluate an Ecodesign project and its results

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7

7 EVALUATION

How to evaluate an Ecodesign project and its results

Outline of the stage

OBJECTIVES	To evaluate the results of the project in order to draw conclusions and learn to transmit the environmental results internally and externally periodically.

PERSONS OR DEPARTMENTS INVOLVED	- ***Product Development Manager:*** evaluate the environmental improvements of the new product compared to the basic product and transmit the results to other departments of the company which take charge of disseminating them internally or externally.
	- ***Human Resources Department:*** draw up an internal communication plan and transmit the results of the project within the company in parallel with the action plans at the level of the company.
	- ***Marketing Department:***
	  - Draw up a marketing plan once the results of the Ecodesign project and the environmental characteristics of the product are known.
	  - Analyse and integrate (if it is of interest to the company) green marketing techniques.
	- ***Management:*** approval and conclusions of the evaluation. Approval of the internal communication and marketing plans.

TOOLS	- Evaluation table. - Documentation references on green marketing.
PLANNING	40-60 hours

7.1.- Why evaluate the Ecodesign project and for what purpose?

Evaluating the Ecodesign project will help us to see the extent to which we have fulfilled or improved the motivating factors which have led the company to perform Ecodesign and establish mechanisms to obtain the greatest advantage from the improvements.

EXAMPLE

The evaluation of the Ecodesign project of its coffee-maker helped the company CAFETERAS ENSUEÑO, S.L., among other things, to obtain interesting data on energy saving for its customers and to prepare its marketing campaign on this basis.

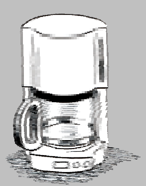
Furthermore the results of the evaluation may be very valuable information to train, inform and motivate personnel INTERNALLY and to include green marketing in the company's marketing campaigns or strategy, or inform other agents EXTERNALLY (social pressure groups, financial institutions giving green loans, business groups, environmental organisations, etc.).

7.2.- How to evaluate the Ecodesign project.

There are many ways to evaluate an Ecodesign project and the interesting thing is that ***each company should integrate it into its methodology or usual procedures for evaluating projects***.
Nevertheless we shall consider that there are a number of criteria to be taken into account in this evaluation:

- **Evaluate the improvement of the main environmental aspects, comparing the main environmental aspects of the new product with those of the initial product (wherever possible) and checking the fulfilment of the environmental requirements set out in the set of conditions.**
- **Analyse how environmental improvements affect the fulfilment of the Motivating Factors. Once it is seen what the improvements of the environmental aspects are, it is appropriate to analyse how these improvements affect the fulfilment of the Motivating Factors. This is to say, analyse the extent to which we have achieved the objectives for which we began to work with Ecodesign.**
- **Combine environmental improvements and the fulfilment of the Motivating Factors and express this in the most understandable way for the agents it is wished to inform (DO NOT USE THE VALUES OF ECO-INDICATORS DIRECTLY FOR MARKETING. THEY ARE A TOOL FOR EVALUATION AND ANALYSIS).**

EXAMPLE



In the evaluation of the Ecodesign project, CAFETERAS ENSUEÑO, S.L. found that:

- It had reduced the result of the utilisation of Eco-indicators (see this tool in stage 2 and in the Eco-indicator '99 Annex) of energy consumption in the "use or utilisation" phase from 13,875 millipoints to 6,938 millipoints (a reduction of 50%).
- The reduction of energy consumption affected the ***Motivating Factor Innovation*** as it appears that innovation in its sector is concentrated on facilitating use and energy saving for the user.
- It is therefore interesting for the company CAFETERAS ENSUEÑO, S.L. to inform its customers of this in terms of kWh and euros saved by the customer throughout the product lifetime.
- In the table below we can see an outline of the evaluation of the Ecodesign project made by CAFETERAS ENSUEÑO, S.L. on the basis of the form and directives proposed in this manual.

	Evaluation of the main aspects/environmental requirements			Evaluation of the main Motivating Factors			
Product improvement measures	**Energy consumption**	**Paper filter Waste**	**Use of polystyrene**	**Innovation**	**Legislation**	**Customer demand**	**How to express it for EACHAGENT AFFECTED**
Obtainment & consumption of materials & components							
- Unification in the use of materials, using those of recycled origin where possible (grouping of measures a and b)				Use of recycled materials makes the product innovative	Unifying materials facilitates recycling (WEEE Directive requirement)		- Recycled plastic in internal parts / *customers.* - New studies and search for information/ *(action plan) Technical and Quality Departments.*
- Less thickness and weight of the coffee-maker body. (measure c)			Reduce the quantity of polystyrene (PS)				- Review of structural measurements and strength tests in prototypes/ *(action plan) Technical Department.* - Lighter and easier to use coffee-maker / *customers.*
Factory production							
- Elimination of electrostatic printing and painting of parts (measure d)					Facilitate the recycling of plastic parts (requirement of the WEEE Directive)		- Modified moulds / *Technical Department.* - Elimination of stages in the manufacturing process (cost saving) / *customers.*
Distribution							
- Use of recycled cardboard (measure e).				Environmental improvement understood as innovation.			- Application made / *Purchasing Department.*
- Insert graphics to encourage recycling of cardboard packaging among consumers (measure f).					Encourage recycling by the user (requirement of WEEE Directive).		- Modifications made in the design of the cardboard boxes / *Technical Department.*

Use or utilisation

- Reduction of energy consumption of the appliance *(combination of measures g, i and j).*	50% reduction (achievement in short term)			Innovation			- Changes in design / *technical department.* - Reduction of consumption and energy costs by 50% / *customers.* - Improvement of the main environmental aspects of the company (energy consumption, consumption of filters, etc.) / *rest of the company* - Search for new information */ (action plan) Purchasing Department.*
- Use of permanent filter *(measure h).*		Total elimination		Innovation			- New parts / *Technical Department.* - Innovative product: first coffee-maker with permanent filter / *customers.* - Improvement of the main environmental aspects of the company (energy consumption, consumption of filters, etc.) / *rest of the company.*

End of life system. Final disposal.

- More durable glass jug – unbreakable material *(measure k).*	Thermos jug initially adopted.					More durable jug Keeping the coffee hot	- Search for further information/ *(action plan) Purchasing Department.* - Jug which addition to being more durable keeps the coffee hot / *customers.*
- Easily demountable electric part *(measure l).*					Facilitate recycling of the various components (requirement of WEEE Directive)		- Internal redesign, testing and prototypes/ (action plan) *Technical Department.*
- Marking of plastic parts to facilitate their subsequent recycling *(measure m).*					Requirement of WEEE Directive		- Logos inserted in moulds according to ISO 11469 / *Technical Department.*

New product ideas

- Neapolitan coffee maker (no filters, gas heated) *(measure n)*							RULED OUT

7.3.- Practical applications of the evaluation of the Ecodesign project: GREEN MARKETING

The results of the evaluation of the Ecodesign project may be used for different particular objectives of each company:

- Evaluation or internal justification of the Ecodesign project.
- Documentation serving as a guide for future Ecodesign projects in the company (% of improvements which have been possible in a specific aspect, etc.).

However we wish to state a further two aspects which we consider to be of common interest for most companies:

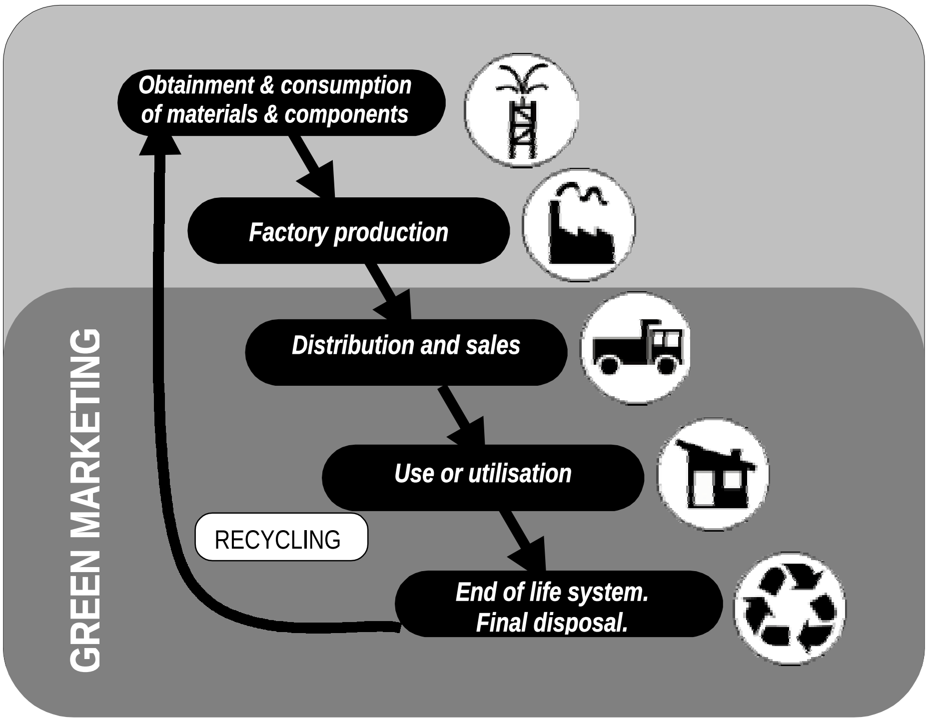
- **Staff motivation.**

If an action plan has been established at the level of the company for familiarisation with the Ecodesign methodology, the results of the project are key for motivating each department to carry out the tasks which correspond to it and not to see Ecodesign as an added obligation but as an opportunity for improving products and the Environment. It is therefore proposed to use the said results as key material for the dissemination of the Ecodesign company action plan.

- **Green marketing.**

If the Environment is a differentiating aspect for the company or improves the quality of the product, it may be very interesting to integrate the environmental improvements into the company's marketing campaigns and start working on GREEN MARKETING.

Green marketing of a product



Nevertheless, green marketing is not as simple as it may appear at first sight, but like other marketing strategies it requires specific techniques and when referring to such a global and important matter as the environment, it must be based on a series of basic principles which are mentioned below.

Normally, as we may see in the figure above, the design of marketing campaigns usually begins in parallel with the distribution and sales phases. Working in Ecodesign marketing must be influenced by all stages and must influence (by means of the results of the analysis for Motivation Factors) all stages of the Life Cycle.

Basic principles of green marketing

- Be and remain au fait with fashions/development/future legislation/ etc.
- Take account of new stakeholders or agents involved.
- Not only talk green but be green:
    - integrity.
    - be pro-active (not only comply with what is mandatory).
    - extend Ecodesign to all departments.
    - the general management must be aware and motivated.
    - motivate – involve – train employees.
- There is no finishing line, this is a process of continuous improvement.
- The company must be accessible to the public and information must be transparent.

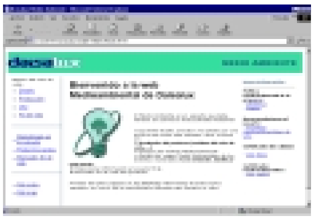
Source of the information: Ottman, J.A., Green Marketing, Opportunity for Innovation. Second edition NIC BUSINESS BOOKS, Chicago, 1998.

Nevertheless, the objective of this manual is not to describe how to conduct green marketing. Therefore the ***Tools*** chapter contains a number of references which deal with this matter in depth and we consider to be of interest.

EXAMPLE

The four companies participating in the Ecodesign project: Daisalux, S.A., Fagor Electrodomésticos – Minidomésticos, S. Coop., OFITA S.A.M.M:. and Fagor Electrodomésticos – Lavadoras, S. Coop have used the results of the project to conduct Green Marketing always following the basic principles of green marketing, on the basis of knowledge of green marketing acquired in the project and in the information of the Motivating Factor customers of stage 1 of the project.
Some marketing tools which have been used by the companies are included below:

Daisalux, S.A.



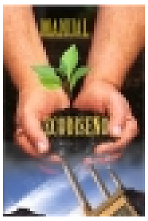
Inclusion of the steps followed, results of the Ecodesign project and environmental recommendations for installers and users.

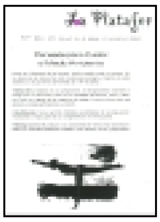
Creation of an internal environmental logo for its products designed taking account of environmental criteria.

Fagor Electrodomésticos – Minidomésticos, S. Coop.

Inclusion of results of environmental improvement in the product launch brochure.

Ofita S.A.M.M.



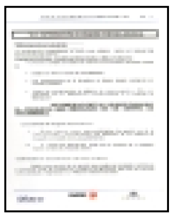


Publicity in the press and on TV of participation in the IHOBE Ecodesign pilot project and the results in its specific product.

Open door seminar organised by IHOBE and ADEGI.

Fagor Electrodomésticos – Lavadoras, S. Coop.

Creation of a logo for raising awareness of environmental information to the user.



Creation of an environmental information brochure for the user.

1

PRACTICAL EXPERIENCES

DAISALUX, S.A.

HYDRA AUTOTEST emergency luminaire

IHOBE
Sociedad Pública Gestión Ambiental

DAISALUX, S.A.

Hydra Autotest Emergency Luminaire

Daisalux, S.A. is a company which engages in the manufacturing of emergency lighting, battery charger equipment, rechargeable torches etc. It is based at Vitoria-Gasteiz (Alava) and has over fifty employees. In addition to being present in the domestic market, it exports to many countries all over the world.

In 1999 Daisalux, S.A. decided to participate in the Ecodesign pilot project led by IHOBE, S.A. with the Association of Industries of Electronic and Information Technologies of the Basque Country, GAIA.

1.- Preparation of the project.

IHOBE, S.A. led the Ecodesign pilot project of Daisalux, S.A., and the Dutch consultants BECO, an expert in Ecodesign, and the TRES D., Innovación y diseño integral, S.L. design engineering company participated in the project in order to support Daisalux, S.A. throughout. Within Daisalux various departments collaborated on the development of the project. The R & D department was in charge of the general co-ordination and the work team had the participation of:

- ***Quality Department:*** supervising and reporting on the directives existing with regard to legislation (not only the environment but also quality regulations and so forth).
- ***Mechanical Design Department:*** providing a solution for the technical aspects of the product (materials, manufacturing processes and so forth).
- ***Marketing Department:*** reporting on demands and trends in the market.
- ***Outside Designer:*** The company TRES D. - Innovación y diseño integral, S.L. collaborated with Daisalux on the projects supporting the company in the process and internalising the methodology in order to be able to integrate environmental criteria into the design of other products.

Figure 1.- Ecodesign team of Daisalux, S.A. together with the other participants in the project, such as the Public Company IHOBE, S.A., the Dutch consultants BECO and the TRES D – Innovación y diseño integral, S.L. design engineering company.

Furthermore throughout the project it was considered appropriate to have the opinions of other departments of the company: purchasing, software, production etc.

The commitment by the company management was present at all times in decision taking and project monitoring.

The product selected was the HYDRA emergency luminaire. The reasons for its choice were based on the fact that it was a product affected by the appearance of new regulations (WEEE European Directive relating to waste and the design of electrical and electronic equipment) and it also has sufficient degrees of freedom for its modification. As a first step towards the development of the project per se, the main Motivating Factors of the company to perform Ecodesign were analysed. This affected the selection of the most interesting measures.

The following was obtained as a result:

EXTERNAL Motivating Factors for the application of Ecodesign

ADMINISTRATION: legislation and regulation

A critical factor. The proposed "Directive relating to waste of electrical and electronic equipment" (WEEE) directly affected the product. This future regulation seeks the elimination of all heavy metals (including Cd and Hg) and also to facilitate as far as possible the treatment and subsequent recovery – recycling of the equipment (recyclability rates of products, systems of collection and treatment etc).

INTERNAL Motivating Factors for the application of Ecodesign

Power of innovation

This is a sector in tight competition where differentiation is necessary. Daisalux relies on innovation in its products as a differentiating aspect and Ecodesign may be a factor of innovation.

The manager's sense of environmental responsibility

An essential aspect. At all times the manager encouraged the project team to take decisions aimed at an environmental improvement of the product.

Figure 2.- Motivating Factors to perform Ecodesign in Daisalux, S.A.

2.- Environmental aspects.

After defining the Motivating Factors, the design team analysed the main environmental aspects of the previous Hydra model in order to study possible ways of environmental improvement on the basis of these. Various tools, shown below, were used for this:

- ***MET Matrix***

A matrix showing the main consumptions of **M**aterials, **E**nergy consumption and **T**oxic emissions related with all stages of the lifetime of the product.

	Use of MATERIALS (Inputs) M	Use of ENERGY (Inputs) E	TOXIC EMISSIONS (Outputs: emissions, effluent,waste) T
Obtainment and consumption of materials and components	- NiCd Batteries. - Fluorescent lamps. - Plastic parts. - Phenolic paper circuit. - Indicator lamp.	- Energy for the obtainment for the various components: NiCd batteries, fluorescent lamps, plastics etc. - Energy for the plastics injection process.	- Emissions from the production of the various components. - Emissions from zinc plating, copper plating and tin plating. - Waste from supplier's packaging.
Factory production	- Epoxy adhesive - Sn and Pb.	- Energy of curing for wave soldering. - Energy of various processes: production of compressed air, laser marking, welding, lighting, conveyor belts etc.	- Emissions from wave soldering. - Internal waste and rejects.
Distribution	- Cardboard box - Corrugated paper filling. - Wooden pallets.	- Diesel fuel of lorries for haulage.	- Cardboard box. - Corrugated paper filling. - Transport emissions.
Use or utilisation	- Flourescent lamps (spares). - NiCd batteries (spares).	- *Energy consumption of the product throughout its useful lifetime.*	- Emissions deriving from energy consumption. - *Fluorescent lamps (Pollutant Hg waste).* - *NiCd batteries (Pollutant mainly owing to the presence of Cd).*
End-of-life system. Final disposal.			- Recycling: 0% - Incineration: 0% - *Dumping: Pollutant elements in NiCd batteries, Hg from fluorescent lamps, printed circuit elements etc.*

Priority impacts

Figure 3.- MET matrix of the Daisalux HYDRA luminaire.

- ***Golden rules for the electrical and electronics sector.***

These are general directives which have been concluded from various Ecodesign projects in the sector which give guidance on the main environmental aspects of an electrical or electronic product. They are as follows:

1. *In most cases the environmental impact caused during the phase of utilisation is dominant, mainly owing to the energy consumption of the product.*

2. *Facilitate the separation of the parts of the product for recycling in the end-of-life phase usually causes a smaller environmental impact.*

3. *The importance of transport is great for heavy and voluminous circuits which are sent by air with all their components ready assembled. It is less when the integrated circuits are transported to be encapsulated for example in South East Asia.*

4. *Precious metals, scarce metals and silicon have a very high environmental impact.*

5. *The processing of microcircuits has a priority environmental impact in the end-of-life phase, not in their production. This impact is not proportional to the weight of the components (as they are more problematic when they are assembled together etc.).*

6. *Various LCA studies give a different appraisal to heavy metals when they are deposited in a tip. This has a variable effect on the appraisal of this phase of the life cycle.*

- ***Eco - indicators***

They were used and were considered to be important, although their specific weight at present cannot be assessed, as Eco-indicators have not yet been developed for some of the critical components of the product. In any case research is being carried out continuously in order to obtain new Eco-indicators so this will be a problem which will shortly find an answer.

We can find from an analysis of the tools used that they all stress the same critical environmental aspects of the product, that is: ***energy consumption in the phase of utilisation, presence of heavy metals and optimisation of the end-of-life system.***

3.- Ideas for improvement.

Taking the main environmental aspects of the product as a starting point, a brainstorming session was organised in which a total of fifteen persons participated. Seven departments of the company were present (electronic design, mechanical design, quality, marketing, production, purchasing and software), in addition to the management, and the outside design company TRES D. – Innovación y Diseño Integral, S.L. and environmental experts from IHOBE, S.A. and the consultants BECO.

Ten out of a total of over 30 ideas for improvement were finally selected to work on, on the basis of their potential feasibility and the fulfilment of the motivating factors to perform Ecodesign of Daisalux, S.A.:

Measures of environmental improvement selected in brainstorming

- a. ***Use green lamps (without Hg).***
- b. ***Use an environmentally friendly printed circuit (without halogenides).***
- c. ***Use recycled materials.***
- d. ***Replace Sn-Pb alloys by alloys without Pb.***
- e. ***Replace flux by a less toxic product.***
- f. ***Optimise the energy consumption of the product in the utilisation phase.***
- g. ***Seek a non-polluting alternative to NiCd batteries (NiMH battery).***
- h. ***Creation of an environmental logotype for green products of Daisalux.***
- i. ***Optimise information to the user with a view to the end of the product life.***
- j. ***Participate in systems of collection and recycling of the product (WEEE Directive requirement).***

Figure 4.- Improvement measures selected from the brainstorming at Daisalux, S.A.

4.- Develop concepts.

With these measures the **specification** was prepared for the design of the new product, which included broadly speaking, the environmental improvements it was intended to obtain.

The concept of product which was arrived at after this stage was a luminaire which included an NiMH battery free of Cd in addition to a printed circuit without halogenides. The energy consumption of the luminaire appeared to be able to become quite lower and the basis would be established for an environmental logo for the green products of Daisalux, S.A. which of course would be granted to this luminaire. Also, as a whole, the management of the company's plastic waste was going to be optimised by making use of waste from this model for parts of other models with lower technical and aesthetic requirements.

5.- Product in detail.

Finally the following measures were adopted with the necessary studies carried out:

- **b** ***Use an environmentally friendly printed circuit (without halogenides).*** Directives were given to the supplier to replace the circuits immediately by the alternative without halogenides. Thus it was managed to make progress in the fulfilment of a requirement of the WEEE Directive (that corresponding to the elimination of retardants with halogenides).
- ***c.*** ***Use recycled materials.*** It was managed to reduce completely internal plastic waste, by means of its recycling, reaching agreements with the supplier for the collection of its plastic waste, recycling and supply of new parts. With this measure it was managed to reuse 100% of recycled plastic from its own waste.
- ***f.*** ***Optimise the energy consumption of the product in the utilisation phase.*** By redesigning the circuit (optimised tracks, etc.) with optimisation criteria, it was finally managed to reduce by 50% the energy consumption of the appliance.
- ***g.*** ***Seek a non-polluting alternative to NiCd batteries (NiMH battery).*** Its application required internal changes to be made in the appliance, so these were carried out and this new type of battery started to be purchased.

h. Creation of an environmental logo for green products of Daisalux. The following criteria were established:

Criteria for allocating the logo

- ***Reduction of energy consumption.-*** *When there is a reduction of energy consumption by 20% compared to the reference product of the competition.*
- ***Replacement of batteries.-*** *The use of NiMH batteries or other alternatives to NiCd batteries free from heavy metals.*
- ***Use of recycled materials.-*** *Utilisation of parts susceptible of being injected with recycled plastics, also being recyclable waste.*
- ***End-of-life manual.-*** *Preparation of a manual of dismantling, components and environmental characteristics of all the products obtaining the green mark of Daisalux, and also make them public in available media (web, catalogues, price lists etc.).*
- ***Printed circuit.-*** *Use environmentally friendly printed circuit (without halogenides).*

As a consequence of the application of these criteria, if at least 4 of the 5 above criteria are met, DAISALUX will show the chosen environmental logo on the packaging by means of a sticker.
At the bottom of the logo the following note will appear: "PRODUCT INCLUDES ENVIRONMENTAL CRITERIA".

i. Optimise information to the user relating to the end-of-life of the product. A web page and instruction sheet were developed (include web page address).

6.- Action plan.

Once stages 4 and 5 were completed and improvements b, c, g, h, i and j were implemented, Daisalux established an action plan for the implementation of the measures for improvement which were still pending in the product with regard to the future.

Product Action plan for future improvements

Improvement measures	*Time scale*	*Action*	*Person responsible*	*Regularity*
a. Use green lamps (without Hg)	MT	Check availability with suppliers	Purchasing Department	Quarterly
Replace toxic substances: *d. Sn-Pb alloys* *e. Flux*	LT	Check with suppliers	Purchasing Department	Quarterly
j. Participate in systems of collection and recycling of the product (requirement of the WEEE directive)	LT	Contact regularly with sectorial associations and IHOBE, S.A. to detect possible initiatives	Quality Department	Half yearly

Figure 5.- Product action plan for future improvements of Daisalux, S.A..

Also, after analysing the stages of the Ecodesign methodology (stages of the manual) and comparing them with the product development process itself of Daisalux, S.A., an action plan was established with a view to integrating Ecodesign into the company and thus into new products. The design plans included the use of the MET matrix and the Eco-indicators (according to their progress). Also, as a consequence of the project, several tools were developed which would be useful at the time when Ecodesign was carried out (list of green materials, list of prohibited materials, survey of environmental demands of clients and installers etc.).
All of this can be seen in the action plan at the level of the company for anchoring Ecodesign in Daisalux, S.A., which is shown below:

Action plan at the level of the company for anchoring Ecodesign

Daisalux design plan | **Integrated Ecodesign stages**

DAISALUX
DOSSIER DE ACTIVIDAD

PLAN DEL DISEÑO

FECHA ACTUALIZACION:

DESCRIPCION: Plan de diseño de Subfamilia de artículos Luminarias y lista de revisiones asociadas. Basado en el DOC-FUN (I+D): PLAN-SUBF

INSTRUCCIÓN DE AYUDA AL DISEÑO: DIS-ID

GRUPO DE DISEÑO:

INDICE

PLAN

0-DATOS DE PARTIDA
A- ESTUDIOS, VIABILIDAD
B- DISEÑO TEORICO
C-MAQUETAS ELECTROMECANICAS
D- PROTOTIPOS Y PRUEBAS FINALES
E- DOCUMENTACION
F- INSTALACION

REVISIONES
VERIFICACIONES

PLAN

0- DATOS DE PARTIDA DEL DISEÑO Y PLAN
- Previo al desarrollo del diseño se debe haber revisado y acordado con el responsable de pedido los Datos de Partida del diseño contestando a la petición de Oferta de la actividad de diseño.
- Seguidamente se debe haber elegido o desarrollado un Plan de desarrollo entre los descritos en la Instrucción (I+D): DIS-ID y se debe haber adaptado al diseño que se acomete.
- Abrir carpeta de la Actividad de Diseño

A-ESTUDIOS, VIABILIDAD. La realiza el puesto:
Inicio de fase (fecha):
- Apertura de carpeta de Dossier de Producto Subfamilia (IND-SUB) y declaración en Dair Materiales.
- Análisis del pliego de pedido: datos de partida. Preparar el documento de datos de partida si no existe.
- Planificar la actividad concretando este plan.
- Esquema de cableado básico (con nominativos). Conexión exterior (indicaciones para etiquetas)
- Pilotos, lámparas, materiales funcionales... Lista de materiales clave: Lámparas, Baterías...
- Análisis de costes
- Análisis medioambiental: estudio de ciclo de vida (LCA), Ecoindicadores. Utilizar DOC-APY: ECODIS.
- Lanzamiento de búsquedas de materiales clave
- Fusibles, baterías, instalación del producto, manipulación del usuario, mantenimiento. Desmontaje, separación de las partes y reciclado.

Study of Motivating Factors (Chap. 1)
Study of environmental aspects (Chap. 2)
Ideas for improvement (Chap. 3)
Action plan (Chap. 6)
Project appraisal (Chap. 7)

Figure 6.- Action plan at the level of the company for anchoring Ecodesign in Daisalux, S.A..

7.- Appraisal.

This project has provided the following benefits to Daisalux, S.A.:

- ***Total elimination of Cd from the luminaire according to one of the requirements of the WEEE Directive, the fulfilment of which Daisalux, S.A. has anticipated.***
- ***Reduction by 50% of energy consumption of the lamp to the benefit of the user.***
- ***An innovative product has been launched in the market: "the first emergency luminaire including Ecodesign criteria in its development".***
- ***Great increase in environmental motivation of employees of Daisalux, S.A..*** As proof of this, as a result of the Ecodesign project, the company commenced a process of implementation and environmental certification according to standard ISO 14001 within the framework of a project of IHOBE, S.A. and in collaboration with GAIA.

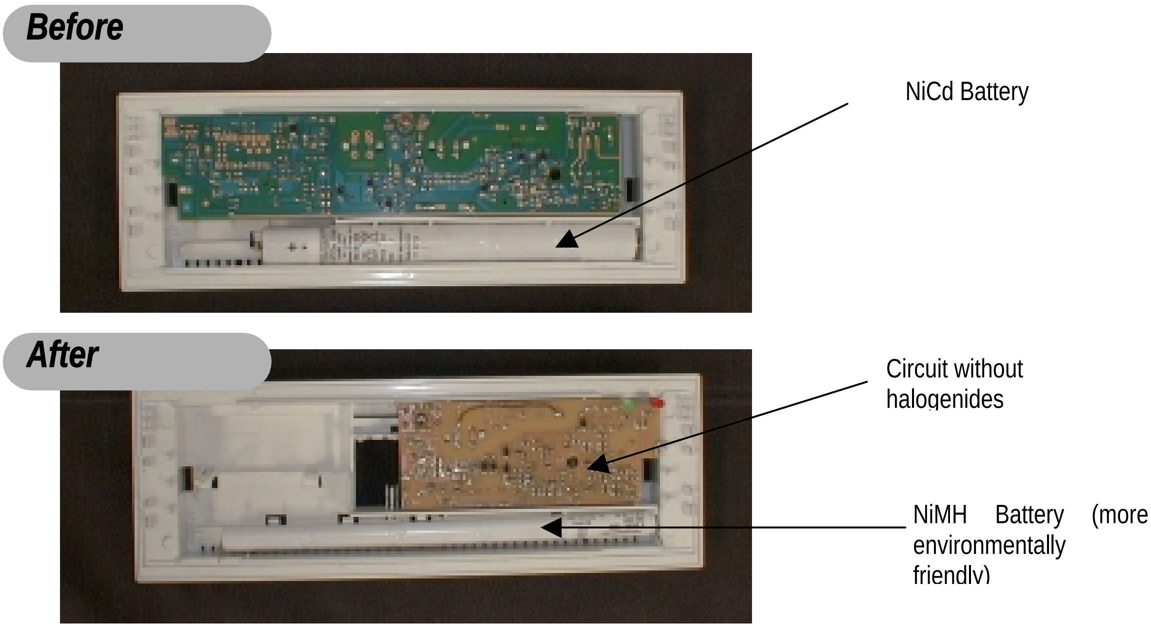


Figure 7.- Comparison of the HYDRA product before and after the Ecodesign project. As may be seen, the printed circuit is smaller and does not contain halogenides and the battery has been replaced by a better one from the environmental point of view.

PRACTICAL EXPERIENCES

FAGOR ELECTRODOMÉSTICOS, S. Coop. (small appliances)

FUTURE pressure cooker

IHOBE
Sociedad Pública Gestión Ambiental

FAGOR, S. Coop.(Small appliances)

FUTURE pressure cooker

Fagor Electrodomésticos is a business group which engages in the manufacture of all types of electrical domestic appliances. The company consists of seven business units, one of which, small appliances, situated in the locality of Eskoriatza (Gipuzkoa), manufactures and markets pressure cookers and various types of small domestic appliances.

This business unit has 148 employees and among its main production processes are pressing, impact welding, polishing and assembly.

Its sales are concentrated in the state market (65%).

In 1999 Fagor (small appliances) in relation with its objective of improvement and raising environmental awareness, decided to participate in the Ecodesign pilot project led by IHOBE, S.A. in collaboration with the engineering firm Diara Diseñua, S. Coop. with which it usually works.

1.- Preparation of the project.

a) For the project a team was organised between IHOBE, S.A., the Dutch consultants BECO, the design engineers Diara Diseñua, S. Coop. and Fagor Minidomésticos, S. Coop. Within Fagor, the team was formed by the following departments:

- ***Central Quality Department of Fagor*** , issuing directives and directing the integration of Ecodesign into the procedures of the whole Fagor Group, pulling other business units and motivating the various departments.
- ***Product Development Department:*** providing technical solutions, directing the internal team and integrating the environmental factor in the company.
- ***Marketing Department:*** reporting on customer demand, integrating environmental improvements into product marketing campaigns in accordance with the corporate image.

Occasionally there was the collaboration of the purchasing department for information requests, and the integration of environmental requirements into suppliers.

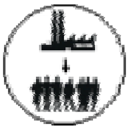
b) The selected product was a pressure cooker (SPLENDID model), as this is a product destined for the end user, it is a star product of the business unit and has a fully integrated design process (the latter facilitated the integration of Ecodesign for the first time).

Figure 1.- Ecodesign team of Fagor Small Appliances together with IHOBE and Diara Diseñua.

c) Once the work team had been formed and the product selected, the project per se was commenced, establishing the main Motivating Factors of the company to perform Ecodesign with the Splendid pressure cooker.

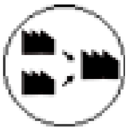
EXTERNAL Motivating Factors for the application of Ecodesign

MARKET: Customer demand (ind. & final)



As this is an end user product of globalised use, a number of specific demands to be taken into account have been detected: safety in opening, short handles, smaller volume, light materials and being easy to clean are among the main ones. It must be taken into account that Ecodesign can help with meeting these demands.

SUPPLIERS: Technological innovation



Possible advances of materials and technologies had been detected (pressing technologies which permit a smaller thickness of steel, etc.) which could improve the environmental aspects of the product.

INTERNAL Motivating factors for the application of Ecodesign

Improvement of the image of the product and company

It is important to improve the image of the product in this connection. Some Ecodesign measures can facilitate this improvement of the product image.

Reduction of costs

In a market such as this one, which is so tight and competitive with regard to prices, it is very important for measures for improvement to be directed towards a reduction of costs. Ecodesign may often facilitate this reduction of costs (less consumption of materials and energy, reutilisation of materials).

Innovative power

THIS IS THE MOST IMPORTANT MOTIVATING FACTOR.
In an increasingly demanding market, innovative power and distinctive factors are important; Ecodesign may doubtless be one of these.

The company's sense of enviromental responsibility

THIS IS ASSUMED.
The policy both of MCC and of the Fagor Group includes the commitment to continuous environmental improvement, which includes the utilisation of methodologies such as Ecodesign.

Figure 2.- Motivating Factors to perform Ecodesign at Fagor Minidomésticos, S. Coop.

All these Motivating Factors were subsequently useful when it came to selecting the most interesting measures for environmental improvement for the company.

2.- Environmental aspects

The Ecodesign team then studied the environmental aspects of the Splendid model of pressure cooker in order to seek to improve them. The various tools described in chapter 2 of the manual were used, but in this case the Eco-indicators were the tool of preference.

Product of component ***Fagor Splendid pressure cooker***	***Project*** ***Fagor Small Appliances***
Date ***7-02-00***	***Author*** ***Pedro Lizarralde / Lordi Elorza***
Notes and conclusions	

Production (Materials, processes and transport).

Material or process	Quantity	Indicator	Result
Wooden boards	0,0075 kg.	39	0,29
High alloy steel (stainless steel)	2,2 kg.	910	2002
Phenolic resin (1)	0,484 kg.	510	246,84
Cutting of steel	2857 mm^2	0.00006	0,17
Pressing of steel (2)	2200 mm^2	0.00006	0,13
Nickel plated brass (3)	0,017 kg.	2320	39,44
Packaging cardboard (cellulose)	0,350 kg.	69	24,15
Polyamide (PA 6.6)	0,004 kg.	630	2,52
100% recycled aluminium	0,294 kg.	60	17,64
Cutting of aluminium	-	0.000036	-
PPS (GPPS)	0,002 kg.	370	0,74
EPDM rubbers	0,001 kg.	360	0,36
Food grade nitrile (4)	0,078 kg.	360	28,08
Ultem 1000 (5)	0,029 kg.	510	14,79
Total			2377,15

Use (Transport, energy and auxiliary materials).

Material or process	Quantity	Indicator	Result
28 ton Olry (volume)	53 m^3km	8	424
Electricity BV Europa (UCPTE)	2728,3 kWh	26	70935,8
Total			71359,8

Waste (for each type of material).

Material & type of process	Quantity	Indicator	Result
Brass (tip) (6)	0,017 kg.	1,4	0,02
Phenolic resin (tip) (7)	0,488 kg.	3,9	1,9
Recycling of steel (ferrous metals)	2,2 kg.	-70	-154
Recycling of aluminium	0,294 kg.	-720	-211,68
Recycling of cardboard (cellulose packaging)	0,35 kg.	-8,3	-2,9
Food grade nitrile (tip) (8)	0,078 kg.	-	-
Total			-366,66

TOTAL(all phases)	73370,29

Priority and environmental aspects.

(1).- For phenolic resin the Eco-indicator of PC has been used, as we consider it to be the most similar material in terms of impact.
(2).- For pressing steel we have used the Eco-indicator of cutting/pressing of steel as both processes are similar.
(3).- For nickel plated brass we assume the following mixture: 60% of copper (Eco-indicator = 1400), 30% zinc (Eco-indicator = 3200) and 10% enriched nickel (Eco-indicator = 5200).
(4).- For food grade nitrile we have used the Eco-indicator of EPDM Rubber, as this is a material of similar characteristics.
(5).- In the case of Ultem 1000, we have adopted the Eco-indicator corresponding to Polycarbonate (PC), which with regard to its impact we consider it to be the most similar material.
(6).- For brass (tip) we have used the Eco-indicator of the tip of steel.
(7).- In the case of phenolic resin (tip) we have used the value of the Eco-indicator for the PE tip.
(8).- In the case of food grade nitrile (tip), there is no similar Eco-indicator available. Nevertheless, this is no problem as it is not considered to be a priority matter.

CONCLUSIONS.- In this case it was very important to define properly the system of the pressure cooker. This is to say, from the outset it was thought that, as this is a product without any direct connection to the electric supply, it was not necessary to take account of the energy consumption, but as the design of the pressure cooker can significantly affect the reduction of this consumption, and as this supply of heat is irremediably joined with the use of the pressure cooker, it was decided to take this into account among the main environmental aspects.
Precisely this aspect was with a great difference the main environmental aspect of the product.

Figure 3.- Study of the environmental aspects of the Fagor Splendid model of pressure cooker carried out using Eco-indicators.

From the analysis of the Eco-indicators and other tools, it was concluded that the main environmental aspects of the Splendid pressure cooker were the following:

- ***The utilisation of energy in the phase of use.***
- ***Energy consumption and emissions deriving from transport (weight, volume and logistics).***
- ***The consumption of stainless steel.***
- ***To a lesser extent, the consumption of phenolic resin.***

3.- Ideas for improvement.

In this phase a number of ideas were generated and selected which might improve the main environmental aspects defined and comply with the Motivating Factors of Ecodesign of the company.
The ideas which were generated and the selection in bold of the most interesting ones on the basis of various criteria determined by the company (Motivating Factors and environmental aspects) are shown in a table below:

2	Very good score
1	Good score
0	Neutral score
-1	Negative score
-2	Very negative score

ST:	Short Term
MT:	Medium term
LT:	Long Term

Measures for improvement	Environmental improvement	Motivating Factor Innovation	Economic viability	Technical feasibility	Other: customers, quality etc.	Pre–selection (✓)
Obtainment & consumption of materials & components						
- Materials with less impact for the vessel	2	1	-1	-2	0	
a.- Handles of material with a smaller impact	**2**	**1**	**1**	**1**	**2**	**✓ ST**
- Reception with re-usable packing.	1	0	2	-1	0	
- Replace steel by ferritic steel (with less chrome).	2	0	1	-2	0	
b.- Reduce the weight of the body of the pressure cooker (less thickness)	**2**	**1**	**1**	**1**	**2**	**✓ ST**
- Pressure cookers without handles.	1	0	1	1	-2	
Factory production						
- Minimise the use of oil and drill coolant.	1	0	2	-1	0	
- Elimination of the polishing process (matt pressure cooker).	1	0	2	-2	-2	
- Oils of the process reusable for other operations.	1	0	-1	-1	0	
Distribution						
- Fit some bodies into others for despatch (design).	1	0	-2	0	-2	
c.- Packaging 100% recycled cellulose.	**1**	**0**	**1**	**1**	**2**	**✓ ST**
- Warehouse at the factory itself instead of at a central warehouse.	2	0	-2	-2	0	
d.- Reduce the total volume of the pressure cooker (size or orientation of the handles).	**1**	**2**	**1**	**1**	**2**	**✓ ST**
Use o utilisation						
- Insulated pressure cooker.	2	2	-2	-2	0	
- Automatic disconnection from the heat source.	2	2	-2	-2	0	
e.- Pressure cooker (diffuser base, etc.) to adapt to each energy source making maximum use of the heat.	**2**	**2**	**0**	**-1**	**2**	**✓ LT**
End of life system. Final disposal.						
- Assembly without screws, facilitating change of parts.	1	2	1	-1	-2	
f- System of collection, recycling or re-manufacture of	**1**	**2**	**-2**	**2**	**2**	**✓ LT**
pressure cookers.	1	1	1	-1	0	
- Replace the old pressure cooker by a new one at a lower price.	**1**	**1**	**2**	**2**	**2**	**✓ ST**
g.- End-of-life manual for the pressure cooker.						
New product ideas						
- Programming of cooking by means of organo-electric sensors	1	2	-1	-2	2	
- Lid which can be used as a plate or frying pan.	0	-2	-1	0	1	
- Easy to change handle.	0	1	-1	1	-1	

Figure 4.- Some measures for improvement generated in the brainstorming session and their selection on the basis of criteria of the company.

CONCLUSIONS.- It is important to observe how the selection criteria are the precisely the Motivating Factors to perform Ecodesign and the environmental aspects of the product. Those which have been evaluated separately: environmental aspects, innovation, technical feasibility (suppliers) and economic viability, are given the greatest value. Each company which must attach greater weight to some criteria or others on the basis of their importance for it.

After analysing and selecting these measures, it was decided to include precisely the ideas selected as basic requirements of the Specification; including measures with a guarantee of feasibility as compulsory requirements and the others as requirements for their analysis in greater detail and attempt at implementation.

4.- Develop concepts.

On the basis of the selected measures (requirements of the specification), each of these was analysed in depth, and the following conclusions were obtained:

a.- Handles of material with a lower impact.

The various possibilities of thermostable plastics, (required by the standard) were studied in relation to the relevance of the environmental aspect, costs and technical quality of the material.

Material	Relevance of the evironmental aspect	Costs	Technical quality
Phenolic resin	Low	High	High
Urea	Medium to high	Low	Not feasible
Melamine	Medium to high	High	High
Saturated polyester	High	Medium	Low
Unsaturated polyester	Low	High	Low

High.- Very good conditions of the criterion ***Medium.-*** Neutral conditions ***Low.-*** Poor conditions of the criterion

Figure 5.- Various possibilities with regard to the use of the material for the handle.

One may see that finally the one which had the best global evaluation of the criteria was phenolic resin, so its replacement was RULED OUT, and an improvement in these materials and their prices was awaited.

b.- Reduce the thickness (weight) of the pressure cooker body.

In order to improve the environmental aspect deriving from the consumption of stainless steel, it would also be possible to try to replace this material, but as seen in the selection of measures, this had already been previously analysed by the company for other reasons and it was concluded that the stainless steel was the best material from all viewpoints (production, economics, the environment, etc.). Therefore, the measure selected was the reduction of consumption of **this** material.
For the present time the technique used at present of pressing limits the reduction of thickness. However the existence of alternatives and their state of development are known from the technological centre with which there is constant collaboration.
After several consultations and analysis, experimentation was carried out on new alternatives.

c.- Packaging of 100% recycled cellulose.

It was started to prepare designs of 100% cellulose packaging in order to comply with the quality requirements for protection of the product. In a first step and in view of the fragility of the pressure cooker owing to the location of the handle, it was seen that the designs were very complicated and required a great quantity of labour (costs) for assembly, so it was continued to research new more simplified designs.

d.- Reduce the volume of the pressure cooker (size and position of the handle).

Reducing the volume affected very positively the reduction of the environmental aspect of transport and this is largely due to the handle. Work started with Diara S. Coop. on the design of a new handle with would reduce the volume of the pressure cooker, and at the same time comply with the technical and quality requirements. At the outset it was seen that this design could go along the lines of changing the orientation of the handle towards the centre of the lid, reducing the volume of the pressure cooker by 10 to 20%.

e.- Pressure cooker which adapts to each energy source.

Initially the most widely used heat sources were studied and on the basis of this research started into materials and designs which are better conductors of heat (diffuser bottom) and which have optimum behaviour with induction (which is the heat with the best use of energy) but at the same time they may serve for other sources.

f.- Systems of collection, recycling or re-manufacturing of pressure cookers.

This measure was analysed and it was concluded that it had to be carried out in three stages:

- Organisation of user information systems (internet and so forth).
- Getting distributors used to the idea.
- Adaptation of the company for the re-use – recycling of these pressure cookers.

The three stages were influenced by each other, but it was decided to start to apply them in the order presented, as it was foreseeable that the response by customers would take some time.

g.- End-of-life manual of the pressure cooker.

It was decided to prepare a manual which would include the directives in order to perform Ecodesign with the idea of using it not only in Fagor Small Appliances but also that it could serve as a basis for preparing this manual in other business units.

The product concept which was arrived at was a pressure cooker with a handle oriented towards the centre of the lid, an optimised diffuser bottom and packaging of recycled cellulose, guaranteeing quality and seeking to minimise costs.

5.- Product in detail.

The viable measures were developed until their implementation:

c.- Recycled cellulose packaging.

The design of the packaging was completed in collaboration with the usual supplier. It was impossible to guarantee the quality only with cellulose, so it was decided to include a part of EPS which in turn allows a reduction in the quantity of cellulose by 12-15%, but research continues on the development of this packaging until the elimination of EPS. They started to purchase this packaging, reducing labour costs and guaranteeing the necessary strength, after subjecting it to various normative tests.
This measure was developed in parallel with d. and by achieving a more compact pressure cooker, without a projecting handle, the design of simpler packaging was facilitated.

d.- Reduce the volume of the pressure cooker (size and direction of the handle).

It was managed to design a handle pointing towards the centre of the pressure cooker, thus achieving lower volume, a more compact pressure cooker, improved ergonomics (as the handle is situated nearer the centre of gravity and allows better movement of the pressure cooker and a guarantee of quality) as this was a basic requirement.

The costs for the company have been only the usual ones of design as the material used is the same. With this measure, the volume of the pressure cooker was reduced by 15%, with the corresponding improvement in the environmental aspect of emissions related with transport, not only considering the individual cooker but the overall production of Fagor.

f.- System of collection, recycling or remanufacture of pressure cookers.

The study phase commenced, bearing in mind that everything must be applicable to the use of the internet.

g.- End-of-life manual of the cooker.

On the basis of the Ecodesign project, it was started to prepare a manual which would include all the steps taken and which will serve for other business units. This measure was developed more towards the end of the project in the action plan phase, integrating it with the corresponding procedures for development of product of the company.

The manual has been prepared in collaboration with the design engineering company Diara, S. Coop. and IHOBE, S.A. within the framework of the project and has not entailed any additional cost for the company. This measure may also lead to numerous benefits, of staff motivation, information on Ecodesign and so forth.

6.- Action plan.

When the preliminary stages have been completed and with the new product designs, the FUTURE and ELEGANCE PRESSURE COOKERS, Fagor Minidomésticos S.Coop. established an action plan for the implementation of the measures related with the environment:

Product action plan of medium and long term improvements

Measures for improvement	Time scale	Actions	Responsible	Time scale &/or frequency
b.- Reduce the body of the pressure cooker (less thickness).	UNDER WAY (3 years ballpark figure).	- Commence new searches and contacts. - Contact technology centres and universities to check the state of new technologies.	- Product Development Department.	- Quarterly - Quarterly
c.- Recycled cellulose packaging.	UNDER WAY (1 year)	- Investigate packaging until reaching a concept of 100% cellulose.	- Product Development Department with packaging supplier.	- Continuous
e.- Pressure cooker which adapts optimally to the energy source.	UNDER WAY (2 years ballpark figure)	- Continue research in collaboration with a technology centre with Fagor cocción.	- Product Development Department. - Production Development Departm. of Fagor cocción.	- Continuous
f.- System of collection, recycling or remanufacture of pressure cookers.	EN MARCHA (2 años)	- Motivate – making distributors aware of this collection. - Adaptation of the company to the re-utilisation–recycling of old pressure cookers.	- Sales and Marketing Department.	- Continuous

Figure 6.- Product action plan of medium and long term improvements of Fagor Small Appliances.

NOTE.- This phase has had special importance in the case of Fagor Small Appliances as they plan medium and long term projects in relation to the 2 main environmental aspects, so REALLY REMARKABLE reductions of environmental impact are estimated.

An action plan was also developed at the level of the company for anchoring Ecodesign, which also has special importance in the case of Fagor for several reasons:

- This measure is the one which best fulfils the objectives of the management to integrate Ecodesign into the whole business group.
- In view of the size and importance of the Fagor group, this anchoring of Ecodesign may have very important repercussions with regard to resulting products and influence another companies.

Action plan at the level of the company for anchoring Ecodesign

At Fagor Small Appliances all stages of Ecodesign have been already integrated into the design procedure of the company.

In this procedure actions are included such as conducting surveys amongst customers or suppliers in order to study Motivating Factors, analyse the environmental aspects of the product using Eco-indicators, use the list of prohibited materials when designing a new product etc. The tools mentioned in this procedure (Eco-indicators, list of prohibited materials, etc) are contained in the end-of-life manual of the pressure cooker.
After preparing both tools for anchoring a start has been made on transmitting the basic concepts of Ecodesign in various groups and committees of the company within the framework of an incipient process of internal training and motivation.

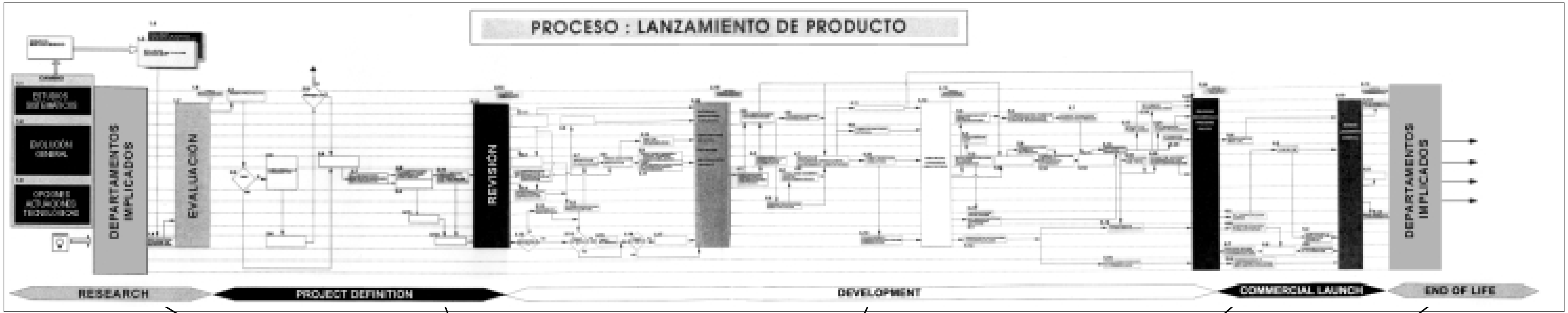


Figure 7.- Product development procedure

RESEARCH

- External Motivating Factors – legislation, environmental demand by customers, technological alternatives (suppliers) (Stage 1).

PROJECT DEFINITION

- Specifications – environmental aspects (Eco-indicators).
- Costs and quality – repercussion of environmental aspects.
- Analysis of risks – environmental risks = Motivating Factors + environmental aspects (Eco-indicators).

DEVELOPMENT

- Demand from suppliers – more environmentally friendly components and processes (Eco-indicators + Motivating Factors).
- ANFE - Environmental aspects (Eco-indicators).
- Selection of materials – less polluting (Eco-indicators).
- Validation – of the environmental requirements.
- End-of-life tests (separation and recyclability of components).

COMMERCIAL LAUNCH

- Discussion, environmental recommendations to users and recyclers (users and recyclers manuals).

END OF LIFE

- Talks and agreements with recyclers, treatment companies and other companies in the sector.

Figure 8.- General Product Development Manual.

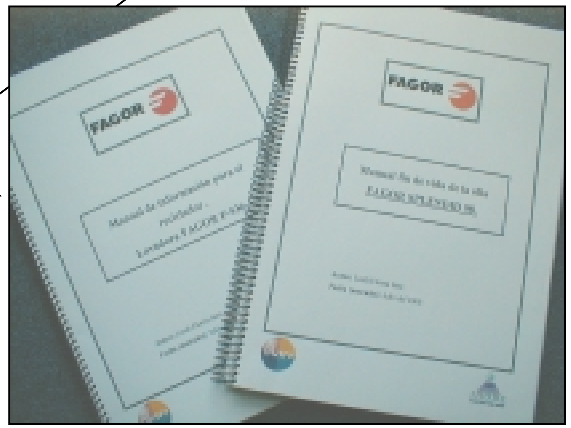
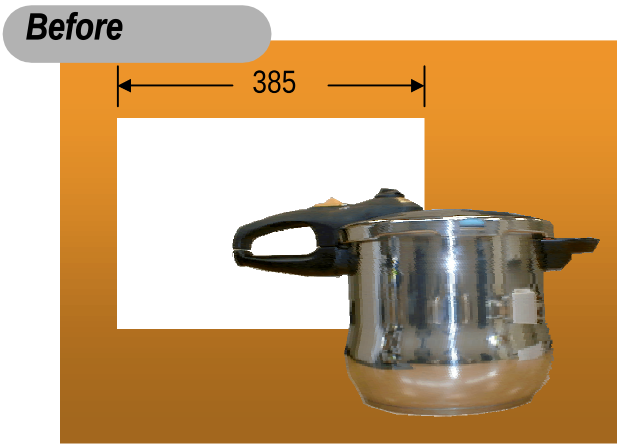


Figure 9.- End-of-Life Manuals developed in the Ecodesign pilot project.

7.- Evaluation.

In order to see the results of the project, a comparison of the Eco-indicators of the previous product (SPLENDID Pressure Cooker) was made with those of the new products (FUTURE and ELEGANCE Pressure Cooker) and it was observed that despite the fact that some environmental aspects had been reduced, this reduction was not very obvious owing to the barriers to improving the aspect of energy consumption, which is by far the most important. Nevertheless, the company was satisfied with the results, and stressed the following benefits:

- Innovative technology of the FUTURE and ELEGANCE Pressure Cookers, with an improvement of quality and respect for the environment.
- Reduction of the volume of the pressure cooker by 15%, facilitating its ergonomic characteristics, and also its packaging, transport and storage (in use).
- Increase of the ENVIRONMENTAL MOTIVATION of the employees and the CORPORATE FEELING to design in way more respectful of the environment.
- Having initiated a process of integration of Ecodesign in the company which, in addition to other benefits, will considerably improve the image of the Fagor Group and its products among its customers.



Figures 10 and 11.- Comparison of the SPLENDID (BEFORE) and FUTURE (AFTER the Ecodesign project) pressure cookers. The reduction in volume of the pressure cooker may be observed.

PRACTICAL EXPERIENCES

OFITA, S.A.M.M.

GENIUS office desk

IHOBE
Sociedad Pública Gestión Ambiental

OFITA, S.A.M.M.

GENIUS office desk

Ofita, S.A.M.M. is an office furniture company situated in Vitoria-Gasteiz with another base in Madrid. The company has 94 employees and is a highly aware company from the environmental point of view, and it achieved ISO 14001 certification in the year 2000.

Its main production processes are machining, welding, pre-treatment and painting, assembly and packing.

The company has a level of exports of 15%, which is also increasing, exporting to countries in Europe, America and Asia.

In 1999 the company, in the middle of its process of certification by an environmental management system and with the desire to improve not only its process but also its products, from the environmental point of view, decided to participate in the Ecodesign pilot project led by IHOBE, S.A. and with the collaboration of the BECO Dutch environmental consultancy.

1.- Preparation of the project.

a. For the development of the project a team was organised in which the following departments participated:

- ***Technical Department:*** two persons from this department led the project, following and familiarising themselves with the whole of the methodology and involving all the other departments. The company usually collaborates with an outside designer. Both persons from the technical department took charge of passing on to him all the details of the Ecodesign project, and also the environmental requirements as they arose, for him to work in this direction.
  The support provided by a grant-holder was interesting, she gave considerable help in searching for information, adapting the internal documentation for anchoring Ecodesign and contributing ideas for improvement.
  Also worthy of note is how these persons considerably involved their suppliers within the framework of the Ecodesign project, not only passing on to them the demands or environmental requirements, but visiting each of the companies and explaining to them their environmental interests. This had a very positive result as it improved the knowledge and customer-supplier relation and motivated suppliers towards environmental improvement.
- ***Quality, Environment, Financial, Purchasing Departments:*** these departments were informed about the Ecodesign project periodically and they contributed the necessary information throughout the whole project.
- ***Central Marketing Department:*** the central marketing department of the company supplied information about the demand of customers and was informed of the results of the Ecodesign project for the preparation of the marketing campaign, in which they closely collaborated with the technical department.
- ***Management:*** played a very important role throughout the project, always deciding in favour of environmental actions, even on occasions where they entailed a greater economic cost.

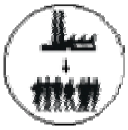
Figure 1.- Ecodesign team of Ofita, S.A.M.M. together with IHOBE, S.A..

b. The selected product was a desk, GENIUS, which was about to be designed at that time and which would also form the central axis of a whole product line (chairs, filing cabinets, accessories etc.), with the idea of integrating Ecodesign criteria into the whole line.

c. When the decisions about the team and the product had been taken, work started by defining the main Motivating Factors of Ecodesign for the GENIUS desk.

EXTERNAL Motivating Factors for the application of Ecodesign

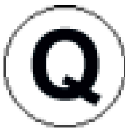
MARKET: Demand by customers (ind. & final)



THIS IS NOT IMPORTANT AT THE MOMENT. Surveys were carried out but no specific environmental demands were detected. Nevertheless, the increasing level of exports and sales to customers of the type of insurers, financial institutions etc. means that these demands may arise at any moment, so performing Ecodesign will help Ofita S.A.M.M. not only to respond to these demands but also to anticipate them.

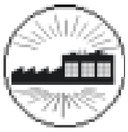
INTERNAL Motivating Factors for the application of Ecodesign

Increased product quality



At the desk is aimed at quite a select public, the aspect of good quality is essential, and also its final result.

Improvement in the product and company image



As it is a product with a final customer, the product image is a keen topic.

Power of innovation

THIS IS THE MOST IMPORTANT MOTIVATING FACTOR. In this final customer market in which both the aesthetic and functional design is so important, Ecodesign is undoubtedly a very interesting innovative factor which may lead to differentiation. Also it was considered that the fact of also including the environmental factor could make the design richer and more creative.

Manager's sense of environmental responsibility

UNQUESTIONABLE. The manager's interest and his commitment in this sense is unquestionable, and is reflected in the environmental policy of continuous improvement. The manager wanted to improve not only processes but also products.

Figure2.- Motivating Factors to perform Ecodesign of Ofita S.A.M.M.

Conclusion.-The power of innovation was the most important Motivating Factor and the rest of the Motivating Factors were not considered to be relevant as there are no ecolabels or environmental European Directives which affect this type of product and the customers and competitors are not yet very active in the environmental field. Nevertheless, it is considered important to review these Motivating Factors regularly, as the growing development of environmental legislation and the increase in social awareness will foreseeably make the factors of market, social environment, competitors and administration become relevant, even more so in a product such as this one, aimed at a final user.

2.- Environmental aspects.

Both the MET matrix and the Eco-indicators were used in the analysis of the environmental aspects. The utilisation of the MET matrix was very interesting in order to understand the process and the results and facilitated the organisation of the information. Nevertheless, the company preferred the Eco-indicators as a tool owing to the greater facility this offered them, (as they are not experts and have no experience of Ecodesign) when it came to prioritising the main aspects.

Product or component ***Lisis Desk***	***Project*** ***Ofita S.A.M.M.***
Date ***15-04-00***	***Author***
Notes and conclusions	

Production *(Materials, processes and transport).*

Material or process	Quantity	Indicator	Result
100% recycled aluminium	13,22 kg.	60	793,2
Sheet (steel)	12,5 kg.	86	1075
Chipboard (wooden board)	26,4 kg.	39	1029,6
High pressure laminate (1)	1,6 kg	510	816
Flexible PVC	0,2 kg.	240	48
Extrusion-aluminium (Al)	8,536 kg	72	614,59
Cutting wood (2)	2,088 dm³	6.4	13,36
Injection – aluminium (Al) (3)	4,684 kg	72	337,25
Extrusion PVC (4)	0,2 kg.	44	8,8
Powder painting (6)	1 m²	-	-
Cutting steel	-	0,00006	-
Gluing (high pressure laminate) (6)	2,56 m²	-	-
Gluing (PVC edge) (6)	0,0832 m²	-	-
Cardboard (reception)	0,3 kg.	69	20,7
Total			4756,5
Hardwood (solid wood)	28,35 kg	6,6	187,11
Wood veneer(5)	0,9 kg	39	35,1

Use *(Transport, energy and auxiliary materials).*

Material or process	Quality		Result
Cardboard	2,5	69	172,5
LDPE	1	360	360
28 t. Lony	23,67	22	520,74
Total			1053,24
Ocean going cargo shico	180,47	1,1	198,51
Contineltal air transport	58,72	120	7046,4
Inter.-continental air transport	704,952	80	56396,16

Waste *(For each type of material).*

Material & type of process	Quantity	Indicator	
Aluminium (tip)	13,22 kg.	1,4	18,51
Steel (tip)	12,5 kg.	1,4	17,5
Chipboard (6)	26,4 kg.	-	-
High pressure laminate (6)	1,6 kg.	-	-
PVC (tip)	0,2 kg.	2,8	0,56
Cardboard (recycle)	2,8 kg.	-8,3	-23,24
LDPE (tip)	1 kg.	3,9	3,9
Total			17,23

TOTAL(all phases)	**5826,97**

[grey box] Priority environmental aspects

(1).- For high pressure laminate the Eco-indicator of PC has been used, as we consider it to be the most similar material in terms of its impact.
(2).- For cutting wood we have used the Eco-indicator of granulating, drilling plastic, owing to the similarity of processes of material.
(3).- For aluminium injection we have used the Eco-indicator of extrusion – aluminium (Al), as injection and extrusion are similar processes with regard to their environmental impact.
(4).- For extrusion of PVC, we have used the Eco-indicator of injection moulding – 2 (which includes PVC), again owing to the similarity of the processes of injection and extrusion.
(5).- For the wood veneer we have used the Eco-indicator of wooden board.
(6).- Eco-indicators not available. Nevertheless, the environmental expert considers that they are not priority matters, so they do not entail a problem.

NOTA 1.- The eco-indicators of hardwood and wood laminate are included to see the priorities when the desk has those materials. The same occurs with transport by air and sea which is included even though it is only used in urgent cases.

Figure 3.- Study of the environmental aspects of the Lisis desk carried out using the Eco-indicators.

CONCLUSION.- It may be observed that the main environmental aspects of the Lisis desk were:

- **Transport by air (which is only performed occasionally for urgent shipments and this should be avoided).**
- **The consumption of steel.**
- **The consumption of wood and chipboards.**

There were materials and processes such as high pressure laminate and gluing high pressure laminate and the PVC edge for which no developed Eco-indicators existed in the Eco-indicator '99 tool, so support from the BECO environmental consultancy in the prioritisation of aspects was very important, and this urged the company to consider the consumption of high pressure laminate as one of the main ones; therefore it appears as a prioritised aspect in the table.

3.- Ideas for improvement.

After the main environmental aspects were defined and always taking account of the Motivating Factors Innovation and Image, ideas for improvement were generated in a brainstorming session in which the Technical, Quality and Environment Departments, the environmental consultants BECO and IHOBE, S.A. participated.

A summary of the measures for improvement generated, selected and evaluated for implementation is given below:

2	Very good score.
1	Good score
0	Neutral score.
-1	Negative score
-2	Very negative score.

ST:	Short term
MT:	Médium term
LT:	Long term

Measures for improvement	Environmental improvement	Motivating Factor Innovation	Motivating Factor Image	Motivating Factor Quality	Technical feasibility	Economic viability	Selection (✓)
Obtainment & consumption of materials & components							
a.- Utilisation of easily recyclable aluminium and steel.	**2**	**0**	**2**	**2**	**2**	**2**	✓ ST
b.- Board made from alternative materials.	**2**	**2**	**2**	**-2**	**-2**	**1**	✓ MT/LT
c.- Replace PVC and chrome.	**1**	**1**	**2**	**1**	**-1**	**-1**	✓ ST
d.- . Reduction of the quantity of steel and aluminium to the minimum.	**2**	**1**	**1**	**0**	**1**	**2**	✓ ST
e.- Overall reduction of volumes; lightweight aspect.	**2**	**2**	**2**	**0**	**2**	**2**	✓ ST
- Apron only optional.	1	-1	-2	-1	2	2	
Factory production							
f.- Energy evaluation of the necessary processes and optimisation of processes.	**1**	**2**	**2**	**1**	**2**	**2**	✓ LT
- Energy evaluation of the necessary processes and optimisation of processes.	1	0	0	0	2	2	Under way owing to ISO 14001
Distribution							
- Fabrication of parts at destination.	1	0	0	0	-1	-2	
g.- Desk occupying little volume in transport (stackability)	**2**	**2**	**2**	**0**	**2**	**2**	✓ ST
- Optimise logistics.	1	0	1	0	1	0	Under way owing to ISO 14001
- Packing re-usable by the user: bag.	1	1	1	0	0	-1	
Use or utilisation							
h.- Avoid the utilisation of boards with phenols	**2**	**2**	**2**	**2**	**-2**	**0**	✓ LT
End-of-life system. Final disposal.							
i.- Clip type rapid fasteners.	**1**	**2**	**2**	**1**	**2**	**2**	✓ ST
j.- Minimisation of welds.	**1**	**0**	**0**	**1**	**2**	**2**	✓ ST
k.- Marking of parts for recycling.	**1**	**1**	**2**	**1**	**2**	**2**	✓ ST
l.- RENOVE plan: collection of old desks and replacement by new desks.	**2**	**2**	**2**	**0**	**-1**	**-1**	✓ LT
New product ideas							
m.- Modular desk.	**1**	**1**	**1**	**1**	**1**	**1**	✓ ST
- Roll-on system at the base of the feet, lockable.	0	1	1	-1	1	0	

Figure 4.- Some measures for improvement generated and preselected in the brainstorming session and their assessment according to the company's criteria.

CONCLUSION.- It is important to stress that there were interesting measures such as the replacement of wood or chipboard of the board by alternative materials which, when analysed in a little greater depth (consultation with suppliers), had to be ruled out owing to their unfeasibility.

4.- Developing concepts.

The selected measures which affected the design were integrated into the technical environmental specification which was supplied and duly explained to the outside designer. This specification included the following:

- ***Technical requirements:***
  - Compliance with standards ISO (ISO/DIS 8019-86) and UNE PrEN527p3 September 1996/UNE 11022 and projects of European standard for office desks.
- ***Environmental requirements:***
  - Utilisation of aluminium and steel, easily recyclable (measure a).
  - Replacement of PVC and chrome (measure c).
  - Reduction of weights and volumes (measures d, e, g).
  - Energy appraisal of the necessary processes and optimisation (measure f).
  - Facilitate the dismantling – recycling of the product by means of clips, unification of screws, minimisation of welds (measures i, j).
  - Marking of all parts for recycling (measure k).
  - Modular desk (measure m).

The measures directed towards the optimisation of the factory production phase were not included among the requirements of the designer's specification, but were transmitted to the affected responsible persons in the company in order for them to be taken into account immediately and be included at the end of the project in the ISO 9001 or ISO 14001 procedures. They are the following measures:

- Marking of parts for recycling (measure k).
- RENOVE plan: collection of old desks and replacement by new ones and re-utilisation – recycling of parts and/or components (measure l).

In this stage the Ecodesign team of Ofita S.A.M.M., together with the outside designer, developed several concepts and analysed in depth the possibilities with regard to each of the selected measures, obtaining the following conclusions:

a. ***Utilisation of easily recyclable aluminium and steel.-*** Secondary aluminium and steel will be used in the possible quantities in order to comply with the technical requirements established.

b. ***Replacement of PVC and chrome.-*** It was seen that it was possible to avoid chrome completely in the desk. The replacement of PVC was directly possible. Alternatives of materials were appraised with regard to their technical, economic and aesthetic performance and it was seen that polypropylene was the best option. The company then made an economic appraisal and a study of the improvement of the environmental aspect with the Eco-indicators, and it was observed that there was hardly any difference between them.

Material or process	*Quantity*	*Indicator*	*Result*
PVC production	0,2 kg	270	54
PVC processing	0,2 kg	44	8,8
PVC recycling	0,2 kg	-170	-34
TOTAL			**28,8**

Material or process	*Quantity*	*Indicator*	*Result*
Granulated PP production	0,2 kg	330	66
PP processing	0,2 kg	21	4,2
PP recycling	0,2 kg	-210	-42
TOTAL			**28,2**

Figure 5.- Environmental comparison of PVC and PP with Eco-indicators.

The available bibliography in the market relating to both plastics was then studied in order to see whether the replacement really was of interest. The conclusion was reached that polypropylene was rather better from the environmental point of view as can be seen from the comparison made with the Eco-indicators, however polypropylene did not comply with the necessary technical requirements, so it was decided to postpone this measure.

d, e,g. ***Reduction of weight and volume.-*** Various concepts were designed and this was the criterion which defined the choice, the lighter and less voluminous desk. It was observed that weight and volume could be greatly reduced, complying with the technical requirements owing to an innovative central anchoring piece, which was the axis of the system.

Figure 6.- Anchoring piece of the axis of the system.

f. ***Energy evaluation of the necessary processes and optimisation of these processes.-*** The company searched the bibliography and contacted its suppliers consulting about the energy consumption of each process and possible alternatives. It was observed at the outset that the available information was scarce.

k. ***Marking of parts for recycling.-*** Mainly plastics, as metals are already recycled. The Quality Department was informed in this connection and directives of the standard ISO 11469 of marking plastics were followed.

m. ***Modular desk.-*** The selected concept allowed not only for the apron, panels etc. to be accessories, but made it possible to add further modules to the desk to increase its size from different sides.

The selected product concept which was arrived at was a desk with considerably reduced weight, volume and content of steel and aluminium; without chrome; most of the unions of which were clips and with a modular design which made it possible to adapt the desk to different configurations.

5.- Product in detail.

The viable measures were developed up to their implementation.

a. ***Utilisation of easily recyclable aluminium and steel.-*** Parts and quantities were detailed. The possible percentages of secondary aluminium and steel were defined and the suppliers of these materials were informed.

c. ***Replacement of PVC and chrome.-*** The supplier of closing pieces was informed for their detail design in polypropylene.

d, e and g. ***Reduction of weight and volume.-*** The new GENIUS desk was designed in detail achieving reductions of 27.18% by weight and 52.32% by volume. In the definition of materials it was not necessary to analyse environmental aspects as there were no new materials and there was a reduction of hazardous substances or components and the quantities of the usual materials.

i, j. ***Facilitate dismantling and recycling of the product.-*** Measurements and materials etc. were detailed and prototypes were made of the desk and all types of technical tests, testing the quality and compliance with the technical and environmental requirements. The selected concept made very much progress in this aspect, with a large quantity of clips and unions which are easily dismantled and which in turn fully comply with all the technical requirements.

f. ***Energy evaluation of the necessary processes and optimisation.-*** The company contacted its suppliers to see how this was possible and consulted various sources of information. The problem was found that nowadays information in this connection is limited (see Eco-indicator '99) but it already obtained an idea of the situation of its production processes (highly optimised, having a powder painting system with 0% waste for example) and the measure will consist subsequently of asking for information and keeping informed in this connection.

k. ***Marking of parts for recycling.-*** The Quality Department gave information to suppliers of plastic parts about these requirements, supplying the standard ISO 11469. This measure did not entail any additional cost for the company.

m. ***Modular desk.-*** The product was designed in detail and tests and prototypes were made and the GENIUS desk complied with all the necessary technical requirements in this connection.
The result is a highly innovative desk, adaptable to the customer's needs which is meeting with a very positive response from customers.

6.- Action plan.

When the design of the product was completed, the company started to draw up an action plan to include the measures for improvement of the product in the medium and long term which had not been able to be implemented:

Product action plan of medium and long term improvements

Measures for improvement	Time scale	Actions	Responsible	Time scale &/or frequency
b.- Board of alternative materials.	MT/LT	- Send notification to suppliers and designers about this demand. - Consult periodically about new information. - Consult at fairs about this matter.	- Purchasing and Product Development Department. - Purchasing and Product Development Department. - Marketing Department.	- Every 3 months. - Every 3 months. - Each fair.
f.- Energy appraisal of the necessary processes and optimisation of processes.	LT	- Inform suppliers and designers to compile this information. - Check regularly about new information. - Consult with IHOBE, on the internet, etc. about sources of information which may arise.	- Purchasing Department. - Purchasing and Product Development Department. - Product Development Department.	- Every 3 months. - Every 3 months. - Every 3 months.
h.- Avoid the utilisation of boards with phenols.	MT / LT	- Inform suppliers and designers of this demand. - Check periodically about new information.	- Purchasing and Product Development Department. - Purchasing and Product Development Department.	- Every 3 months. - Every 3 months.
c.- Replace PVC	ST	- Inform suppliers and designers of this demand. - Check regularly for new information.	- Purchasing and Product Development Department. - Purchasing and Product Development Department.	- Every 3 months. - Every 3 months.
l.- RENOVE plan: collection of old desks and replacement by new desks.	LT	- Organise logistics with regard to collection: collection points. - Reach agreements with suppliers for the acceptance and recycling of materials. - Talk and reach agreements with other recyclers for surplus materials. - Inform the user.	- Logistics Department. - Purchasing Department. -Environment Department. - Environment Department.	- 2 years (ballpark figure). - 6 months (ballpark figure). - 1 year (ballpark figure) - 2 years (ballpark figure).

Figure 7.- Product action plan for improvements in the medium and long term of Ofita S.A.M.M.

Action plan at the level of the company for anchoring Ecodesign.

Furthermore, the company has anchored the Ecodesign methodology in its product development process, starting with the following outline and introducing modifications to the procedures affected. For this an internal Ecodesign manual has also been prepared, which includes the associated documentation referred to in the procedures of ISO 9001 and ISO 14001.

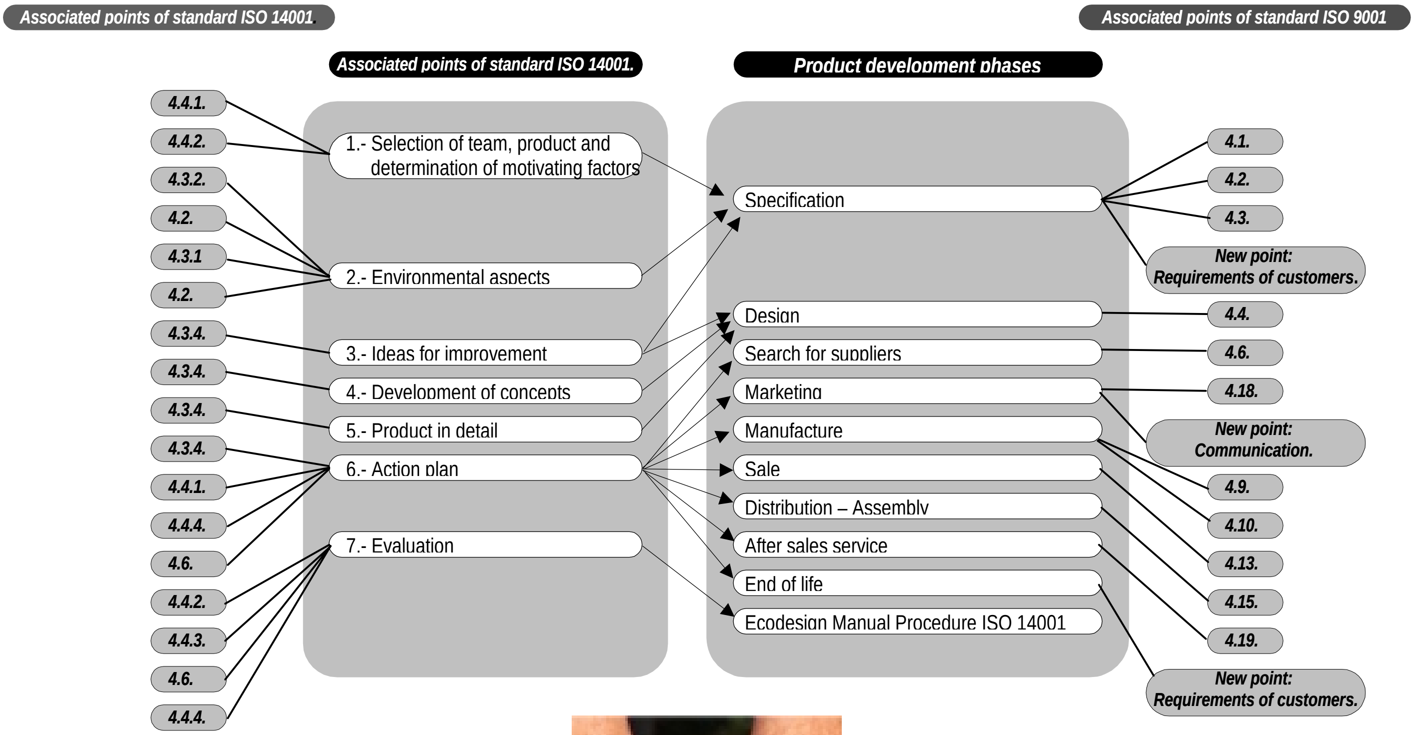


Figure 8.- Anchoring of Ecodesign in the product development process, ISO 9001 and ISO 14001 of Ofita S.A.M.M.

Furthermore, the company has included the results of the Ecodesign project into its marketing plan, and has already carried out actions such as the following:

- Open doors seminar in collaboration with IHOBE and the employers organisation ADEGI to explain the Ecodesign project.
- Articles in the press about the project and its results.
- Television news item about the project and its results, in collaboration with IHOBE.

As shown in stage 7 of this manual.

7.- Evaluation.

In order to see the environmental results of the project, a comparison was made of the preliminary and final products, the Lisis desk and the Genius desk respectively, and it was found that the environmental results were really good.

BEFORE (Lisis Desk)

Production (Materials, processes and transport)

Material or process	Quantity	Indicator	Result
100% recycled aluminium	13,22 kg.	60	793,2
Sheet (steel)	12,5 kg.	86	1075
Chipboard (wooden board)	26,4 kg.	39	1029,6
High pressure laminate (1)	1,6 kg	510	816
Flexible PVC	0,2 kg.	240	48
Extrusion-aluminium (Al)	8,536 kg	72	614,59
Cutting wood (2)	2,088 dm^3	6,4	13,36
Injection – aluminium (Al) (3)	4,684 kg	72	337,25
Extrusion PVC (4)	0,2 kg.	44	8,8
Powder painting (6)	1 m^2	-	-
Cutting steel	-	0,00006	-
Gluing (high pressure laminate) (6)	2,56 m^2	-	-
Gluing (PVC edge) (6)	0,0832 m^2	-	-
Cardboard (reception)	0,3 kg.	69	20,7
Total			4756,5

Hardwood (solid wood)	28,35 kg	6,6	187,11
Wood veneer (5)	0,9 kg	39	35,1

Use (Transport, energy and auxiliary materials).

Material or process	Quantity	Indicator	Result
Cardboard	2,5	69	172,5
LDPE	1	360	360
28 t Lorry	23,67	22	520,74
Total			1053,24

Ocean going cargo shipo	180,47	1,1	198,51
Continental air transport	58,72	120	7046,4
Intercontinental air transport	704,952	80	56396,16

WASTE (For each type of material)

Material & type of process	Quantity	Indicator	Result
Aluminium (tip)	13,22 kg.	1,4	18,51
Steel (tip)	12,5 kg.	1,4	17,5
Chipboard (6)	26,4 kg.	-	-
High pressure laminate (6)	1,6 kg.	-	-
PVC (tip)	0,2 kg.	2,8	0,56
Cardboard (recycle)	2,8 kg.	-8,3	-23,24
LDPE (tip)	1 kg.	3,9	3,9
Total			17,23

TOTAL(all phases)	**5826,97**

NOTE 1.- The Eco-indicators of hardwood and wood laminate are included to see the priorities when the desk has those materials. The same occurs with transport by air and sea, which is included although it is only used in urgent cases.
NOTE 2.- See notes overleaf.

AFTER (Genius Desk)

Production (Materials, processes and transport)

Material or process	Quantity	Indicator	Result
100% recycled aluminium	5,464 kg.	60	327,84
Sheet (steel)	7,934 kg.	86	682,32
Chipboard (wooden board)	21,3 kg.	39	830,7
High pressure laminate (1)	1,6 kg.	510	816
PP	0,340 kg.	330	112,2
LDPE	0,004 kg.	360	1,44
Rigid PVC	0,736 kg.	270	198,72
Flexible PVC	0,2 kg.	240	48
Injection aluminium (Al) (3)	2,264 kg.	72	163
Extrusion-aluminium (Al)	3,2 kg.	72	230,4
Cutting wood (2)	2,088 dm^3	6,4	13,36
Injection/Extrusion PP (7)	0,340 kg.	21	7,14
Injection LDPE (7)	0,004 kg.	21	0,08
Extrusion PVC (8)	0,936 kg.	44	41,18
Powder painting (6)	1 m^2	-	-
Cutting steel	-	0,00006	-
Gluing (high pressure laminate) (6)	2,56 m^2	-	-
Gluing (PVC edge) (6)	0,0832 m^2	-	-
Cardboard (reception)	0,3 kg.	69	20,7
Total			3493,08

Hardwood (solid wood)	22,8 kg.	6,6	150,48
Wood veneer (5)	0,9 kg	39	35,1

Use (Transport, energy and auxiliary materials).

Material or process	Quantity	Indicator	Result
Cardboard	1,6	69	110,4
LDPE	0,4	360	144
28 t Lorry	15,99	22	351,78
Total			606,18

Ocean going cargo ship	121,89	1,1	134,08
Continental air transport	39,678	120	4761,36
Intercontinental air transport	476,14	80	38091,2

WASTE (For each type of material)

Material & type of process	Quantity	Indicator	Result
Aluminium (tip)	5,464 kg.	1,4	7,65
Steel (tip)	7,934 kg.	1,4	11,1
Chipboard (6)	21,3 kg.	-	-
High pressure laminate (6)	1,6 kg.	-	-
PP (tip)	0,340 kg.	3,5	1,19
PVC (tip)	0,936 kg.	2,8	2,62
Cardboard (recycled)	1,9 kg.	-8,3	-15,77
LDPE (tip)	0,404 kg.	3,9	1,57
Total			8,36

TOTAL(all phases)	**4107,62**

(1).- For high pressure laminate the Eco-indicator of PC has been used, as we consider it to be the most similar material with regard to its impact.
(2).- For cutting wood we have used the Eco-indicator of granulating, drilling plastic, owing to the similarity of processes and material.
(3).- For aluminium injection we have used the Eco-indicator for extrusion-aluminium (Al), as injection and extrusion are similar processes with regard to their environmental impact.
(4).- For PVC extrusion, we have used the injection moulding-2 Eco-indicator (including PVC), again owing to the similarity of the processes of injection and extrusion.
(5).- For wood veneer we have used the Eco-indicator for wooden board.
(6).- Eco-indicators not available. Nevertheless, the environmental expert considers that they are not priority topics, so they are not a problem.
(7).- Both for injection/extrusion PP and for injection LDPE, we have used the Eco-indicator of injection moulding-1 (which includes both PP and PE).
(8).- For extrusion of PVC we have used the injection moulding Eco-indicator-2 (which includes PVC).

CONCLUSION: As it may be seen from the estimates and deductions made, it is very important to have the collaboration of an expert on the environment or on the use of this type of tools, at least the first time one works with Eco-design.

The most noteworthy benefits resulting from the project:

- A MORE ENVIRONMENTALLY FRIENDLY TABLE. Reduction of the **most important** environmental aspects of the table; transport (reduction of volume by 52.32%); consumption of steel (4.5 kg/desk); and the consumption of wood (5.6 kg/desk).
- HIGHLY INNOVATIVE image of the whole product line. Ideas arose for the aesthetic design of the desk deriving from the environmental improvements. Thus the process was much richer. We ended up with "a desk which sells itself".
- Improvement of the ENVIRONMENTAL MOTIVATION of the employees and willingness to continue working in this direction, greater interconnection between the various departments of the company.

Before

After

Figure 10.- Comparison between the GENIUS and LISIS desk. Observe the reduction in weight and volume in the new product (board of smaller thickness, lighter feet and beams etc.).

PRACTICAL EXPERIENCES

FAGOR ELECTRODOMÉSTICOS, S. Coop. (washing machines)

FAGOR F-536 washing machine

IHOBE
Sociedad Pública Gestión Ambiental

FAGOR, S. Coop.(Electrodomésticos)

FAGOR F-536 Washing machine

Fagor Electrodomésticos is a business group within MCC which has seven business units including Fagor Washing Machines, which engages in the exclusive manufacture of this type of domestic appliances (washing machines).
Fagor Washing Machines has a production plant situated in the locality of Arrasate (Gipuzkoa), where 579 employees work.
The main production processes of the company are folding, cutting, pressing and welding of sheet steel, moulding of plastics, powder painting, painting on solvent base, assembly and packing.
The Garagarza plant where Washing Machines is situated holds the ISO 9001 and ISO 14001 environmental management certificate.
When learning in 1999 of the commencement of the pilot project of Ecodesign of IHOBE, it decided to participate in this, considering that it was essential to start integrating environmental criteria into the design of its products, for which customers already demand this type of characteristics.

1.- Preparation of the project.

a. For the development of the project a team was organised in which the following departments participated:
   - ***Fagor Central Quality Department:*** which informed about the quality requirements, environment requirements (ISO 14001) and the requirements of the legislation mainly. In this case it was this department which directed the project, coordinating the results and the learning of Fagor – Small Appliances and Fagor – Washing Machines, in which the project concentrated on the environmental improvement of the product (in Fagor – Small Appliances) and in the integration of Ecodesign for the long term improvement or strategic Ecodesign (in Fagor – Washing Machines).
   - ***Product Development Department*:** which directed the application of the methodology with a view to the washing machine product specifically.
   - ***Outside designer:*** The company Diara, S. Coop. also collaborated on this project internalising the methodology and concepts of Ecodesign in order to continue to collaborate with Fagor and other customers, introducing environmental criteria into the design of products.

b. The product selected was a FAGOR brand washing machine (upper range) which was being redesigned, so the ideas and evolution of the Ecodesign project could be integrated as the design was being questioned.

c. After taking the preliminary decisions relating to the project team and product, the company defined its main Motivating Factors to work in Ecodesign which in this case were KEY as they clearly defined the direction of the project:

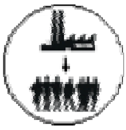
EXTERNAL Motivating Factors for the application of Ecodesign

ADMINISTRATION: legislation y regulation

THIS IS THE MOST IMPORTANT MOTIVATING FACTOR. The company already complies with environmental legislation owing to the fact that it is certified according to ISO 14001. But it is also affected by the WEEE Directive (Directive on the end of life of electrical and electronic products) (in draft version) which requires among other things:

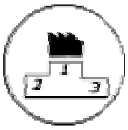
- The elimination of some heavy metals
- The increase in the percentage of recyclability of the product to 90%
- The marking of plastics
- The elimination of fire retardants with halogenides
- The responsibility of producers, which must participate in a system of collection of products at the end of their life
- Information to users, recyclers and authorities on the environmental characteristics of the product and recyclability.

MARKET: Demands of customers (ind. & final)



The demands of customers are going towards a reduction in consumables in the phase of use, this is energy, detergents and water; and towards the elimination of noise.

COMPETITORS: What they are doing in Ecodesign



Some competitors already offer an image of environmentally friendly products, concentrating on the topic of recyclability, the minimisation of the consumption of energy, water and detergent and noise reduction.

INTERNAL Motivating Factors for the application of Ecodesign

The manager's sense of environmental responsibility.

There is a commitment to environmental improvement both by MCC and the Fagor Group which includes certification by standard ISO 14001 and the integration of the methodology of Ecodesign into the company's management tools.

CONCLUSION. As may be observed, the most important Motivating Factor of Ecodesign is progress in compliance with the requirements of the WEEE European Directive.

Figure 2.- Motivating Factors to perform Ecodesign of Fagor S. Coop. (Electrodomésticos).

2.- Environmental aspects

The environmental aspects of the product were analysed using the MET matrix and Eco-indicator tools. The table of Eco-indicators in which the said aspects are prioritised is shown below:

Product or component	Project
FAGOR WASHING MACHINE	ECODESIGN PILOT
Date: Mayo 1999	Author: FAGOR WASHING MACHINES
Notes and conclusions	

Production (Materials, processes and transport).

Material & type of process	Quantity	Indicator	Result
Cement	26 kg.	20	520
Steel	16 kg.	16	256
High alloy steel (ferritic stainles steel)	3,5 kg.	910	3185
Wooden boards	-	39	-
EPDM rubber	1,5 kg.	360	540
ABS	1,0 kg.	400	400
Glass (white)	1,0 kg.	58	58
100% recycled aluminium	0,8 kg.	60	48
Expanded PS (EPS)	0,8 kg.	360	288
HDPE	0,5 kg.	330	165
Cables (1)	0,5 kg.	994	497
Rigid PVC	0,5 kg.	270	135
Packing cardboard	0,5 kg.	69	34,5
PS (GPPS) – general use	0,5 kg.	370	185
PA 6.6	0,2 kg.	630	126
POM (2)	0,1 kg.	630	63
Steel	6 kg.	86	516
Copper (Cu)	1 kg.	1400	1400
Aluminium motor (100% recycled)	0,7 kg.	60	42
EPDM rubber	0,5 kg.	360	180
Folding of sheet (3)	10 m.	0,00008	0
Cutting steel (sheet)	28000 mm²	0,00006	1,68
Pressing sheet (4)	15079,6 mm²	0,00006	0,9
Welding (5)	10	-	-
Moulding of PP (6)	5 kg.	21	105
Moulding of ABS (6)	1 kg.	21	21
Solvent painting (5)	0,137 kg.	-	-
Powder painting (5)	0,182 m²	-	-
Total			8767,08

Use (Transport, energy and auxiliary materials).

Material & type of process	Quantity	Indicator	Result
28 t. lorry (CAPV) (470 km)	37,6 tkm.	22	827,2
Electricity BV Europa (UCPTE)	1500 kWh	26	39000
Water (5)	-	-	-
Detergent (5)	-	-	-
Total			39827,2

Waste (For each type of material).

Material & type of process	Quantity	Indicator	Result
Cement (tip) (7)	26 kg.	1,4	36,4
Recycling of steel (ferrous metals)	22 kg.	-70	-1540
Recycling of ferritic stainless steel (ferrous metals)	3,5 kg.	-70	-245
Aluminium (Al) tip	0,8 kg.	1,4	1,12
Glass tip	1 kg.	1,4	1,4
Recycling of copper (Cu) (5)	1 kg.	-	-
Aluminium of motor tip	7 kg.	1,4	9,8
PS tip (expanded PS and PS general use)	1,3 kg.	4,1	5,33
PE tip (HDPE)	0,5 kg.	3,9	1,95
PA tip (8)	0,2 kg.	3,9	0,78
ABS tip (9)	1 kg.	3,9	3,9
Tip of cables (10)	0,5 kg.	1,89	0,95
PVC tip	0,5 kg.	2,8	1,4
Paper tip	0,5 kg.	4,3	2,15
Total			-1719,82

TOTAL(all phases)	46874,46

Priority environmental aspects (shaded)

(1).- For cables we assume the following composition: 65% copper (Eco-indicator = 1400) and 35% flexible PVC (Eco-indicator = 240).
(2).- In the case of the Eco-indicator of POM, we have used the Eco-indicator of PA 6.6 as this is the most similar material.
(3).- For folding sheet we have adopted the Eco-indicator of bending steel, as it is the same operation.
(4).- For pressing sheet we have taken the Eco-indicator of cutting/pressing steel, as it is the most similar process.
(5).- Eco-indicators not available. Nevertheless the environmental expert considers that they are not priority matters, so they are not a problem.
(6).- Both for moulding PP and for moulding ABS, we have used the Eco-indicator of injection moulding – 1 (which includes both PP and ABS).
(7).- For cement (tip), we have used the Eco-indicator of tip of glass, as both materials are inert.
(8).- For the PA tip we have used the Eco-indicator of the PE tip.
(9).- For the ABS tip we have used the Eco-indicator of the PE tip.
(10).- For the tip of cables we assume the same composition as in production: 65% of tip of copper (we adopt the Eco-indicator of tip of steel = 1.4) and 35% of the PVC tip (Eco-indicator = 2.8).

Figure 3.- Study of the environmental aspects of the previous washing machine carried out using Eco-indicators.

CONCLUSION.- It may be observed that the main environmental aspects are:

- **The consumption of energy, water and detergent during the phase of use (despite the fact that there are no Eco-indicators).**
- **The consumption of steel.**

Nevertheless, the consumption of energy, water and detergents is in a continuous process of optimisation as these are the main demands of customers and the topics of greatest competitiveness in the market.

3.- Ideas for improvement.

In this phase no ideas for improvement were generated as the reduction of the consumption of energy, water and detergents was already being studied and the main Motivating Factor of Ecodesign was compliance with the requirements of the WEEE Directive. Therefore the prioritisation was made on these requirements, as shown in the table below:

2	Very good score.
1	Good score
0	Neutral score.
-1	Negative score
-2	Very negative score.

ST:	Short Term
MT:	Médium Term
LT:	Long Term

Requirements of WEEE Directive	Technical feasibility	Economic viability	Selection (✓)
a.- Elimination of heavy metals such as Pb, Hg, Cd, Cr, Cr VI and brominated flame retardants.	2	2	✓ ST
b.- Marking of plastic components > 50 g. according to standard ISO 11469.	2	2	✓ ST
c.- Establish a system of collection – recycling of appliances and meet the costs	-2	-2	✓ LT
d.- Selective collection of 4 kg per inhabitant per year of electrical and electronic equipment.	-2	-2	✓ LT
e.- Supply instructions for extracting hazardous substances in treatment	2	2	✓ ST
f.- Recyclability of 90% in washing machines.	-1	-2	✓ MT
g.- Inform the user about the systems for collection and their contribution to recycling.	2	2	✓ ST
h.- Supply the necessary information to the recycler to facilitate the treatment of the appliances at the end of their useful lifetime.	2	2	✓ ST
i.- Inform the authorities about the quantity in weight of appliances placed in the market.	2 (Not yet necessary)	2	✓ LT

Figure 4.- Some measures for improvement generated and preselected in the brainstorming session and their assessment on the basis of criteria of the company.

CONCLUSIONS.- The establishment of a system of collection and recycling of appliances is a measure which at the moment cannot be implemented as it depends on the consensus with other manufacturers and importers of domestic appliances and involves the creation of a complicated and costly infrastructure, nevertheless the company participates in various European Committees and in the State and Basque associations of domestic appliance manufacturers ANFEL and ACEDE respectively, in which theses topics are already being discussed.
Measure h. is feasible for the moment but as the WEEE Directive is still at the draft stage, it is not necessary to issue this information to the authorities so it will be postponed until the entry into effect of the Directive.

4 and 5.- Develop concepts and product in detail.

In this case the measures were strategic measures and not only measures which affected the design of the product; therefore it may be said that stages 4 and 5 overlapped. The company analysed each measure in greater detail until its implementation was achieved as described below.

Elimination of toxic substances and halogenated flame retardants. Initially the company made an itemisation of the washing machine and a check of the safety record cards with the help of Diara, S. Coop., identifying in an itemised list the parts which contained any of these toxic substances.

Then talks were held with suppliers to check alternatives to these substances and once the possibility of their substitution was confirmed, the documents of technical specifications and purchasing documents were checked in order to include the elimination of these hazardous substances.

a. ***Marking of plastic components > 50 g according to standard ISO 11469.*** These components were also identified in the itemised list of the washing machine, the instructions for work in the factory were reviewed and compulsory marking was included in cases where it had been omitted, although for the most part it was already being carried out.

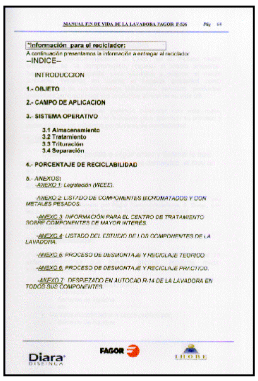
b. ***Establish a system for the collection and recycling of appliances and meet the costs.*** The importance of this requirement was passed on internally. The Dutch case and the cases of European private companies which had already organised the system of collection and recycling were studied within the framework of the project, in order to study the advantages and disadvantages of each case and draw conclusions.

The topic and the concern about the problems which it presents and the needs for a solution were passed on at European Committees and at the National Association of Domestic Appliance Manufacturers (ANFEL). For the moment it is a topic which requires further discussion and a consensus among all parties.
Contact was also made with a company which separates and recycles electronic and domestic appliances, to obtain information about the trends in the technology of separation and recycling of these appliances and to try to adapt the design of the appliances to these technologies. The most important conclusions which were obtained were the following:
The most widely used technique is grinding and separation. Automatic disassembly is also used, although in a smaller amount.
Thinking about a grinding and separation treatment, the following measures would be of interest:

- *Decontamination of heavy metals, PCBs, halogenated fire retardants, glass fibres and additives in plastics.*
- *Analysis and prevention of mixtures of different plastics (and information to the recycler) in plastic parts.*
- *Use preferably PE, PP, PVC, PET and ABS, which are accepted by recyclers.*
- *Avoid composites or complex materials, of which their recyclability is not yet known.*
- *Facilitate the simple separation of voluminous elements of great hardness such as the balancing weight and the motor.*
- *Facilitate the simple separation of electronic elements (printed circuits).*

c. ***Selective collection of 4 kg. per inhabitant per year of electronic equipment.*** In a preliminary phase, it only seems to be realistic to achieve 1.5 kg. This matter is being discussed in European Committees.

e., h. ***Supply instructions for extraction of hazardous substances in treatment. Supply necessary information to the recycler to facilitate the treatment of the appliances at the end of their useful lifetime.*** A start was made on preparing an information manual for the recycler which included the itemised list of the washing machine indicating the hazardous substances contained in the appliances manufactured so far, plastic parts > 50 g. and guidelines for treatment, grinding and separation of their components


MANUAL FIN DE VIDA DE LA LAVADORA FAGOR F-536 Pág 64

*Información para el reciclador:
A continuación presentamos la información a entregar al reciclador
--INDICE--

INTRODUCCION
1.- OBJETO
2.- CAMPO DE APLICACION
3.- SISTEMA OPERATIVO
3.1 Almacenamiento
3.2 Tratamiento
3.3 Trituración
3.4 Separación
4.- PORCENTAJE DE RECICLABILIDAD
5.- ANEXOS:
-ANEXO 1: Legislación (WEEE).
-ANEXO 2: LISTADO DE COMPONENTES BICROMATADOS Y CON METALES PESADOS.
-ANEXO 3: INFORMACIÓN PARA EL CENTRO DE TRATAMIENTO SOBRE COMPONENTES DE MAYOR INTERÉS.
-ANEXO 4: LISTADO DEL ESTUDIO DE LOS COMPONENTES DE LA LAVADORA.
-ANEXO 5: PROCESO DE DESMONTAJE Y RECICLAJE TEORICO.
-ANEXO 6: PROCESO DE DESMONTAJE Y RECICLAJE PRACTICO.
-ANEXO 7: DESPIEZADO EN AUTOCAD R-14 DE LA LAVADORA EN TODOS SUS COMPONENTES

Diara DISEINUA FAGOR IHOBE

Figure 5.- Index of the information manual for the recycler of Fagor Electrodomésticos – Lavadoras S. Coop.

d. ***Recyclability of 90% in washing machines.*** 90% is not considered to be realistic in the short term. Nevertheless, non-recyclable materials were marked on the itemised list of the washing machine, for replacement, as far as possible, by recyclable materials in the medium term. The present rate is 40% of recyclability.

h. ***Inform the user about systems of collection and their contribution to recycling.*** An information card for the user was prepared in which information will be given about compliance with WEEE Directive, implementation of ISO 14001 and recommendations for use will be used for a smaller environmental impact. A logotype was designed (a draft is shown below) which included these keys to be placed on the product.

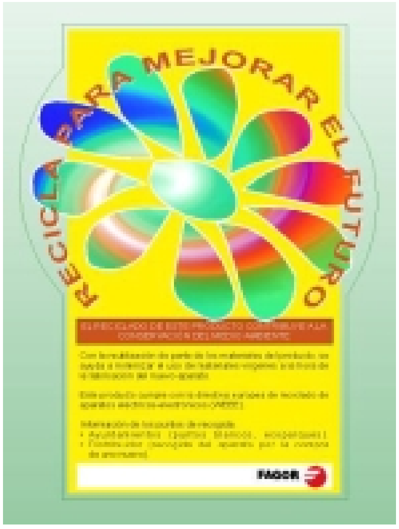


Figure 6.- Logotype of the Fagor washing machine.

i. ***Inform the authorities about the quantity by weight of appliances placed in the market.*** The measure has been postponed until this requirement is applied by the authorities.

The product as such will be gradually modified therefore by the elimination of Hg, Cd, Pb, Cr VL and halogenated retardants, marking of plastics and increase in recyclability up to 90% and easy dismantling of heavy and voluminous components and electronic components.

6.- Action plan.

A number of key measures arose from the requirements of the WEEE Directive and the discussion with the treatment company of domestic appliances and electrical and electronic appliances, and these were included in a basic specification.

The design with the use of this basic specification constitutes part of the product action plan of improvements in the medium and long term.

Product action plan of improvements in the medium and long term

Measures for improvement	Time scale	Actions	Responsible	Time scale &/or frecuency
a,b.- Design on the basis of the basic specification.	6 months	- Delivery of specification to designers.	- Product Development Manager.	- Each new design.
c.- Establish a system for collection and recycling of the appliances.	1 year (?)	- Agreement with the affected sectors. - Agreements with Government and recyclers.	- Fagor Central Quality Manager. - Fagor Central Quality Manager.	- 6 months. - 1 year (?).
d.- Selective collection of 4 kg. per inhabitant per year.	1 year	- Discussions in committees until an agreement is reached. - Parallel with measure c.	- Fagor Central Quality Manager. - Fagor Central Quality Manager.	- Each committee. - 2 years (?).
i.- Inform the authorities of the quantity by weight of appliances placed in the market.	?	- Await the entry into force of the Directive. - When it comes into force prepare information and send it to the authorities. - Allocate persons responsible for sending this and the frequency.	- Fagor Central Quality Manager. - Fagor Central Quality Manager. - Fagor Central Quality Manager.	- Each week. - ? -?

Figure 7.- Product action plan of improvements in the medium and long term of Fagor Electrodomésticos – Lavadoras S. Coop.

In addition to the product action plan, an action plan has been prepared at the level of the company for anchoring Ecodesign..
This anchoring has been carried out in parallel with the project in Fagor Electrodomésticos – Minidomésticos, S. Coop. (Small Appliances).
In Small Appliances, Ecodesign has been anchored with ISO 9001 in the product development procedure, General Product Development Manual and the pressure cooker launch manual. This will be extrapolated to washing machines and will also be included in the launch manual of the washing machine and other products. In turn, the conclusions about the end of life of the washing machine will be included in the launch manual of the pressure cooker and other products.
In this way the project has taken two different directions in both business units, which means that the learning has been richer and extrapolating the conclusions of each project to the rest of the business units of Fagor.

Accordingly, the action plan at the level of the company contains the following:

Action plan at the level of the company of anchoring Ecodesign

Measures for improvement	Time scale	Actions	Person Responsible	Time scale &/or frequency
Include the conclusions of the end-of-life manual of washing machines in end-of-life manuals of other products	6 months	- Pass on to managers of other business units. - Internal meetings between product development managers. - Preparation of specific manuals for each product. - Pass on to the whole company.	- Fagor Central Quality Manager. - Product Development Manager of each business unit. - Product Development Manager of each business unit. - Fagor Central Quality Manager.	- 1 month - 4 months - 6 months - 6 months
Pass on to other business units (including washing machines) the conclusions of the project of the other Fagor (Small Appliances) and the anchoring of Ecodesign with ISO 9001.	6 months	- Pass on to managers of other business units. - Internal meetings between product development managers. - Preparation of specific end-of-life manuals for each product. - Pass on to the whole company.	- Fagor Central Quality Manager. - Product Development Manager of each business unit. - Product Development Manager of each business unit. - Fagor Central Quality Manager.	- 1 month - 4 months - 6 months - 6 months
Develop tools for the ISO 9001 product development manuals: list of good practices, list of good materials, etc.	6 months	- Define the necessary tools. - Contact with IHOBE for support in development of tools. - Develop/acquire tools. - Pass on to each business unit.	-Pressure cooker Product Development Manager and Fagor Central Quality Manager. -Pressure cooker Product Development Manager. -Product Development Manager. - Product Development Manager of each product.	- 1 month - 2 months - 6 months - 6 months

Figure 8.- Action plan at the level of the company for improvements in the medium and long term of the whole Fagor Electrodomésticos – Lavadoras S. Coop. Group in relation with anchoring Ecodesign with ISO 9001.

7.- Evaluation.

When the project was completed, the benefits obtained were evaluated and it was defined how it was going to be passed on to the agents involved. These benefits are:

- Advance towards compliance with most of the requirements of the WEEE Directive.

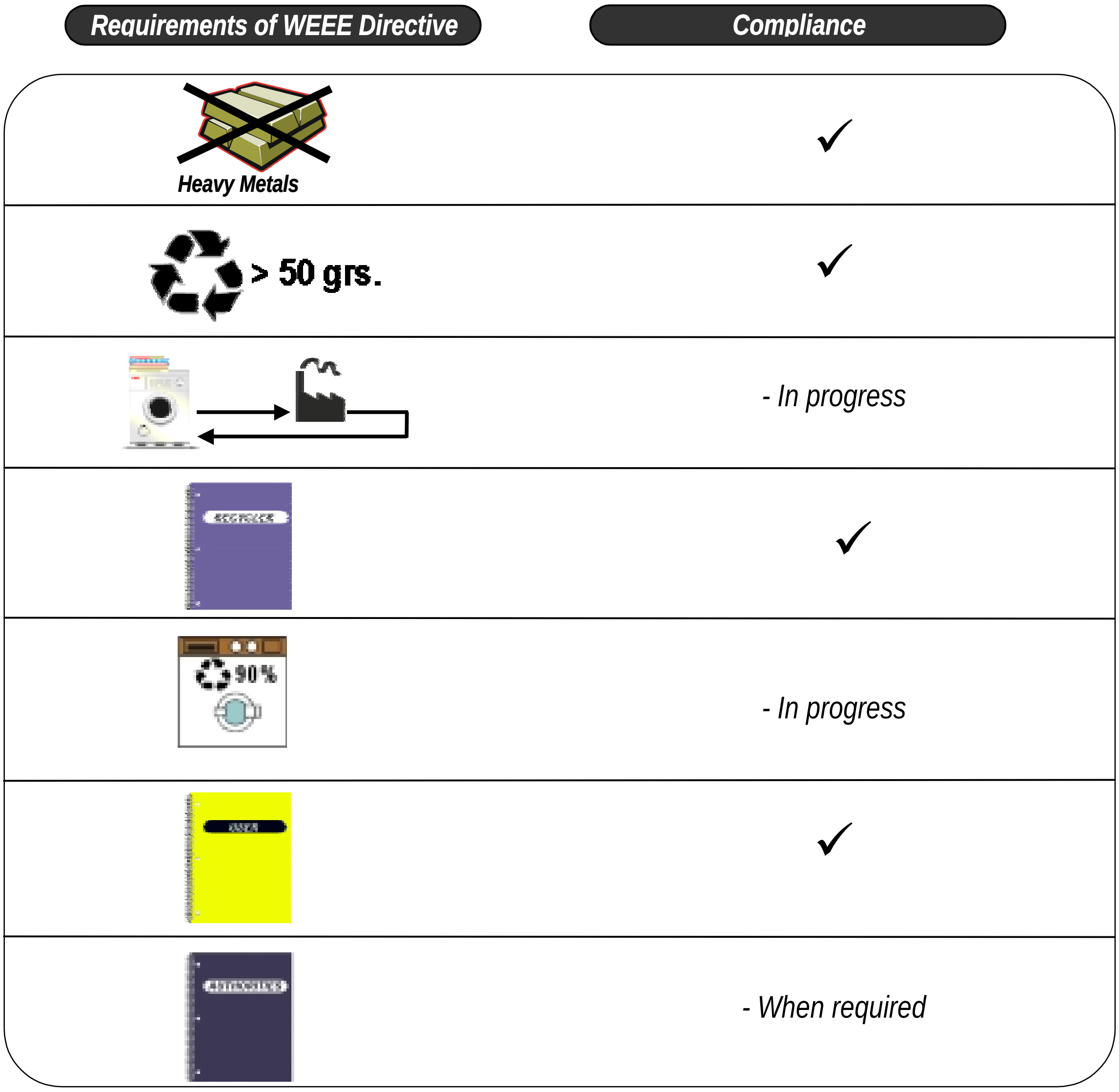


Figure 9.- Requirements of the WEEE Directive and compliance by Fagor Electrodomésticos Lavadoras S. Coop. as a result of the Ecodesign project.

- Be an innovative company with an innovative product which has different environmental characteristics from those disseminated by other competitors (elimination of heavy metals and brominated flame retardants, continuous increase in recyclability, design for optimum treatment of the product at the end of its useful lifetime, etc).
- To have integrated Ecodesign at the level of the whole company Fagor S. Coop. with ISO 9001 (Product Launch Manuals).

TOOLS

IHOBE
Sociedad Pública Gestión Ambiental

TOOLS

Arranged according to the stages of the manual

Stage of the Manual

1.- Preparation of the project.

- Table of criteria for selecting a product.
- Work sheet of EXTERNAL Motivating Factors.
- Work sheet of INTERNAL Motivating Factors.

2.- Environmental aspects.

- MET Matrix.
- Eco-indicators.
- Table of Software tools for Life Cycle Analysis.

3.- Ideas for improvement.

- Tools for generating ideas for improvement:
  - The eight strategies of Ecodesign.
  - Brainstorming
- Tools for assessing ideas for improvement:
  - Prioritisation Matrix.

4.- Developing concepts.

- Creative techniques.
- Selection tools.
- Tools selected by the company for studying the environmental aspects of the product.

5.- Product in detail.

- Tools selected by the company for studying the environmental aspects of the product.

6.- Action plan.

- Product action plan in the medium and long term.
- Action plan at the level of the company for anchoring Ecodesign with the product development procedures.
- Action plan at the level of the company for anchoring Ecodesign in ISO 9001.
- Action plan at the level of the company for anchoring Ecodesign in ISO 14001.

7.- Evaluation.

- Table of evaluation of results.
- References of documentation on green marketing.

Stage 1.- Preparation of an Ecodesign project.

Criteria for selecting a product

The criteria for selecting a product are specific to each company, but as a general rule they must follow the guidelines below:

- ***The product must have a sufficient number of degrees of freedom to permit its modification.*** (e.g. The polyethylene (PE) plastic bag product does not have any degrees of freedom either with regard to its shape or material used, so it is of no interest to perform Ecodesign).

- ***The product must preferably be the one which is most affected by the Motivating Factors of Ecodesign for the company***, as this is related with the potential benefits which the company will obtain with the project.
  (e.g. If the introduction of environmental criteria into the design of product A may favour compliance with environmental legislation, improve its marketing and give the product the innovative character it needs, it will be more interesting to perform Ecodesign with this product A than with another product B which is not affected by any of these factors when environmental criteria are introduced into its design).

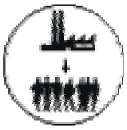
- ***Additionally in the case where this is the first product into which Ecodesign criteria are introduced, it is of interest that the product or part of the product to be modified should be relatively simple*,** as this favours the achievement of rapid results and, with this, the motivation to continue working in Ecodesign.

Stage 1.- Preparation of an Ecodesign project.

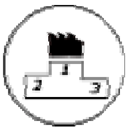
EXTERNAL Motivating Factors for the application of Ecodesign.

ADMINISTRATION:
legislation y regulation

MARKET:
Demands by customers (ind. & final)



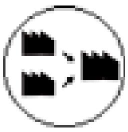
COMPETITORS:
What they are doing in Ecodesign



SOCIALENVIRONMENT:
Responsibility for the Environment

SECTORAL
ORGANISATIONS

SUPPLIERS:
Technological innovations



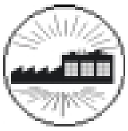
Stage 1.- Preparation of an Ecodesign project.

INTERNAL Motivating Factors for the application of Ecodesign

Increased product quality

Q

Improvement of the image of the product and company

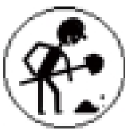


Reduction in costs

Power of innovation

Manager's sense of environmental responsibility

Motivation of employees



Stage 2.- Environmental Aspects.

MET Matrix

	Use of MATERIALS (Inputs) M	Use of ENERGY (Inputs) E	TOXIC EMISSIONS (Outputs: emissions,effluent, waste) T
Obtainment & consumption of materials & components			
Factory production			
Distribution			
Use or utilisation			
End of life system. Final disposal			

Stage 2.- Environmental Aspects.

Eco-indicators

BEFORE

Product or component	Project
Date	Author
Notes and conclusions	

Production (Materials, processes and transport).

Material or process	Quantity	Indicator	Result
Total			

Use (Transport, energy and auxiliary materials)

Material or process	Quantity	Indicator	Result
Total			

Waste (For each type of material).

Material & type of process	Quantity	Indicator	Result
Total			

TOTAL (All phases)	

AFTER

Product or component	Project
Date	Author
Notes and conclusions	

Production (Materials, processes and transport).

Material or process	Quantity	Indicator	Result
Total			

Use (Transport, energy and auxiliary materials)

Material or process	Quantity	Indicator	Result
Total			

Waste (For each type of material).

Material & type of process	Quantity	Indicator	Result
Total			

TOTAL (All phases)	

Stage 2.- Environmental Aspects.

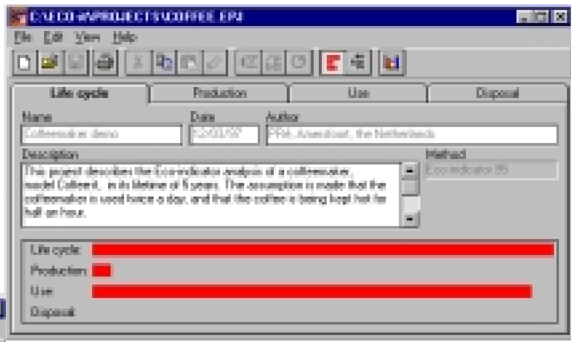
Software Tools

SOME of the most widely used software tools to make LCAs of products are shown below.

Eco-it

Description

A simple tool based on Life Cycle Analysis. The product is divided into the stages of production, use and end of life. For each component the data base of the program offers different options. It uses Eco-indicators '95 although it will soon include the standard values of Eco-indicator '99.
Demo of the program available at:
http://www.pre.nl/eco-it/default.htm
The user licence has a cost of 240 Euros (at September 2000).



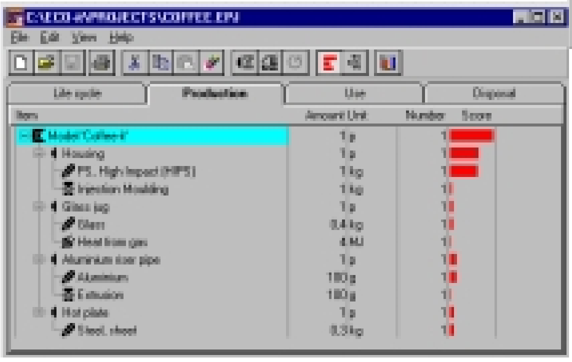


Figure 1.- Global analysis of the project being studied, explaining its characteristics and with a graphic estimate at the bottom of the overall impact and that of each stage.

Figure 2.- One of the stages of the life cycle with the various components and the processes employed in each.

Aplication

Offers a global evaluation of the impacts of each stage of the product Life Cycle.

Operation

Simple. Does not require advanced knowledge of the methodology.

Users

Product design teams. As it does not require any environmental knowledge it may be appropriate for companies without a large R&D or design department.

Adaptability

It does not allow the data base or the methodology of evaluation to be modified, adapted or expanded, unless the additional tool Eco-edit is used (also from Pré and with a demo on the web).

Results

Graphs and tables evaluating the impacts of the stages of the Life Cycle. It offers a global numeric evaluation and does not permit identification of traceability to origin of the environmental impacts. The studies carried out using the average data of the data base (not adapted to the real situation) should not be considered as absolute, but for guidance only for improvement.

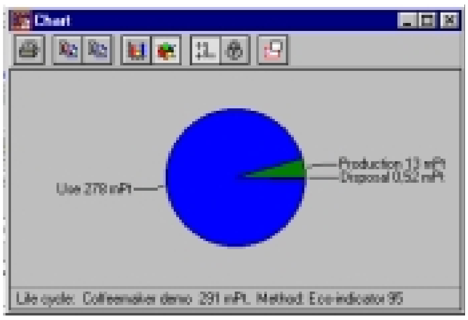


Figure 3.- Pie chart showing the impacts of stages of the Life Cycle.

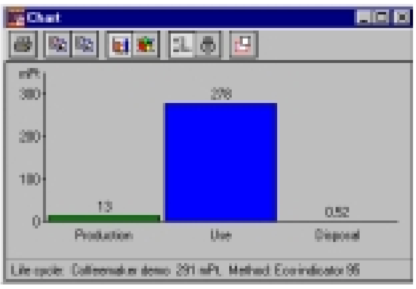


Figure 4.- Bar chart with the same values of the impacts of the stages of the Life Cycle.

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Ecoscan

Description

A simple tool based on Life Cycle Analysis. The product provides the stages which must be completed. By default it includes: production, use and end of life, although it allows new ones to be created (such as transport). The data are obtained by dragging direct from the data base. It allows the use of various environmental indicators, and also the creation of new data bases, although it recommends Eco-indicators '95. (A new version with Eco-indicators '99 will shortly come out).

Demo version of the program available at:
http://www.ind.tno.nl/en/productdevelopment/ecoscan/index.html

The user licence has a cost of 450 Euros (at September 2000).

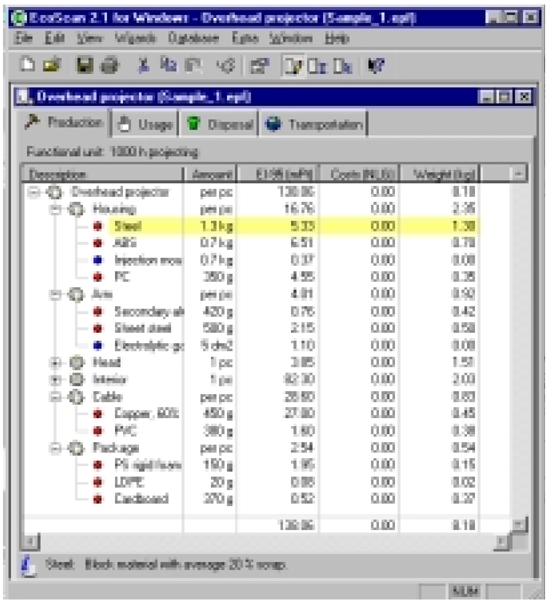

Figure 1.- One of the stages of the Life Cycle with the various components and the processes and materials used in each with their various values.

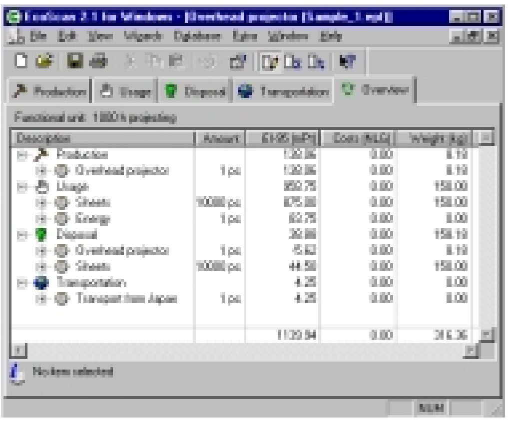

Figure 2.- Global data for all stages of the project.

Aplication

Offers an evaluation of global impacts and impacts for each stage of the product Life Cycle, identifying the critical points.

Operation

Simple. Does not require advanced knowledge of the methodology.

Users

Product design teams. As it does not require environmental knowledge it may be appropriate for companies without a large R&D or design department.

Adaptability

Allows the inclusion of other data bases and also the creation of new ones.

Results

It offers average data in the form of tables or graphs in which the various specified stages of the Life Cycle are evaluated. The results obtained, based on average data, must be considered as a guide only. Traceability to the origin of the environmental impacts is not possible, as the indicators are aggregate data which do not permit access to this information.

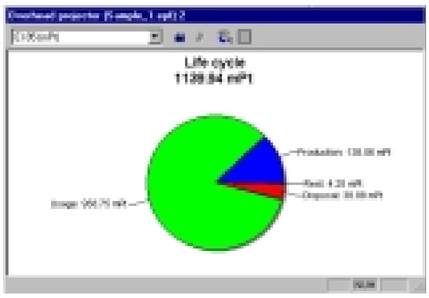

Figure 3.- Pie chart showing the impacts of stages of the Life Cycle.

Figure 4.- Bar chart with the same values of the impacts of the stages of the Life Cycle globally (left) and in detail for the production of one of the components of the product (right).

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Simapro

SimaPro

Description

Complete Life Cycle Analysis Tool. Allows a complex product to be described as a group of interrelated materials and processes. Thus it is possible to carry out simplified Life Cycle Analyses, with average data, or exhaustive studies with specific data. It permits the evaluation of significant environmental impacts (greenhouse effect, etc.,) using various methodologies or with a global environmental value.
It has a very complete data base which includes products and processes.
At present it incorporates the values of Eco-indicators 95, although shortly it will include the standard Eco-indicator 99 values.
A demo version of the program may be obtained at:
http://www.pre.nl/simapro/default.htm
The user licence has a cost of 2800 Euros (at September 2000).

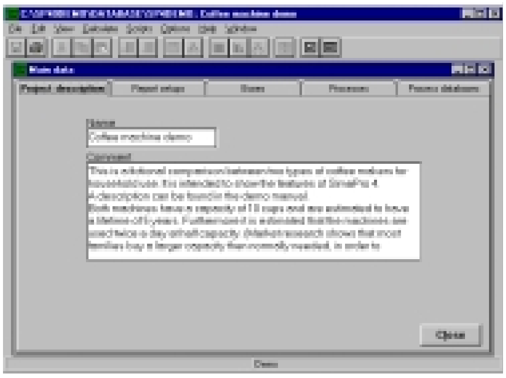
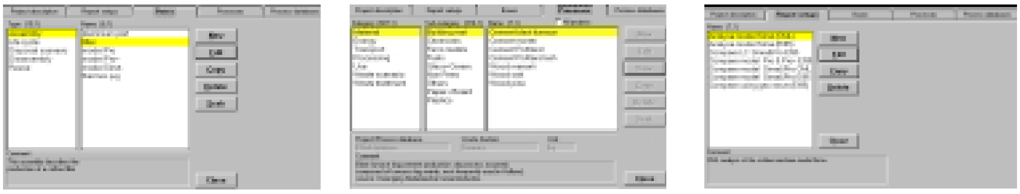


Figure 1.- Initial description of the project (corresponds to the Project description page)



Figures 2,3 & 4.- Tables which provide the necessary data for subsequent analysis and the various options of the program (left to right, the tables of boxes, Processes and program setup Report).

Aplication

Analysis and comparison of products and processes on the basis of Life Cycle Analysis.

Operation

May be complex. Requires knowledge of the Life Cycle Analysis tool.

Users

Design or R&D departments of a company. Requires more complete knowledge of the methodology of analysis to arrive at optimum results.

Adaptability

Allows the user to include new methodologies of evaluation or adapt existing ones, and also include or modify data of products or processes according to needs.

Results

The results allow a product or process to be evaluated, identifying the stages which contribute to each impact. It is also possible to compare different products with each other.
The accuracy and veracity of the results largely depend on the data used for the study, whether these are average data or values adapted to the reality of the product.
Allows traceability of results, facilitating interpretation.

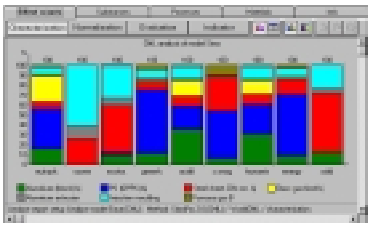
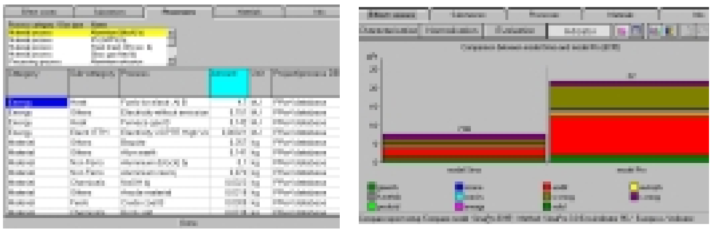


Figure 5.- Graph with the main environmental impacts.



Figures 6 & 7.- Total numeric data of the project (left) and comparison graph between two alternative products in which we can see the traceability of results (right).

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Team

TEAM™ 3.0

Description

Complete Life Cycle Analysis tool. The inventory and analysis are separated into two programs: DEAM and TEAM.
DEAM is the data base, very large, which includes products and processes of various industries.
The product is described in the program by means of its components, which may be taken from the data base by dragging with the mouse. The description of the Life Cycle is very graphic so it may be simpler. For the analysis the TEAM program includes several methods, some of which evaluate the impacts on the environment separately, and others offer an aggregate global evaluation. Among other advanced features to facilitate a detailed and complete analysis, the program allows various scenarios to be established.
A demo version of the program may be obtained at:
http://www.ecobalance.com/software/team/team_trial.html
The user licence has a cost of 3000 Euros (at September 2000).

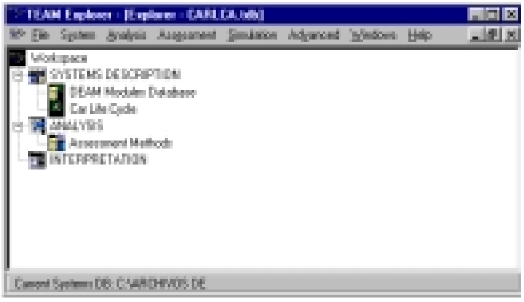


Figure 1.- TEAM Explorer. Initial page.

Figure 2.- TEAM system editor. Entry page.

Aplication

Analysis and comparison of products and processes by means of carrying out complete Life Cycle Analyses.

Operation

Complex. Requires knowledge of the methodology.

Users

Experts in Life Cycle Analysis and designers with broad knowledge of the Life Cycle Analysis tool and the product studied.

Adaptability

Allows somebody with knowledge of the methodology to include new methodologies of evaluation, and also to adapt the data base and include new values easily.

Results

They allow the evaluation of a product or process, identifying the stages which contribute mainly to each impact. It is also possible to compare different products with each other.
It allows the traceability of results, facilitating the interpretation and identification of the most significant environmental aspects. It offers a great variety of graphic options for interpretation.

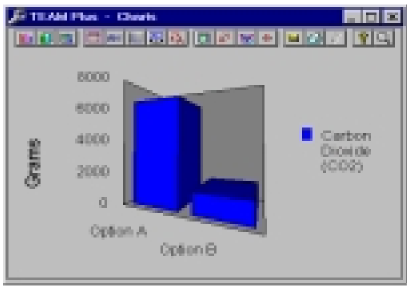
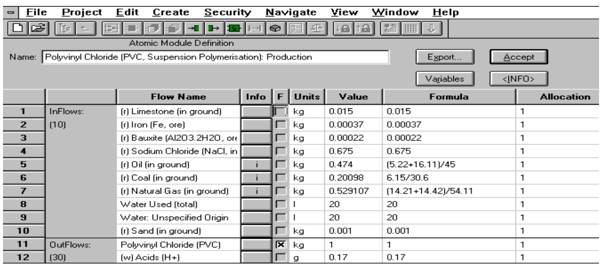


Figure 3.- Comparative graph between two products.



		Flow Name	Info	F	Units	Value	Formula	Allocation
1	InFlows:	(r) Limestone (in ground)			kg	0.015	0.015	1
2	(10)	(r) Iron (Fe, ore)			kg	0.00037	0.00037	1
3		(r) Bauxite (Al2O3.2H2O, ore			kg	0.00022	0.00022	1
4		(r) Sodium Chloride (NaCl, in			kg	0.675	0.675	1
5		(r) Oil (in ground)	i		kg	0.474	(5.22+16.11)/45	1
6		(r) Coal (in ground)	i		kg	0.20098	6.15/30.6	1
7		(r) Natural Gas (in ground)	i		kg	0.529107	(14.21+14.42)/54.11	1
8		Water Used (total)			l	20	20	1
9		Water: Unspecified Origin			l	20	20	1
10		(r) Sand (in ground)			kg	0.001	0.001	1
11	OutFlows:	Polyvinyl Chloride (PVC)		X	kg	1	1	1
12	(30)	(w) Acids (H+)			g	0.17	0.17	1

Figure 4.- List of data supplied by the program.

Author

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Idemat

Description

A simpler tool than the previous ones, based on the environmental, technical and economic evaluation of the materials and processes in order to facilitate their selection. The data base offers ample technical information in the form of text, numbers and graphs.

When establishing the requirements of the desired materials for a product, the program will provide information about their qualities, most usual applications etc. The environmental information is based on environmental indicators such as those present in the other methodologies studied, but the program allows access to the data of origin of these indicators (consumption of resources and emissions into the environment). Accordingly it is possible to know the environmental impacts of the selected materials from their technical characteristics.

A demo version of the program may be obtained at: http://www.io.tudelft.nl/research/dfs/idemat/menu.htm

The user licence has a cost of 3100 Euros (at September 2000).

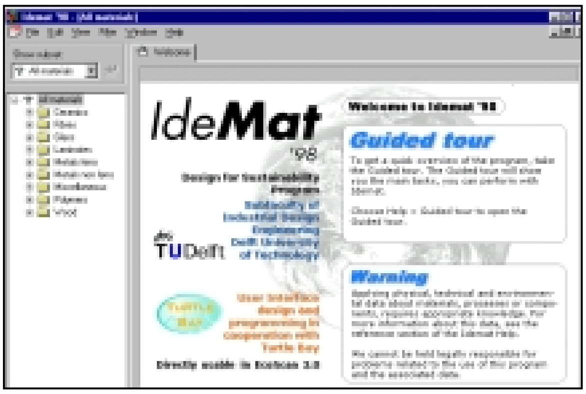

Figure 1.- Start page of the IDEMAT program.

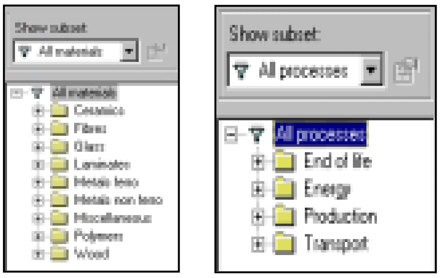

Figure 2.- List of materials and processes offered by IDEMAT.

Aplication

Mainly oriented to the selection of materials and processes.

Operation

Quite simple.

Users

Design teams or purchasing department of a company. Offers complementary environmental information to personnel with knowledge of the technical requirements of materials.

Adaptability

The program allows further data to be added, but does not allow the modification of existing data. The inclusion of further data requires exhaustive knowledge of the Life Cycle of the materials.

Results

Allows different alternatives to be compared in tables or graphs. An evaluation of the different materials or processes is obtained.

Figures 4 & 5.- Tables and graphs showing the various information existing on a particular material.

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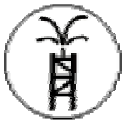
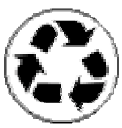
Stage 3.- Ideas for improvement

Generating ideas for improvement: THE 8 STRATEGIES OF ECODESIGN

	Strategies for Improvement	Types of associated measures
Obtainment & consumption of materials & components 	***1.- Select low impact materials***	- Cleaning materials - Renewable materials - Materials with a lower energy content - Recycled materials - Recyclable materials
	2.- Reduce the use of material	- Reduction of weight - Reduction of volume (of transport)
Factory production 	***3.- Select environmentally efficient production techniques***	- Alternative production techniques - Fewer stages of production - Lower/cleaner energy consumption - Less production of waste - Production consumables: fewer/cleaner
Distribution 	***4.- Select environmentally efficient forms of distribution***	- Packaging: less/cleaner/reusable - Energy efficient mode of transport
Use or utilisation 	***5.- Reduce the environmental impact in the utilisation phase***	- Lower energy consumption - Cleaner energy sources - Less need for fuel - Cleaner consumables - Energy wasting/avoid consumables
End of life system. Final disposal 	***6.- Optimise Life Cycle***	- Reliability and durability - Easier maintenance and repair - Modular structure of the product. - Classic design - Strong product-user relation
	7.- Optimise the end of life system.	- Re-utilisation of the product - Remanufacture/modernisation - Recycling of materials - Safer incineration
New product ideas 	***8.- Optimise the function***	- Shared use of the product - Integration of functions - Functional optimisation of the product - Replacement of the product by a service

Stage 3.- Ideas for improvement

Generating ideas for improvement: BRAINSTORMING

	Strategies for Improvement	Measures generated in brainstorming
Obtainment & consumption of materials & components	1.- Select low impact materials.	
	2.- Reduce the use of material.	
Factory production	3.- Select environmentally efficient production techniques.	
Distribution	4.- Select environmentally efficient forms of distribution.	
Use or utilisation	5.- Reduce environmental impact in the utilisation phase.	
End of life system. Final disposal	6.- Optimise the Life Cycle.	
	7.- Optimise the end of life system.	
New product ideas	8.- Optimise the function.	

Stage 3.- Ideas for improvement

Selected Measures

Obtainment & consumption of materials & components

Factory production

Distribution

Use or utilisation

End of life system. Final disposal

New product ideas

Grouping and practical definition of the measures

Obtainment & consumption of materials & components

Factory production

Distribution

Use or utilisation

End of life system. Final disposal

New product ideas

Stage 3.- Ideas for improvement

Appraisal of ideas for improvement: THE PRIORITISATION MATRIX

Measure selected	Technical feasibility	Financial viability	Benefit for the environment	Positive response to the main Motivating Factors	Prioritisation
Obtainment & consumption of materials & components					
Factory production					
Distribution					
Use or utilisation					
End of life system. Final disposal					
New product ideas					

2	Very positive score / very feasible.
1	Positive score / feasible.
0	Neutral score.
-1	Negative score / almost unfeasible.
-2	Very negative score / completely unfeasible.

ST	Short Term
MT:	Medium Term
LT	Long Term

Stage 4.- Developing concepts.

THERE ARE NO SPECIFIC FORMS OF NEW TOOLS

TOOLS

- ***Creative techniques:*** those usually used by the company and/or external collaborating designers.
- ***Selection tools:*** those usually used by the company and/or external collaborating designers.
- ***Tools selected by the company for the study of the environmental aspects of the product (MET, Eco-indicators, software tools):*** See forms in the tools of chapter 2.

Stage 5.- Product in detail.

THERE ARE NO SPECIFIC FORMS OF NEW TOOLS

TOOLS

- ***Tools selected by the company for the study of the environmental aspects of the product (MET, Eco-indicators, software Tools):*** See forms in the tools of chapter 2.

Stage 6.- Action plan.

Product action plan in the medium and long term

Measures for improvement	Time Scale	Actions	Person Responsible	Time scale &/or Frequency

Action plan at the level of the company for anchoring Ecodesign with product development procedures.

Product development phase	Integrated Ecodesign phase (manual)	Task	Person Responsible	Date / Frequency

Stage 6.- Action plan.

Action plan at the level of a company for anchoring Ecodesign in ISO 9001

Points of Standard ISO 9001: 94	Ecodesign topics to be included for anchoring
4.1.- Responsibilities of the management	
4.1.1.- Quality policy	The results of stage 1 (Motivating Factors) and stage 3 (environmental aspects) may be taken into account in the reformulation of the company's quality policy, including the environmental improvement of the product as part of its quality.
4.1.2.- Organisation	In the definition of responsibilities and resources the distribution of tasks for the achievement of an Ecodesign project must be defined in such a way as to guarantee the exchange of interdepartmental information as described in the first page of each stage of this practical manual of Ecodesign. Integrate the responsibilities of the Ecodesign action plans of stage 6.
4.1.3.- Review by the management	As in relation to any quality system, the management of the supplier with executive responsibility should review the relevant topics of Ecodesign at defined intervals which are sufficient for their adequacy and efficacy. The results of each stage of Ecodesign are proposed for review by management.
4.2.- Quality system	
4.2.1.- General	Include environmental requirements among the requirements for the supplier, (as specified in the specification of stage 4 and defined with regard to materials and processes in stage 5).
4.2.2.- Procedures of the quality system	The supplier's quality manual must include the applicable environmental requirements.
4.4.- Control of design	
4.4.3.- Organisational and technical interfaces	For the definition of organisational and technical interfaces, take into account the persons or departments involved in each stage of Ecodesign and see how the organisational and technical interfaces may be defined with a view to optimising the process and ensuring that the different groups making contributions to the design process participate in the stages of Ecodesign which concern them.
4.4.4.- Initial design data	The environmental requirements must be included in the specification as defined in stages 3, 4 and 5 (materials, …).
4.4.5.- Final design data	The data related with environmental requirements as well as the rest of data must also be documented. Tools of analysis of the environmental aspects of the product will be used (stage 2) for their appraisal and documentation.
4.4.6.- Review of the design	Account will be taken of environmental requirements in reviews of the design and their planning. Tools for analysis of the environmental aspects of the product (stage 2) will be used for each review of the design, and also other tools (data bases relating to more environmentally friendly materials or processes etc.).
4.4.7.- Verification of the design	Compliance with the environmental requirements will also be verified. Tools for analysis of the environmental aspects of the product (stage 2) will be used for each verification of the design, and also other tools (data bases relating to more environmentally friendly materials or processes, etc.).
4.4.8.- Validation of the design	Validation will also be carried out on the basis of environmental requirements.
4.6.- Purchases	
4.6.2.- Evaluation of sub-contractors	In the evaluation of sub-contractors account must be taken of compliance with environmental requirements. e.g. Possession of SGMA for suppliers of materials and machinery, knowledge of Ecodesign or the Environment for Designers etc.
4.6.3.- Data relating to purchases	The purchasing documents must define the environmental requirements.

4.15.- Handling, storage, packing, conservation and delivery

The supplier may include environmental requirements on these points in its procedures documented according to the decisions of the company in stages 3, 4 and 5 (materials, etc.) of Ecodesign.

4.18.- Training

The supplier must determine the training needs in relation to Ecodesign for all personnel carrying out activities which affect quality and supply this training (stage 7).

Standard ISO 9001 has been modified on the basis of the demands of the various agents involved to be more easily related with ISO 14001. The novel aspects of this new standard ISO 9001:2000 are shown below, as well as how they can be anchored with Ecodesign and their relation with the points of ISO 14001.

Points of ISO 9001:94 which are modified and affected by ISO 9001:2000.

Ecodesign Topics to be included for anchoring

Quality planning (for continuous improvement)

The planning of environmental requirements must be focussed towards continuous improvement also. The action plans for improvements in the medium and long term must be taken into account in this planning and must be regularly reviewed and improved (stage 6) (in relation to 4.3 ISO 14001).

Communication

Mechanisms must be established to ensure the communication of the results of Ecodesign between different levels and functions internally as mentioned in stage 7 of Ecodesign (in relation to 4.4.3. ISO 14001). Identify and implement provisions for communication with customers. Include in the communication topics of Ecodesign as defined in stage 7 of the manual.

Human Resources

Evaluate the effectiveness of training and carry out activities for raising awareness about Ecodesign on the basis of what is seen in the application of the methodology (stage 7) (in relation to 4.4.2. ISO 14001).

Requirements by customers

The statutory requirements and other environmental requirements may be included. Include environmental requirements according to the Ecodesign procedure (stages 1, 2 and 3) (in relation to 4.3.2. ISO 14001).

Action plan at the level of a company for anchoring Ecodesign in ISO 14001

Points of Standard ISO 14001	Ecodesign Topics to be included for anchoring
4.2.- Environmental policy	The results of stage 1 (Motivating Factors) and stage 3 (environmental aspects) may be taken into account in the reformulation of environmental policy.
4.3.- Planning	
4.3.- Environmental aspects	Analyse and prioritise the environmental aspects throughout the LIFE CYCLE instead of only in the factory production phase (stage 2 of the manual). Modify the system documentation accordingly.
4.3.2.- Statutory and other requirements	The identification of statutory requirements may include drafts of European Directives such as the End of Life Vehicle Directives (ELV Directive) or relating to Waste in the Electrical and Electronics sector (WEEE Directive) and legislation of other countries (of our customers) which affect the design of our products and our Motivating Factor for the company to perform Ecodesign (stage 1 of the manual). Include the identification of the environmental requirements according to the procedure shown in the manual.
4.3.3.- Objectives & targets	Include objectives and targets in relation with the improvement of the environmental aspects of the WHOLE LIFE CYCLE of the product (on the basis of the Motivating Factors of stage 1, prioritisation of environmental aspects of stage 2 and on the measures or objectives of the action plan for the product and company in stage 6 of the manual).
4.3.4.- Environmental management programs	Integrate the Ecodesign action plans (stage 6) in the environmental programs.
4.4.- Implementation and operation	
4.4.1.- Structure and responsibilities	Integrate the responsibilities of the Ecodesign action plans of stage 6.
4.4.2.- Training, raising awareness & professional competency	Define internal and external training and awareness needs of Ecodesign on the basis of what was seen in the application of the methodology (stage 7).
4.4.3.- Communication	a.- Internal: As described in the practical manual of Ecodesign, the work is interdepartmental and internal communication is therefore important. Define how these communications are to be made for the correct operation of all stages of the Ecodesign process. Also include the actions of communication of results of the Ecodesign project in stage 7. b.- External: It must be defined how the topics related with Ecodesign are to be communicated to external agents (see stage 7).
4.4.4.- Documentation of the environmental management system	Include the topics mentioned in the previous points in the system documentation.
4.4.6.- Operational control	In addition to operations "in the factory", identify other significant operations for the significant environmental aspects THROUGHOUT THE LIFE CYCLE. In this case the communication of the procedures and requirements applicable to suppliers and sub-contractors and even managers is very important in this case, and all agents affecting the LIFE CYCLE of the product and its significant environmental aspects.
4.5.- Check and corrective action	
4.5.1.- Monitoring and measurement	Include new topics to be controlled in relation to operations and key activities of the WHOLE LIFE CYCLE of the product which the company may control, and also their records.
4.6.- Review by the management	Senior management of the organisation must review, in addition to the environmental management system, the significant topics of Ecodesign at defined intervals which are sufficient for their adequacy and efficacy. The results of each stage of Ecodesign is proposed for review by the management.

Stage 7.- Evaluation.

Table of evaluation of results

Measures for improvement of the product	Evaluation of the main aspects/environmental requirements			Evaluation of the main aspects/environmental				How to express it for each affected agent
Obtainment & consumption of materials & components								
Factory production								
Distribution								
Use or utilisation								
End of life system. Final disposal								
New product ideas								

Stage 7.- Evaluation.

References of documentation on green marketing

Internet addresses:

- http://www.greenmarketing.com
- http://www.cfsd.org.uk
- http://www.redesign.org/reviews/mktg.html

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A

ECO-INDICATOR'99

IHOBE
Sociedad Pública Gestión Ambiental

ECO-INDICATOR'99

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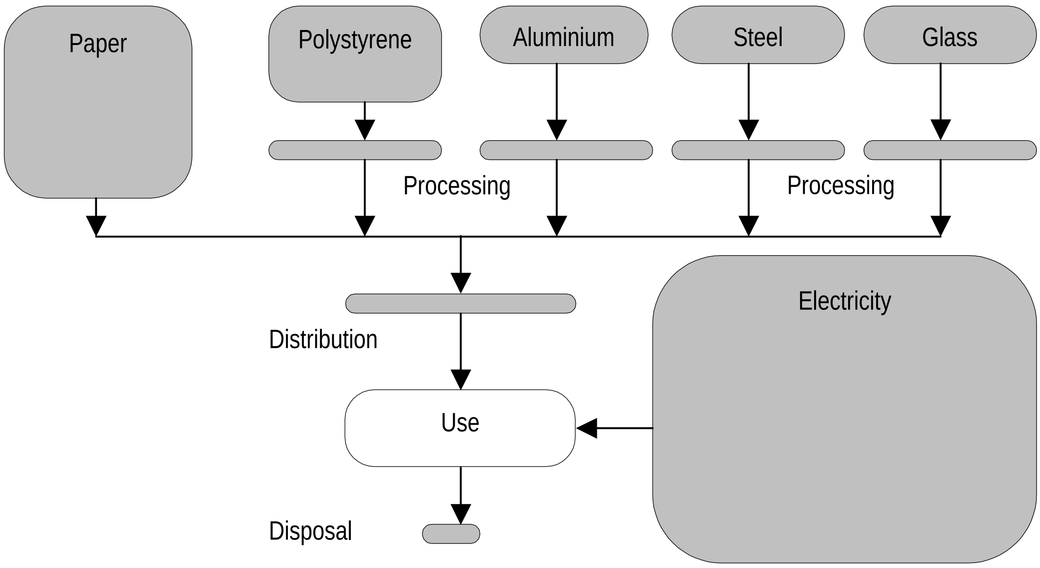
Annex Eco-indicator '99

A damage oriented method for Life Cycle Impact Assessment

Manual for Designers

5 November 1999



(graphical representation of the results of an Eco-indicator analysis of a coffee machine; the size of the boxes indicates the relative contribution to the environmental load)

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Stay updated via the Eco-indicator 99 e-mail user group

In order to receive feedback from you and to be able to send updates we have established a free e-mail user group. The discussion will be monitored and controlled by the development team. This team will encourage factual and concise discussions focussed especially on the Eco-indicator 99 applications and the methodology.

To join the Eco-indicator Internet User Group simply send an empty e-mail to: join-eco-indicator@lists.lyris.net

After confirmation you receive a welcome message with simple instructions and some “house” rules. From that moment, until you unsubscribe you will receive all e-mail send to the user group and of course, you can send e-mail yourself.

Preface

Sustainable production and consumption can only be achieved if all market actors take their own responsibility. The ultimate goal is therefore taking into account environment in every decision making process by industry, retailers and consumers. This is a steadily growing process that needs to be fostered by sufficient incentives both from the demand as the supply side. To this end a comprehensive set of policy instruments has been developed in the Netherlands under the label of Integrated Product Policy (IPP).

At the centre of IPP is the introduction of Product Oriented Environmental Management System [POEM] which is being developed in a concerted action both by industry and by government in recent years. The objective of POEM is to establish a systematic drive for continuous improvement of the life cycle environmental performance of products within all sorts of enterprises by integrating environmental aspects in strategic management decisions.
POEM has to be seen as an elaboration of Environmental Management System that focuses particularly on product development and product (re)design. The complexity of the decision process involving all environmental aspects means very often an unbridgeable gap for designers. Although life cycle assessment [LCA] is a good tool to assess the environmental performance of a product, and although it is widely used by designers, LCA is time consuming and costly. Designers have to make many decisions especially when designing complex products. Moreover the results of LCA are mostly not straightforward in favour of one product or material design over the alternative one. Results of LCA have to be interpreted or weighed. The Eco-indicator 95 methodology is an LCA weighing method specially developed for product design. This method has proved to be a powerful tool for designers to aggregate LCA results into easily understandable and user-friendly numbers or units, the so-called Eco-indicators.

The Eco-indicator '95 methodology is being used very often by designers but is criticised by environmental experts at the same time because some environmental aspects were not accounted for in the method. The new Eco-indicator 99 method includes many more aspects and is therefore more complex than the 95 version but the resulting Eco-indicators are still the same user-friendly units.

The weighing system between the different environmental aspects - the core of the Eco-indicator method - has also been changed. The 1995 Eco-indicator used the so-called Distance-to-Target approach. This method was criticised because there was no clear-cut objective way to define sustainable target levels. This problem is in the present Eco-indicator method avoided by introducing a damage function approach. The damage function presents the relation between the impact and the damage to human health or to the ecosystem.

Contributions of many LCA experts have been merged in this 99 method. I would particularly acknowledge the contributions from several Swiss Experts and of the National Institute of Public Health and the Environment [RIVM].

The Eco-indicator 99 does reflect the present state of the art in LCA methodology and application. This of course does not mean that all problems are solved. Further developments in environmental science, material technology and LCA methodology will take place and should result in future improvements of the Eco-indicator. But we are convinced that the revised Eco-indicator methodology is sufficiently robust to play an important role in eco-design for the next years.
I hope the Eco-indicator 99 method and the resulting Eco-indicators shall contribute to the incorporation of environment in product development decisions.

Jan Suurland
Director Industry- and Consumer Policy

1. The application of standard Eco-indicators

This manual is intended to be used by for designers and product managers that want to apply the standard Eco-indicator values for the assessment of environmental aspects of product systems. Although the application of these standard values is basically very simple it is very important to understand some of the backgrounds, the features and the limitations. This manual aims to give this information.

1.1. Standard Eco-indicators

Standard Eco-indicators are numbers that express the total environmental load of a product or process. These indicators can be found on separate pages in the back cover of this report. UIT appropriate LCA software it is possible to calculate additional indicators. News about updates and additional indicators can be obtained by registering in the internet Eco-indicator usergroup (see text box on the contents page).

With the standard eco-indicators any designer or product manager can analyse the environmental loads of products over the life cycle. Next to this different design alternatives can be compared. This report describes the application of the standard indicators as well as the inherent limitations. The standard Eco-indicators are calculated with a rather complex methodology. This methodology is summarised in a popular way in chapter 5. For an in depth description we refer to the Methodology report “The Eco-indicator 99 Methodology report” and the annexe report. These can also be found on the internet (www.pre.nl).

1.2. Environmental effects of products

Every product damages the environment to some extent. Raw materials have to be extracted, the product has to be manufactured, distributed and packaged. Ultimately it must be disposed of. Furthermore, environmental impacts often occur during the use of products because the product consumes energy or material. If we wish to assess a product’s environmental damage, all it's life cycle phases must therefore be studied. An environmental analysis of all the life cycle phases is termed a Life Cycle Assessment, or LCA for short[1]:

To date, a designer, wishing to use life cycle assessments in the design process, has been faced by two major problems :

1. The result of a full life cycle assessment is difficult to interpret. Within a life cycle The result of a full life cycle assessment is difficult to interpret. Within a life cycle greenhouse effect, acidification and other environmental problems while the total environmental impact remains unknown. The reason is the lack of mutual weighting of the environmental effects.
2. In general the careful collection of all the environmental data in a product’s life cycle is complex and time-consuming. As a result extensive LCAs cannot usually be carried out during a design process.

The Eco-indicator project has resolved these problems as follows:

1. The LCA method has been expanded to include a weighting method. This has enabled one single score to be calculated for the total environmental impact based on the calculated effects. We call this figure the Eco-indicator.
2. Data have been collected in advance for the most common materials and processes. The Eco-indicator has been calculated from this. The materials and processes have been defined in such a way that they fit together like building blocks. Thus there is an indicator for the production of a kilo of polyethylene, one for the injection moulding of a kilo of polyethylene and one for the incineration of polyethylene.

The Eco-indicator of a material or process is thus a number that indicates the environmental impact of a material or process, based on data from a life cycle assessment. The higher the indicator, the greater the environmental impact.

[1] Frequently a distinction is made between full and screening LCAs. Screenings are often based onstandard databases. An Eco-indicator analysis can be regarded as a screening LCA. A good introduction in the LCA methodology is “Beginning LCA, a guide into environmental Life Cycle Assessment, NOH report 9453”, issued by Novem in Utrecht (the Netherlands). Also LCA software demos can be a good introduction into the subject.

1.3. The "Eco" we indicate

Discussions on the environment are frequently confused. An important reason for this is the usually unclear definition of the term environment. In the Eco-indicator 99 we have defined the term "environment" with three types of damage:

1. ***Human Health;*** Under this category we include the number and duration of diseases, and life years lost due to premature death from environmental causes. The effects we include are: climate change, ozone layer depletion, carcinogenic effects, respiratory effects and ionising (nuclear) radiation.
2. ***Ecosystem Quality;*** Under this category we include the effect on species diversity, especially for vascular plants and lower organisms. The effects we include are: ecotoxicity, acidification, eutrophication and land-use.
3. ***Resources;*** Under this category we include the surplus energy needed in future to extract lower quality mineral and fossil resources. The depletion of agricultural and bulk resources as sand and gravel is considered under land use.

Next to the effects mentioned here there are some additional effects that could contribute to these three damage categories. We believe we have captured the most relevant effects, but unfortunately a method as this can never be absolutely complete [2].
Another limitation is in the selection of the damage categories themselves. For instance we could have included damage categories like the damage to material welfare or the damage to cultural heritage, but we did not choose to do so.

1.4. Differences with the Eco-indicator 95

The concept of working with standard Eco-indicators is not new. In the Eco-indicator 95 project this principle was introduced 3 . The most important difference with the 95 version of the method is the much improved methodology for calculating the indicators and the expansion of the indicator lists.
The most important difference in the methodology is the much better scientific basis for the damage model and with that the much greater reliability. Next to this also the concept of the methodology has changed. In the Eco-indicator 95 we used a mixture of damage modelling and the Distance to Target approach. In the Eco-indicator 99 we no longer include the Distance to Target principle in our reasoning. In stead we have fully developed the damage approach (see also preface and chapter 5). Next to a better scientific basis, we made a number of other important improvements:

- A much better and more explicit procedure for the weighting between the damage categories
- A much better description and definition of the damage models
- A thorough description and specification of the uncertainties and assumptions
- Inclusion of the fate (dispersion and degradation) of emissions in the environmental compartments
- A much wider range of emissions and effects, like resource depletion, land-use and ionising radiation.

As a result of these changes the results of Eco-indicator assessments may change when the 99 method is applied in stead of the Eco-indicator 95 method. The most important expected effects are:

- Because resource depletion is included, processes that require oil or gas or certain minerals will get a higher value.
- Because land-use is included, agricultural production processes will have a higher indicator.
- Because the dispersion and degradation of substances is included, substances with a short lifetime will contribute much less to the Eco-indicator scores.

2 The following effects that may be relevant are not included:
• Human Health: Noise, endocrine disrupters and non carcinogenic or non respiratory effects of some substances like heavy metals.
• Ecosystem Quality: Greenhouse effect and ozone layer depletion (both are included in Human Health) and the effect of phosphates.
In general these shortcomings will not have a very big effect, but in specific cases, for instance when systems that produce high noise levels, or emit large amounts of heavy metals or phosphates, the Eco-indicator valuemay misrepresent the environmental load.

3 The Eco-indicator 95 final report, NOH report 9514, July 1995; ISBN 90-72130-77-4

- Although with the inclusion of ionising radiation nuclear energy should get a higher value, in practice this effect is not noticeable.

Apart from these extensions of the methodology, we can also notice a shift of focus.

The Eco-indicator 95 and 99 values are not compatible! This means it is not possible to mix old and new indicators in an analysis. It is also not possible to give a conversion factor.

1.5. Uses and limitations

During the design process a large number of options are usually generated. These solutions are analysed by the designer after which the best design options are chosen. To enable environmentally-aware designs to be produced it must be possible to include the environmental aspects of a product in the analysis and selection of design options. The standard Eco-indicator values have been developed as an instrument to do just that; they are meant to be a tool for designers. It is a tool to be used in the search for more environmentally-friendly design alternatives and is intended for internal use.

- The standard Eco-indicator values are not intended for use in environmental marketing, for environmental labelling or for proving in public that product A is better than product B.
- The standard Eco-indicator values are also not intended as an instrument for the Government to be used for setting standards and drawing up guidelines.

This is made clear in the “Products and the Environment” policy paper in which the Dutch Government announces the development of indicators. The use of Eco-indicators has just one purpose, namely making products more environmentally-sound. It is, therefore, a tool that can be used within companies or sectors.

1.6. ISO and the Eco-indicators

Approximately at the same time this report is published the first ISO 14042 standard on life cycle impact assessment is published. The Eco-indicator methodology that is used to calculate the standard values conforms well to this standard, although some details will perhaps deviate.
IMPORTANT PROVISION IN THE ISO 14042 IS THAT SINGLE SCORES LIKE ECO-INDICATORS MAY NEVER BE USED IN COMPARATIVE ASSERTIONS DISCLOSED TO THE PUBLIC.

1.7. The unit of Eco-indicators

The standard Eco-indicator values can be regarded as dimensionless figures. As a name we use the Eco-indicator point (Pt). In the Eco-indicator lists usually the unit milli-point (mPt) is used, so 700 mPt= 0.7 Pt).

The absolute value of the points is not very relevant as the main purpose is to compare relative differences between products or components. The scale is chosen in such a way that the value of 1 Pt is representative for one thousandth of the yearly environmental load of one average European inhabitant [2].

[2] In the Eco-indicator 95 this was done in an extremely crude way. Substances with a short lifetime were simply disregarded.

2.- Description of the standard Eco-indicators

Standard Eco-indicator 99 values are available for:

- **Materials.** The indicators for production processes are based on 1 kilo material.
- **Production processes.** Treatment and processing of various materials. Expressed for each treatment in the unit appropriate to the particular process (square metres of rolled sheet or kilo of extruded plastic).
- **Transport processes.** These are mostly expressed in the unit tonne-kilometre.
- **Energy generation processes.** Units are given for electricity and heat.
- **Disposal scenarios.** These are per kilo of material, subdivided into types of material and waste processing methods.

Average European figures are used for this calculation. A particular definition was used for the terms “material” and “process” when determining the indicators. The definitions used are explained briefly below.

Production of materials

In determining the indicator for the production of materials all the processes are included from the extraction of the raw materials up to and including the last production stage, resulting in bulk material. Transport processes along this route are also included up to the final process in the production chain. Which process that is, can be derived from the explanation in the Eco-indicator list. For plastic, for example, all the processes are included from extraction of the oil up to and including the production of the granules; for sheet steel all the processes are included from extraction of the ore and coke up to and including the rolling process. The production of capital goods (machines, buildings and such like) is not included.

Production processes

The Eco-indicators for treatment processes relate to the emissions from the process itself and emissions from the energy generation processes that are necessary. Here too, capital goods, like machines and dies, are not included.

Transport

Transport processes include the impact of emissions caused by the extraction and production of fuel and the generation of energy from fuel during transport. The unit is the transport of one tonne (1000 kg) goods over 1 km (1 tkm). A different unit is used for bulk road transport .

- ***Road transport.*** In addition to transport for which the mass is the critical factor (ton*km), an indicator has also been determined for those cases where the volume is the determining factor (m3 volume * km).
- ***Rail transport.*** This is based on the average European ratio of diesel to electric traction and an average load level.
- ***Air transport for different types of cargo plane.***

A loading efficiency for European average conditions is assumed. Account is also taken of a possible empty return journey. Capital goods, like the production of trucks and road or rail infrastructure, and the handling of cargo planes on airports, are included as they are not negligible.

Energy

The energy indicators refer to the extraction and production of fuels and to energy conversion and electricity generation. The average efficiency is used. For the electricity score account is taken of the various fuels used in Europe to generate electricity. An Eco-indicator has been determined for high-voltage electricity, intended for industrial processes, and also for low-voltage electricity, particularly for household and small-scale industrial power consumption. The difference is in mains losses, and the required infrastructure such as cables. Next to European averages specific indicators are given for a number of countries. The large differences The large differences between countries can be explained from the different technologies used to produce electric power.

For solar energy we used photo-voltaic cells that are to be used on houses. The environmental load is mainly from production and disposal of the cells and other equipment.

Waste processing and recycling

Not all products are disposed of in the same manner. Therefore, when using indicators careful consideration must be given to which waste processing method is the most appropriate.
Where a product consists mainly of paper or glass and the design is such that the materials can be disposed of in recycling containers for glass or paper, it is reasonable to assume that a proportion of households will remove these materials from the waste stream and dispose of them separately. If, however, a product has only a small paper or glass component it is not so realistic to assume that these materials will be collected separately. In such cases it is likely that the product will end up in the municipal waste processing system.
Scenarios have been calculated for both of these cases. In addition, scenarios have been provided for the incineration, landfill disposal and recycling of products. The latter scenarios are not widespread in practice.

- ***Household waste.*** In an average household a number of materials such as glass, paper and compostable waste are collected and recycled separately once the decision has been taken to dispose of a product. The rest is put in the dustbin and is thus routed to the municipal waste collection system. The household waste scenario is based on the waste handling in an average household in Europe.
- ***Municipal waste.*** In the municipal waste scenario the average processing of waste in Europe is modelled. It is assumed in this that a certain proportion is landfilled and the rest is incinerated. The environmental impact of transport in the dustcart is also included.
- ***Incineration.*** It is assumed that incineration is carried out in an average Swiss plant with an average (year 2000) scrubbing system. This situation does not represent the average for Europe but this will change gradually in the coming years. A proportion of the steel and aluminium is also reclaimed and recycled from the incinerator slag. In addition, energy is generated and supplied to the grid as electricity.
- ***Landfill disposal.*** Landfill disposal is based on modern Swiss landfill sites (year 2000) with water purification and good seals, as a result of which relatively few harmful substances will reach groundwater sources.
- ***Recycling:*** The interactions between the household waste, municipal waste, incineration and landfill disposal scenarios are shown graphically in Fig. 1.

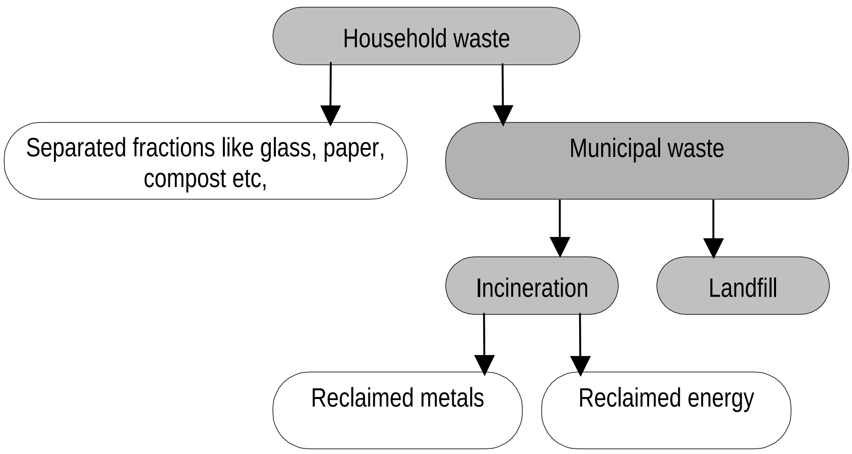

Figure. 1: Schematic representation of the waste scenarios (grey blocks) and mutual interactions. It is up to the user to choose between the different scenarios.

The waste data have been determined for most important plastics, metals and packaging materials. No waste treatment processes have been given for building materials and chemicals. Building materials that do not burn are usually land-filled or reused as road construction material or as coarse fraction in concrete. Building materials that are to be regarded as chemically inert have no other environmental impact than that they occupy an area in a landfill. A general figure for land-filling a certain volume has been given. This value is valid under the assumption that the waste has a height of 10 meters. If the height is only 5 meters, the indicator value should be doubled. For the disposal of chemicals the situation is more complex; no general value could be given, except for the refrigerants.

Negative figures for waste processing

Some disposal scenarios yield negative figures. This occurs when the waste processing results in a useful by-product that can be recycled or reused. The energy and materials flows that are reclaimed are regarded as an environmental profit. If 1 kg scrap is reclaimed less iron has to be produced elsewhere. The environmental effects for the production of 1 kg crude iron are therefore deducted. This is referred to as a substitution rule. In a number of cases, particularly with recycling, the deduction is greater than the environmental impact of a process, which gives rise to the negative figures.

3.- Operating instructions

The following steps must always be followed to ensure correct application of the Eco-indicator:

1. Establish the purpose of the Eco-indicator calculation.
2. Define the life cycle.
3. Quantify materials and processes.
4. Fill in the form.
5. Interpret the results.

In most cases it is recommended that you start simple and carry out a “rough” calculation in the first instance. Details can then be added and data can be revised or supplemented at a later stage. This ensures that you do not waste too much time with details.

Step 1: Establish the purpose of the Eco-indicator calculation

- *Describe the product or product component that is being analysed.*
- *Define whether an analysis of one specific product is being carried out or a comparison between several products.*
- *Define the level of accuracy required.*

If the purpose of the calculation is to obtain a rapid overall impression of a product’s major environmentally-damaging processes, it is sufficient to include a number of core items. This will result in approximate assumptions being made and only main processes being included. At a later stage, however, you may well wish to look specifically and in detail for alternatives to aspects of the problem or, for example, to compare a new design with an existing one. In that case a more meticulous approach is necessary and a solid, fair basis for comparison. It is also possible with comparisons to disregard components or processes that are common to both product life cycles.

Step 2: Define the life cycle

- *Draw up a schematic overview of the product’s life cycle, paying equal attention to production, use and waste processing.*

With a life cycle assessment the essential feature is to analyse a product life cycle and not so much only a product. It is therefore necessary to have not only an (outline) description of a product but also an outline of the life cycle. The performance provided by the product and the waste scenario are important elements of the description. A simplified life cycle of a coffee machine for domestic use is given below. Such a process tree provides a useful insight for further analysis.

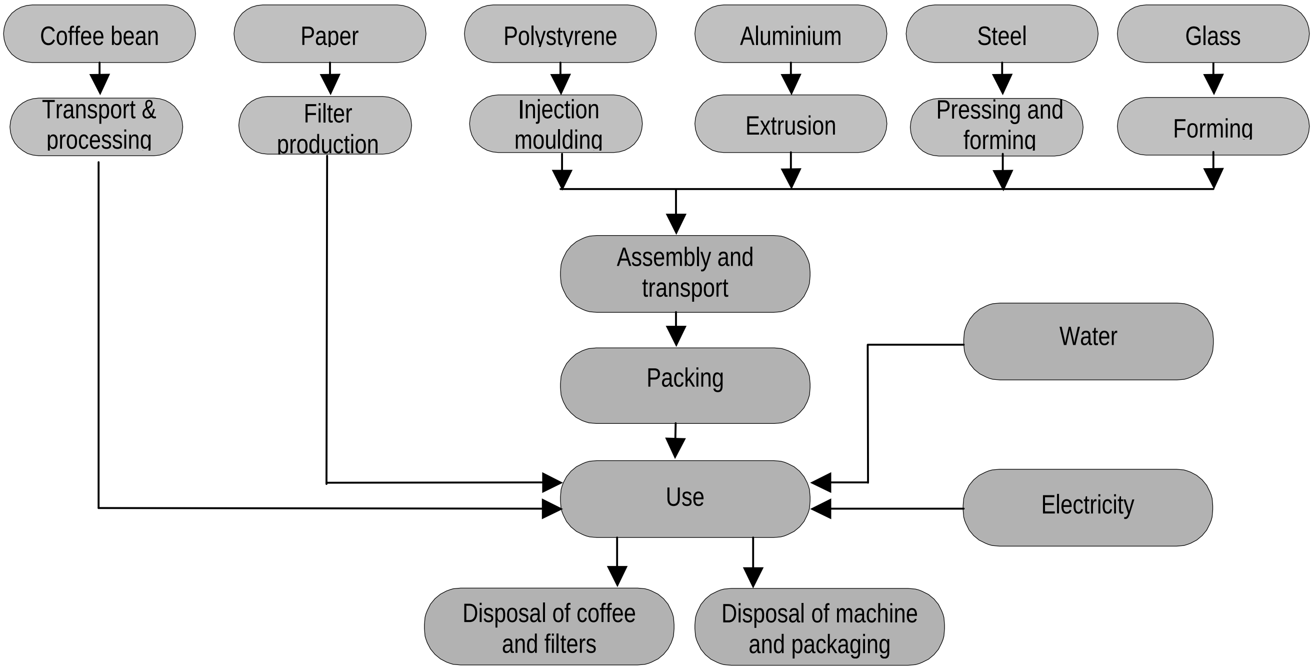

Figure 2: Example of a simplified process tree for the life cycle of a coffee machine.

Step 3: Quantify materials and processes

- *Determine a functional unit.*
- *Quantify all relevant processes from the process tree.*
- *Make assumptions for any missing data.*

In the LCA method the description of product, life cycle and performance is termed the functional unit. A quantity can now be determined for each process in the process tree on the basis of this functional unit and the product data. Particularly when making comparisons it is important that the performance delivered by both products is the same.

Not all details of a product life cycle are generally known; a number of estimates are therefore also needed. These estimates can have two results:

- The omission of a component or process. This is only acceptable if its contribution is minor compared to the rest.
- The user estimates a quantity himself.

In general it is better to make a number of estimates first and to seek more accurate data later on if this turns out to be necessary.

Examples of functional unit

1. A functional unit for a domestic coffee machine is determined as follows. The purpose of the coffee machine is to make coffee and keep it hot. The following are therefore chosen for the functional unit: all the products and processes needed for the provision of coffee for a household for a certain period. A certain period then has to be specified (say, five years) and the average coffee consumption per household has to be estimated. This can be, for example: making 5 cups of coffee twice a day and keeping it hot for half an hour after brewing. The number of filters (3650) and the energy consumption can then be included based on this assumption. A possible difference also surfaces between the use of a thermos jug and a hot plate.
2. A disposable napkin is compared with a washable one. The purpose of nappies is to absorb faeces and urine before an infant is potty-trained. One assumption for a fair basis for

comparison can then be: the number of nappies and processes required for a period of 30 months before the infant is potty-trained. Washing and drying of the washable nappy are then also included.

Step 4: Fill in the form

- *Note the materials and processes on the form and enter the amounts.*
- *Find the relevant Eco-indicator values and enter these.*
- *Calculate the scores by multiplying the amounts by the indicator values.*
- *Add the subsidiary results together.*

A simple form has been developed to make the Eco-indicator calculations. Like the Eco-indicator lists this form is included as separate insert in the back cover of this manual. This sheet can be copied for personal use. Next to this sheet specialised Eco-indicator software is available.

If an indicator value for a material or process is missing this causes a problem that can be resolved as follows:

- Check whether the missing indicator could make a significant contribution to the total environmental impact.
- Substitute a known indicator for the unknown one. If you study the list you will see that the indicator values for plastics are always in the same range. Based on this it is possible to estimate a value for a missing plastic that is within this range.
- Request an environmental expert to calculate a new indicator value. Software packages are available for this purpose.

The omission of a material or process because no indicator value is available is only admissible if it is clear that the anticipated contribution of this part is very small. It is generally better to estimate than to omit.

Step 5: Interpret the results

- *Combine (provisional) conclusions with the results.*
- *Check the effect of assumptions and uncertainties.*
- *Amend conclusions (if appropriate).*
- *Check whether the purpose of the calculation has been met.*

Analyse which processes and phases in the life cycle are the most important or which alternative has the lowest score. Always verify the effect of assumptions and uncertainties for these dominant processes. What happens to the result if an assumption changes slightly? Does the main conclusión stand or do the priorities or the preference for a product change? If so, the assumption will have to be reassessed, and supplementary information will have to be sought.

Please be aware of the fact that the standard Eco-indicator values from the list are not exact. At the end of chapter 5 we discuss some of the reasons for this uncertainty and we suggest a procedure to deal with it.

4.- Example

A number of examples have been described to illustrate the use of the Eco-indicator. The first is the example of a simple analysis of a coffee machine during which the steps defined in the previous chapter are followed again.

4.1. Simple analysis of a coffee machine

A design team is designing a new coffee machine model for domestic use and wishes to take environmental aspects into account. To enable priorities to be established at the outset of development work an analysis of the current model is carried out.

Step 1: Establish the purpose of the Eco-indicator calculation
The purpose of the calculation is to establish priorities, in other words: Where can the designer best start to achieve the greatest possible environmental improvement? The purpose is therefore not to compare two coffee machines. In the first instance it is possible to make fairly "rough" calculations, and simplifications are permissible.

Step 2: Define the life cycle
The process tree is illustrated in Fig. 3. The amounts listed in step 3 are also included in the process tree. A simplified model of a coffee machine is used in which only the polystyrene housing, the glass jug, the steel hot plate and an aluminium riser pipe are included (the mains cable and the switch have been omitted from this example).

The white blocks in the figure below have been disregarded in the Eco-indicator calculation. The consumption of coffee and water has been omitted because it is difficult for the designer to influence this. The packaging has been omitted because this is not under study at this stage.

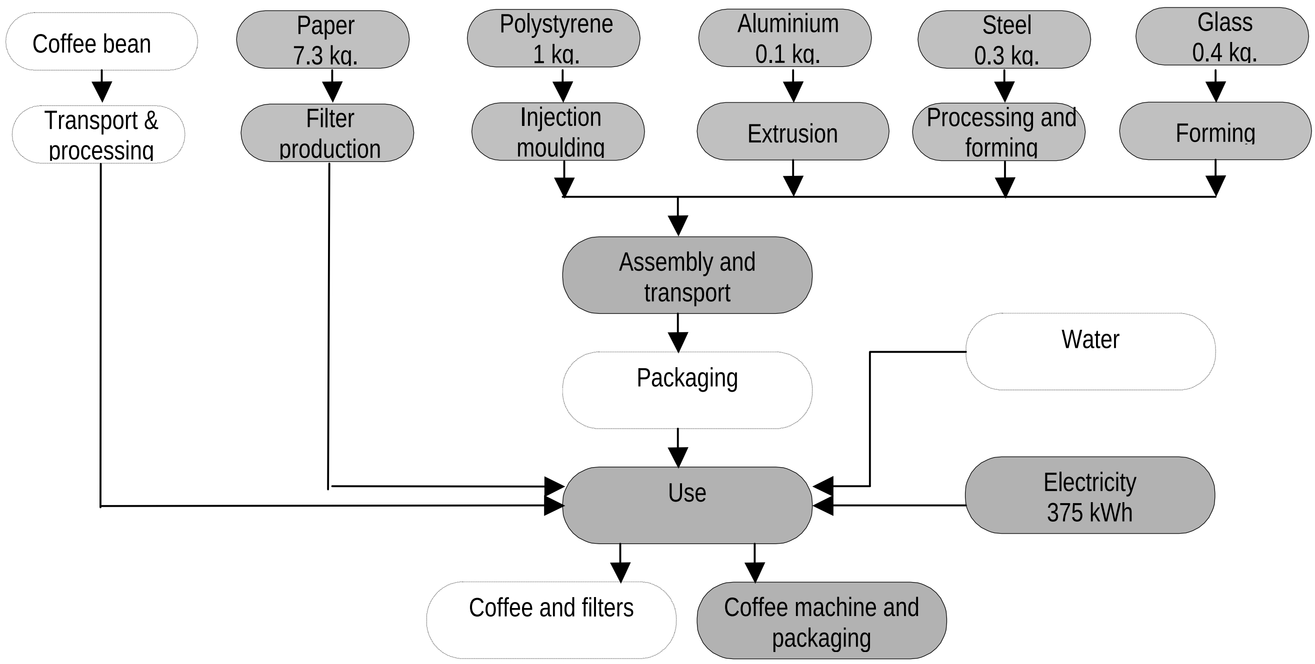

Figure 3: Process tree of a simplified coffee machine model with amounts and assumptions. White boxes are not included in the analysis.

Step 3: Quantify materials and processes
The amounts of materials and the processing processes can now be looked up or measured. The amounts of materials used can be derived from the design specifications or, if it is an existing machine, by weighing the components. An assumption of the frequency of use is needed for the required amount of electricity and the number of filters. In this example it is assumed that the machine is used twice a day for five years at half capacity (5 cups). It is further assumed that the coffee is kept hot for half an hour after it is ready. This is the same functional unit described under step 3 in the last chapter.

It can easily be calculated that in this case 3650 filters are needed with a total weight of 7.3 kg. The electricity consumption is rather less easy to determine, but an initial approximation is possible by multiplying the time taken to brew the coffee by the rated power. The energy consumption for keeping the coffee hot is even more difficult to measure but can be derived from simple measurements.

Assumptions must also be made about consumer behaviour for the disposal stage. It is not reasonable in this case to assume that the machine will be dismantled and disposed of separately in different collection systems by the consumer. We therefore assume that the machine will be put in the dustbin and thus processed as municipal waste. Only the glass jug, provided it is designed such that it will fit through the opening of the glass container, can be regarded as household waste. In this scenario account is taken of the fact that a certain proportion of households dispose of glass in the glass recycling container and that this glass will therefore be recycled. For this reason it isunnecessary to include a separate glass recycling stage in the calculation (see the sample form).Some of the filters end up in the dustbin and some with organic waste.

Step 4: Fill in the form

The form can now be filled in for each phase in the life cycle and the relevant Eco-indicator values can be recorded. Take care with the units! The score is then calculated for each process and recorded in the “result” column.

When the Eco-indicator list is consulted it sometimes turns out that not all the required proceses are included. Assumptions will have to be made for the missing data. In this example this involves a number of treatment processes and waste processes. The following assumptions are necessary:

- The indicators are very low for the stamping and forming of steel. Because of this, metal processing can be disregarded.
- No data are known for the glass forming. However, an estimate of the amount of energy can be made (in this case 4 MJ) based on the melting point, the specific heat and the assumed furnace efficiency.

The disposal phase contains no indicator value for compostable waste. Two approximations are possible:

- Ignore the possibility of composting and assume that all the paper ends up in the municipal waste processing system.
- Assume that composting has a negligible impact and can thus be omitted. In this example it has been decided to choose the approximation that all the paper ends up in the municipal waste processing system.

A fully completed form is shown overleaf:

Product or component	*Project*
Coffee machine	**Example**
Date **17-07-95**	*Author* **Pré**

Notes and conclusions
Analysis of a coffee machine, assumption: 5 years' use, 2 x per day, half capacity, keep hot for 30 minutes

Production *(Materials, treatments, transport & extra energy).*

Material or process	Quantity	Indicator	Result
Polystyrene (EPS)	1 kg	360	360
Injection moulding (PS)	1 kg	21	21
Aluminium.(Al)	0,1 kg	780	78
Extrusion Al	0,1 kg	72	7
Steel	0,3 kg	86	26
Glass	0,4 kg	58	23
gas-fired heat (forming)	4 MJ	5,3	21
Total			536

Use *(Transport, energy and auxiliary materials).*

Material or process	Quantity	Indicator	Result
Electricity low-voltage	375 Kwh	37	13.875
Paper	7,3 kg	96	701
Total			14.576

Disposal *(For each mater al type).*

Material & type of processing	Quantity	Indicator	Result
Municipal waste, PS.	1 kg	2	2
Municipal waste, ferrous	0,4 kg	-5,9	-2,4
household waste, glass	0,4 kg	-6,9	-2,8
municipal waste, paper	7,3 kg	0,71	5,2
Total			2

***TOTAL** (all phases)*	**15.114**

Step 5: Interpret the results

The results on the form reveal that the use phase has the greatest impact. The number of points is many times higher than the totals for the production and waste phases. The design team will therefore have to assign greatest priority to lower energy consumption when developing the new coffee machine model. Reducing paper consumption with the one-off filters is a clear second.

Amongst the materials the impact of the polystyrene housing is predominant.

- **Verification**

The effect of assumptions is negligible in this case, apart from the assumption regarding use (and the service life). The measured electricity consumption is reasonably reliable, but the assumption that coffee will be made twice a day for five years and kept hot for half an hour is not based on any concrete data. If, however, it is assumed that the machine is only used once a week the conclusion that energy consumption is predominant remains unchanged.

The indicator values relating to the assumption for the disposal of aluminium and paper do not give rise to any other conclusions. Even with accurate waste figures, the contribution of the waste phase will remain only a fraction of the indicator for the use phase.

- **Improvements**

Based on this Eco-indicator calculation the design team could consider developing a coffee machine with a thermos jug instead of a hot plate. In addition, the coffee machine could be fitted with a permanent filter in place of one-off paper filters. These design alternatives can, of course, be calculated in the same way with the Eco-indicator.

This result will permit the user to see how much environmental impact these design alternatives will have with reference to the coffee machine as described above. The result of this analysis is gain below shown a in Fig. 4 in the form of a process tree, in which the size of each block is a measure of the relative contribution to the total.

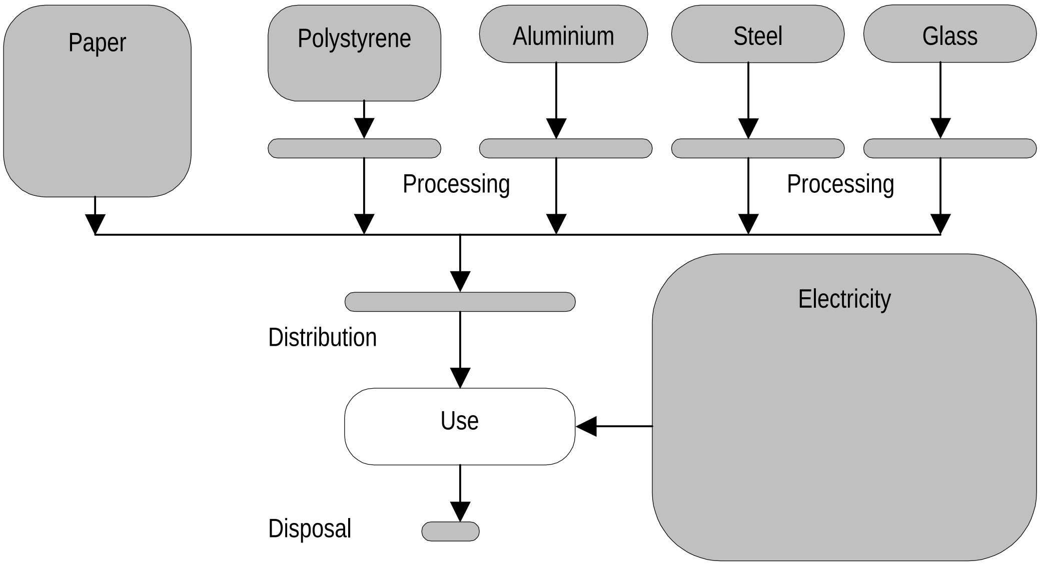

Figure 4: The coffee machine process tree, where the size of the process blocks is proportional to the relative importance of the process

4.2. Example of a complex product

If products contain many components the form quickly becomes too small. In such cases a product can be defined by subdividing it into "subassemblies", in just the same way as in technical drawings. One column in the form can then be used for each assembly. The total scores of these forms are carried over to the main form. The use phase can also be included in this form. Fig. 5 illustrates this method of completing the form for a refrigerator:

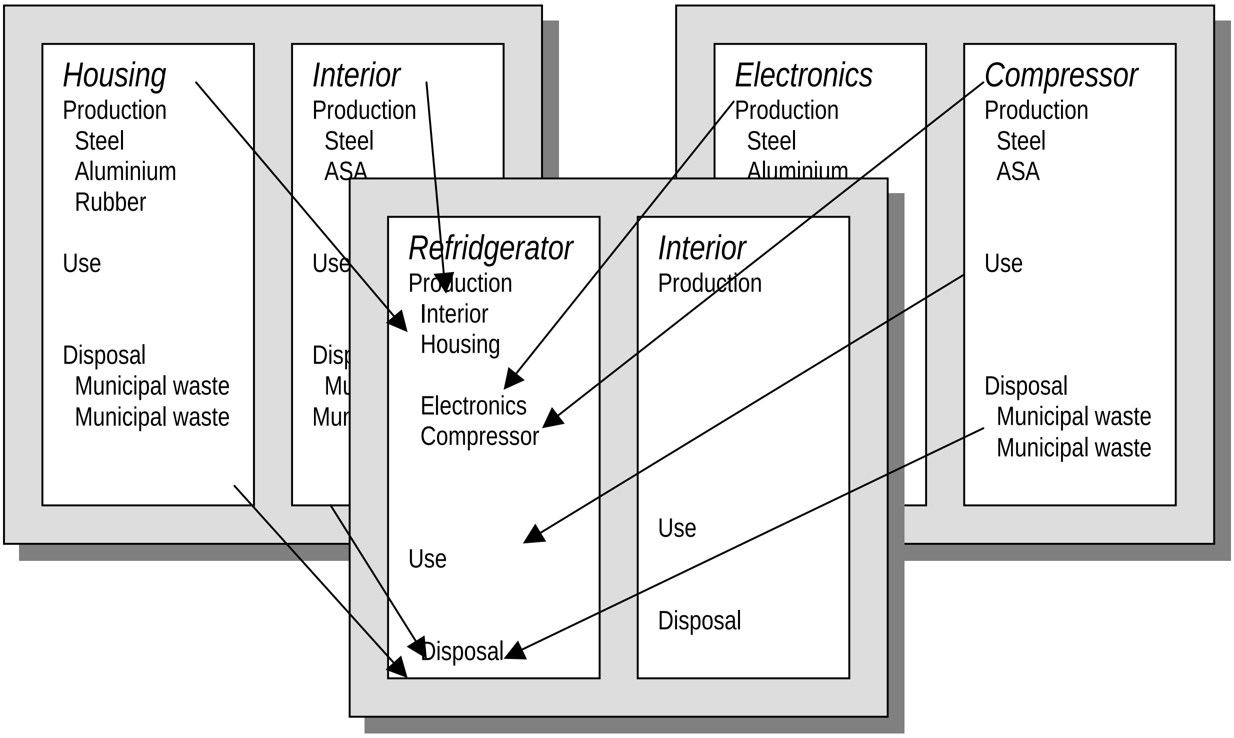

Figure 5: Example of a completed form (in this case without figures) in which the product is subdivided.

5.- The Eco-indicator 99 methodology

The Eco-indicators calculated here have been calculated with a specially developed methodology. The details of this methodology can be found in the Eco-indicator 99 methodology report that is available from www.pre.nl.

5.1. Three steps

In order to calculate the Eco-indicator score, three steps are needed:
1. Inventory of all relevant emissions, resource extractions and land-use in all processes that form the life cycle of a product. This is a standard procedure in Life Cycle Assessment (LCA).
2. Calculation of the damages these flows cause to Human Health, Ecosystem Quality and Resources
3. Weighting of these three damage categories.

In the figure 6 these steps are illustrated. Below we discuss these steps in inverse order, thus starting with step 3. This inverse order was also our line of thinking during the development.

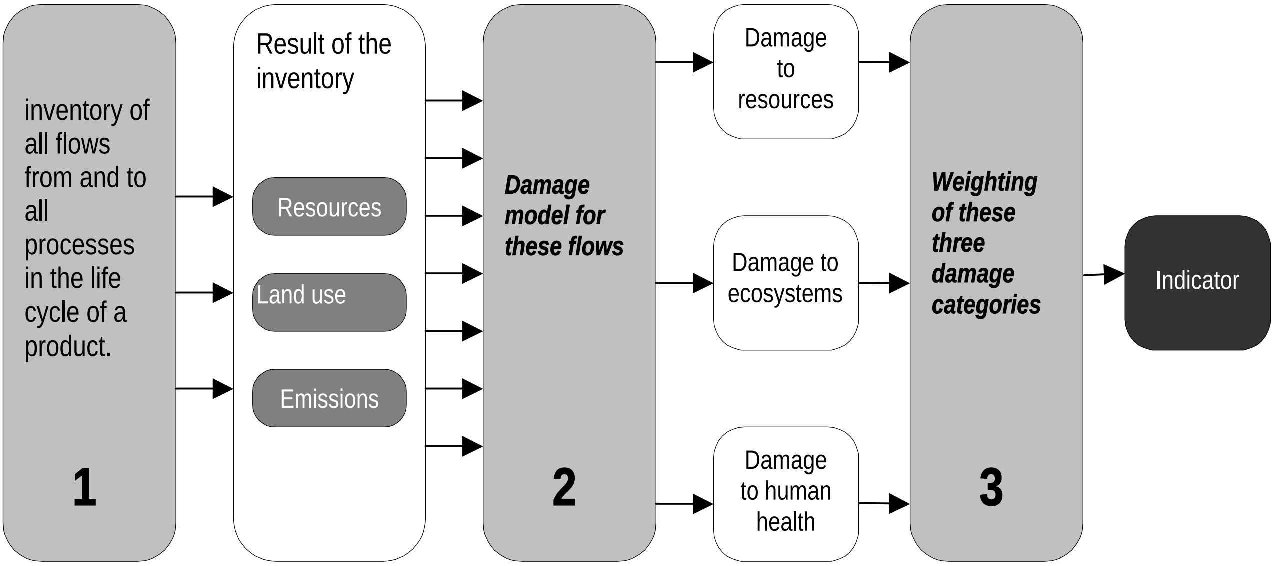

Figure 6: General procedure for the calculation of Eco-indicators.

5.2. Weighting (step 3)

The most critical and controversial step in a methodology as this is the weighting step.

Traditionally in LCA the emissions and resource extractions are expressed as 10 or more different impact categories, like acidification, ozone layer depletion, ecotoxicity and resource extraction. For a panel of experts or non-experts it is very difficult to give meaningful weighting factors for such a large number and rather abstract impact categories. The problem is that panel members cannot really grasp the seriousness of these impact categories, without knowing what effects are associated with them. An additional problem is that 10 is a relative high number of items to be weighted.

In the Eco-indicator 99 methodology development we started with the design of the weighting procedure and asked ourselves what type of information a panel can handle in a weighting procedure. Our conclusion was that we should not ask the panel to weight the impact categories but the different types of damage that are caused by these impact categories. The other improvement is to limit the number of items that are to be assessed to three. As a result, the panel is asked to assess the seriousness of just three damage categories:
1. ***Damage to Human Health,*** expressed as the number of year life lost and the number of years lived disabled. These are combined as Disability Adjusted Life Years (DALYs), an index that is also used by the World bank and the WHO.

2. ***Damage to Ecosystem Quality,*** express as the loss of species over an certain area, during a certain time.
3. ***Damage to Resources,*** expressed as the surplus energy needed for future extractions of minerals and fossil fuels.

The panel used in this project consisted of 365 persons from a Swiss LCA interest group [Mettier 1999]. This group can unfortunately not be regarded as representative for the European population. The reason for choosing this group was the assumption that such a group would better understand the questions posed to them. In spite of this limitation, we still use the results.

The results from this group indicate that the panellist find damage to Human Health and damage to Ecosystem Quality about equally important while damage to Resources is considered to be about half as important.

5.3. The damage model (Step 2)

In order to be able to use the weights for the three damage categories a series of complex damage models had to be developed. In figure 7 these models are represented in a schematic way.

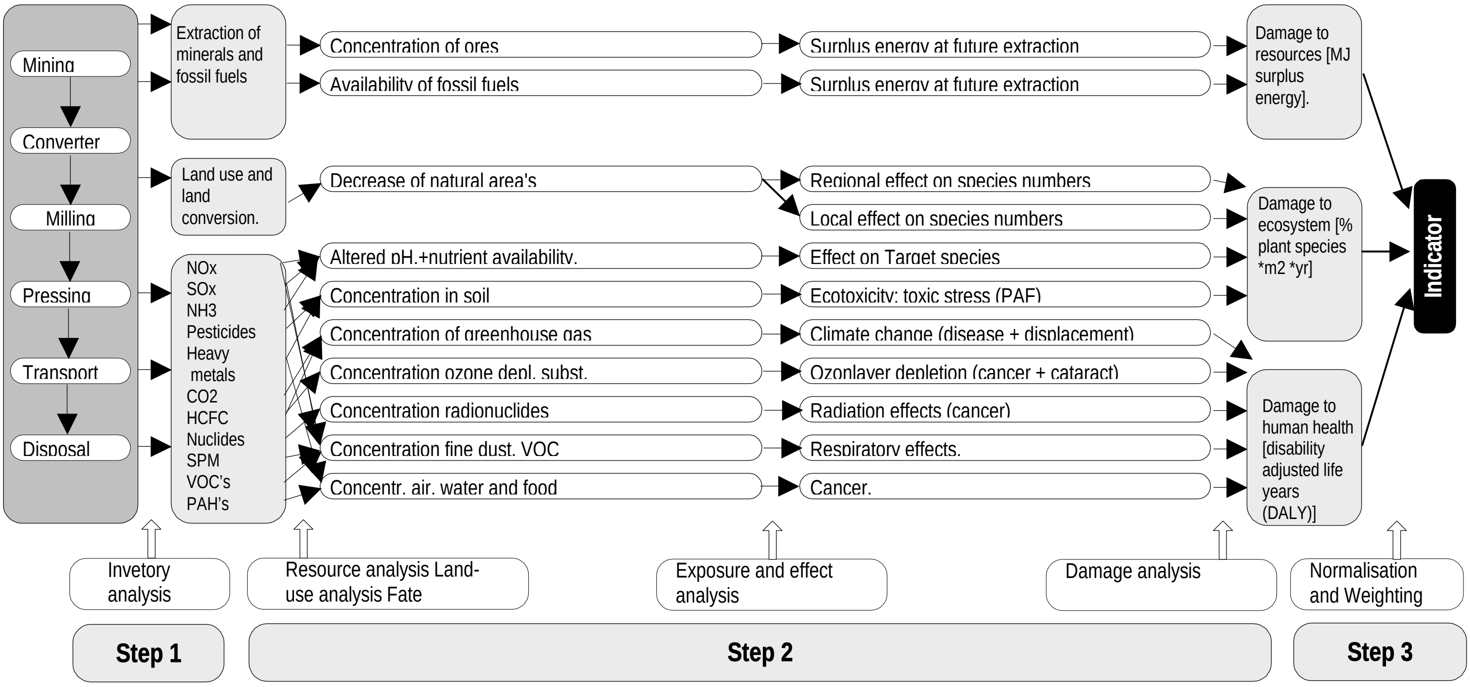

Figure 7: Detailed representation of the damage model (step 2)

5.3.1. The damage model for emissions

For the calculation of the damages caused by emissions four steps are needed [Hofstetter 1998].

- **Fate analysis**

When a chemical substance is released it finds its way through the environmental compartments air, water and soil. Where the substance will go, and how long it will stay depends on the properties of the substance and the compartments. A well soluble substance will be collected in the water compartment, while a substance that easily binds to organic particles may end op in specific types of soil. Another aspect is the degradability, as most organic substances have a limited lifetime. In so called “fate analysis” models the transfer between compartments and the degradation of substances is modelled. As a result the concentrations in air, water, soil and food can be calculated.

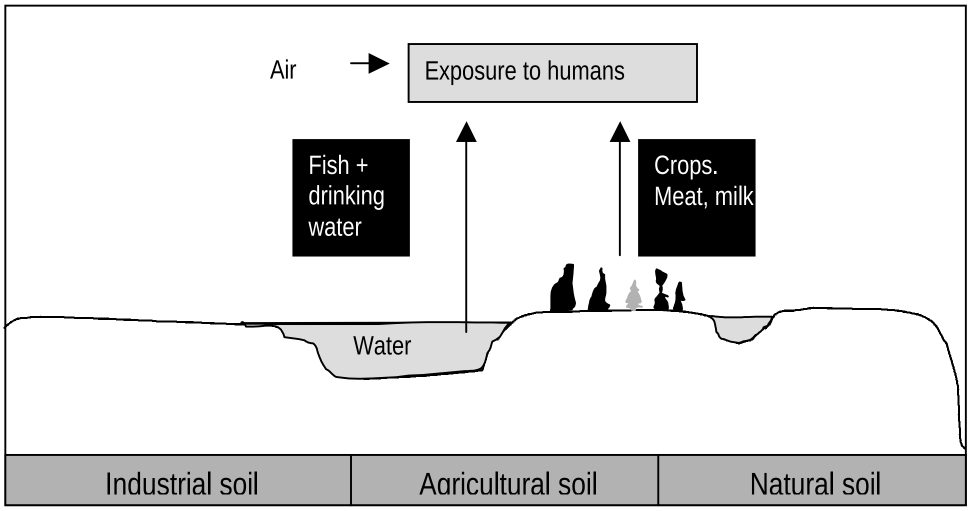

Figure 8: Schematic representation of a fate model used for toxicity. For other substance types other fate models are used.

- **Exposure**

Based on the calculated concentrations we can determine how much of a substance is really taken in by people and by plants or other life forms.

- **Effect analysis.**

Once the exposure of a substance is known it is possible to predict the types and frequencies of diseases and other effects.

- **Damage analysis.**

The predicted diseases can now be expressed into our damage unit. For instance if we know that a certain level of exposure causes ten extra cases of a certain type of cancer, we can find data on the average age people get this type of cancer and the average chance that people will die. Based on this data, we can calculate how many years of life are lost, and how many years are lived disabled, as people are ill and have to be treated in hospital. For the toxic effects on ecosystems we calculate what percentage of plants and lower species are exposed to toxic stress, while for acidification and eutrophication we model what percentage of plants are likely to disappear (Potentially Disappeared Fraction). Damages to higher species like birds and mammals could not be calculated, but there are good reasons to assume that the damage to plants and lower organisms is also representative for the damage to populations of higher animals.

For most substances the damages are calculated on a European scale. For some substances, like greenhouse gasses, ozone-depleting gasses, radioactive substances with a long lifetime, the damage is calculated on a world-wide level, as these substances are dispersed world-wide.

5.3.2. Damage model for land-use

Mankind is occupying large areas for urban and agricultural purposes. This is an important reason why many species are threatened with extinction, and therefore it is important to include the effects of land-use by man-made systems into the Eco-indicator. Also here the disappearance of species is taken as the damage unit.

Different types of land-use will have different effects. For instance a paved parking lot will have less plant species than an organic meadow. On the basis of field observation studies [Köllner 1999] we have developed a scale expressing the species diversity per type of land use. A complication is the fact that the species diversity depends on the size of an area. This means that the construction and use of a parking lot does not only have an effect on the actual area of the lot, but also on thesurrounding region, as due to the parking lot the natural areas will become slightly smaller. We call this the regional effect. In the Eco-indicator 99 both the regional and the local effect are taken into account.

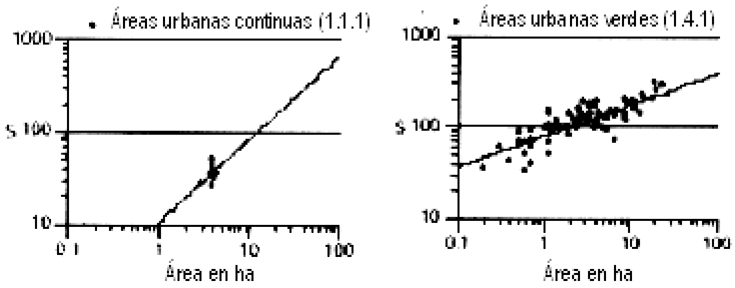

Figure 9 Some examples of the species area relationship. Every dot is based on an actual observation. The line is the calculated correlation between the area size(horizontal) and the species number(vertical). [Taken from Köllner 1999]

5.3.3. Damage model for resources

By extracting minerals we reduce the quality of the remaining resources. This is because mankind always extracts the best resources first, leaving the lower quality resource to future generations. For instance in the Bronze Age, our ancestors found ores with a few percent of copper, while nowadays the average grade is around 0.7%.

The damage to resources will be experienced by future generations as they will have to use more effort to extract the remaining resources. We express this extra effort as “surplus energy” [Müller-Wenk 1998]

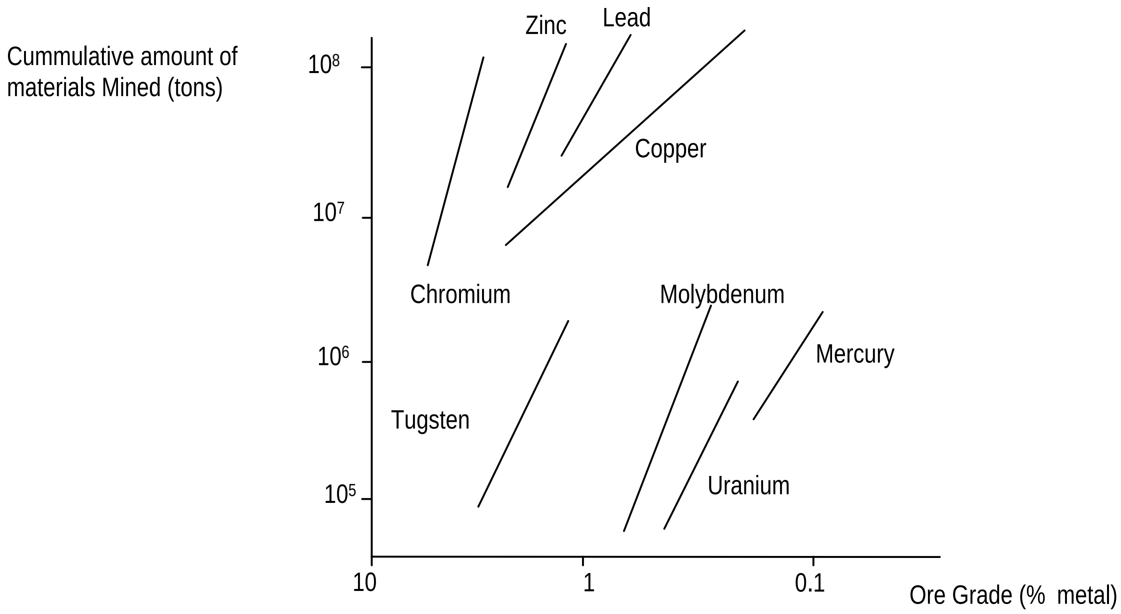

Figure 10: The relation between the availability of resources and the ore grade on a logarithmic scale for a number of minerals. A steep line indicates that the availability increases sharply if mankind is able and willing to accept a slightly lower ore concentration. A flat line means that even at lower concentrations, the availability will not increase very much. The latter case is more problematic than the first. [Taken from Chapman 83]

For fossil fuels a similar reasoning applies, although we cannot use the term concentration here. However, a wealth of statistical data indicates that gradually the supply of easily extractable fossil fuels, like liquid oil will decline. This does not mean we are faced with the end of fossil resource, but that other lower quality resources like oil shale will have to be used. Also here lower quality can be translated into surplus energy, as the exploration of for instance shale will require significant more energy than the extraction of liquid oil.

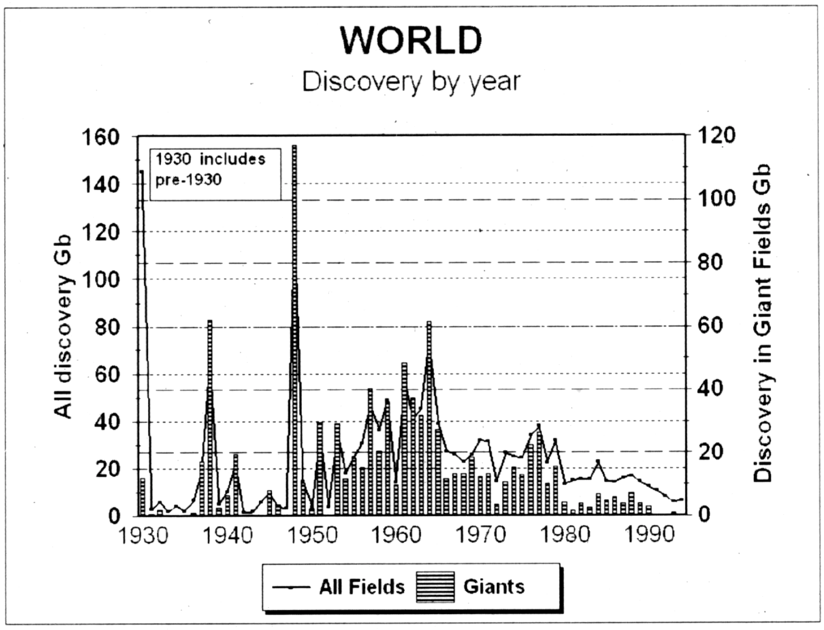

Figure 11: The discovery rate of liquid oil has dropped ton average of about 6 Gigabarrel per year, while the extraction is almost tenfold. The so-called giant fields have all been discovered during the fifties, sixties and seventies. The present knowledge of geology is so well developed that it is unlikely that many new giant fields can be found.

5.4. Inventory of the processes (Step 1)

For the standard Eco-indicators we have mainly used the energy database developed by ESU-ETH in Zürich [ESU 1996]. This data is well known and well documented. Next to this some data from the SimaPro LCA software tool has been used.

In the inventory of such data it is very important to use a consistent methodology concerning items like:

- ***System boundaries*** (what is included and what not).
- ***Allocation*** (how do we deal with industrial processes that produce more than one output).
- ***Regional aspects*** (do we use Dutch, Swiss or average European data).
- ***General data quality issues*** (age, representativeness, average or modern technology etc.).

In annexe 1 a brief description of these issues is given.
We would like to warn users of this methodology not to mix databases with indicators that have been developed with different methodologies, as has been done by some software developers with the Eco-indicator 95 methodology.

5.5. Uncertainties

Of course it is very important to pay attention to the uncertainties in the methodology that is used to calculate the indicators. We distinguish two types:

1. Uncertainties about the correctness of the models used.
2. Data uncertainties.

The first type of uncertainties include value choices like the choice of the time horizon in the damage model, or the question whether we should include an effect even if the scientific proof thatthe effect exists is incomplete.
The data uncertainties refer to difficulties in measuring or predicting effects. This type of uncertainties is relatively easy to handle and can be expressed as a range or a standard deviation. Uncertainties about the correctness of the model are very difficult to express as a range.

Uncertainties about the correctness of the model

In debates about the seriousness of environmental effects opinions are usually very diverse. This may have to do with differences in knowledge levels, but also fundamental differences in attitude and perspective play an important role. Some people would argue long time effects are more important than short term, while others could argue that on the long term environmental problems can be solved by technological developments and if the appropriate measures are taken. An other difference would be that some people would only be concerned about an issue if sufficient scientific proof is available, while others would argue that every possible effect should be takenseriously.

Such fundamentally different perspectives cannot be reconciled, and there is no way to determine if a perspective is right or wrong. This is a problem because as developers of the Eco-indicator 99 methodology we are frequently confronted with model choices that are dependent on such different perspectives. As we cannot develop a different version for every individual perspective we haveused three “Archetypes” of perspectives.

A very simplified characterisation, using just three criteria of these versions is:

	Time perspective	Manageability	Required level of evidence
H (Hierarchist):	Balance between short and long term	Proper policy can avoid many problems	Inclusion based on consensus
I (Individualist):	Short time	Technology can avoid many problems	Only proven effects
E (Egalitarian):	Very long term	Problems can lead to catastrophy	All possible effects

These “Archetypes” are taken form the Cultural Theory framework [Thompson 1990 and Hofstetter 1998], and is frequently used in social science. Of course the theory does not want to imply there are just three types of people. The archetypes are conceptual models; most people use all three perspectives in their daily life.

As a consequence there are three different versions of the Eco-indicator 99 methodology. The figures published in this report are based on the H (Hierarchist) version, which is chosen as default. The other versions are available in LCA software, and can be used to investigate the influence of the different modelling choices on the result.

Also in the panel procedure (step 3) it was possible to distinguish the archetypes. For the inventory (step 1) this has not been tried as we used standard available data.

Data uncertainties

Data uncertainties deal with completely different issues. For instance we are confronted with the uncertainty in the expected number of cancer cases when a group of people are exposed to a certain substance, or the uncertainty in the concentration of a certain mineral. In the methodology report the data uncertainties for almost all human health effects and for most ecosystem effects, as well as for the panel procedure are determined and described. Unfortunately uncertainties in the acidification, eutrophication and resources, as well as the uncertainties in the normalisation values are not available.

In considering uncertainties it is important to distinguish between the absolute and relative uncertainties. With the latter we mean the uncertainties in the differences BETWEEN the indicators. This relative uncertainty is the most important for the practical application of the user who wants to compare materials or design options.

The relative uncertainty can be much smaller than the absolute uncertainty. This is because these uncertainties are correlated and have the tendency to compensate each other.

Examples:

1. Suppose product A is made of 5 kg polyethylene and product B is made of 6 kg of the identical polyethylene. In this case it is safe to assume that product B will always have a higher environmental load no matter how big the uncertainties in the indicators are, because any flawin the methodology would be completely compensated.
2. Suppose now that product B is made out of polypropylene. In this case the uncertainties play a limited role, as the production processes and the most important emissions and raw materials will not be very different. For instance if there is a large flaw in the data for extraction of oil in the damage model for resources, this flaw would have the same effect in both cases. Similarly a flaw in the CO2 damage model would also work almost exactly the same. As a result we canconclude that the uncertainties in the Eco-indicators when more or less similar processes are compared will be small.
3. Suppose now that product B is made out of wood. Now the uncertainties can be very significant, as the processes and the most important emissions and resources are almost completely different. A flaw in the damage model for extraction of oils is not compensated by asimilar flaw in the production process of wood, as relatively little oil is used in the harvesting and transport of wood. Similarly, a flaw in the model for land-use (production forest) is not compensated by the flaw in the model for a refinery, as the amount of land used per kg of oil is low. This means that when the Eco-indicator values are used to compare two completely different materials or processes one must allow for a large error margin before a conclusion can be drawn.

From this we can conclude that it is very difficult to generalise the uncertainties in the indicator, as much depends on the way model flaws compensate each other. As a very provisional and general guideline we recommend the following guidelines when different life cycles are compared:

1. ***Determine the most important processes (the processes with the highest contributions)***
2. ***Determine if these processes are expected to have similar or dissimilar raw materials, operating principles and emissions .***
3. ***If these dominant processes are considered to be quite similar, the difference between the Eco-indicator scores should be 10 to 50% if a conclusion is to be drawn on which one is the best option***
4. ***If these dominant processes are considered to be dissimilar or completely different the Eco-indicator scores should at least differ more than 100% before a reliable conclusion can be drawn.***

When important strategic decisions are to be based on the analysis, we recommend using the Eco-indicator methodology in fully transparent LCA software, as this will allow for a much better understanding of the uncertainties.

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Production of ferro metals (in millipoints per kg)

Material	Indicator	Description	
Cast iron	240	Casting iron with > 2% carbon compound	1
Converter steel	94	Block material containing only primary steel	1
Electro steel	24	Block material containing only secondary scrap	1
Steel	86	Block material containing 80% primary iron, 20% scrap	1
Steel high alloy	910	Block material containing 71% primary iron, 16% Cr, 13% Ni	1
Steel low alloy	110	Block material containing 93% primary iron, 5% scrap, 1% alloy metals	1

Production of non ferro metals (in millipoints per kg)

Material	Indicator	Description	
Aluminium 100% Rec.	60	Aluminium 100% Rec.	1
Aluminium 0% Rec.	780	Block containing only primary material	1
Chromium	970	Block containing only primary material	1
Copper	1400	Block containing only primary material	1
Lead	640	Block, containing 50% secondary lead	1
Nickel enriched	5200	Block containing only primary material	1
Palladium enriched	4600000	Block containing only primary material	1
Platinum	7000000	Block containing only primary material	1
Rhodium enriched	12000000	Block containing only primary material	1
Zinc	3200	Block, containing only primary material (plating quality)	1

Processing of metals (in millipoints)

Process	Indicator	Description	
Bending – aluminium	0,000047	one sheet of 1mm over width of 1 metre	4
Bending – steel	0,00008	one sheet of 1mm over width of 1 metre	4
Bending – RVS	0,00011	one sheet of 1mm over width of 1 metre	4
Brazing	4000	per kg brazing, including brazing material (45% silver, 27% copper, 25% tin)	1
Cold roll into sheet	18	per thickness reduction of 1 mm of 1 m2 plate	4
Electrolytic Chromium plating	1100	per m2, 1 µm thick, double sided; data fairly unreliable	4
Electrolytic galvanising	130	per m2, 2.5 µm thick, double sided; data fairly unreliable	4
Extrusion – aluminium	72	Per kg	4
Milling, turning, drilling	800	per dm3 removed material, without production of lost material	4
Pressing	23	per kg deformed metal. Do not include non-deformed parts!	4
Spot welding – aluminium	2,7	per weld of 7 mm diameter, sheet thickness 2 mm	4
Shearing/stamping –aluminium	0,000036	per mm2 cutting surface	4
Shearing/stamping – steel	0,00006	per mm2 cutting surface	4
Shearing/stamping – RVS	0,000086	per mm2 cutting surface	4
Sheet production	30	per kg production of sheet out of block material	4
Band zinc coating	4300	(Sendzimir zink coating) per m2, 20-45 µm thick, including zinc	1
Hot galvanising	3300	per m2, 100 µm thick, including zinc	1
Zinc coating (conversion um)	49	per m2, 1 extra µm thickness, including zinc	1

Production of plastic granulate (in millipoints per kg)

Material	Indicator	Description	
ABS	400		3
HDPE	330		1
LDPE	360		1
PA 6.6	630		3
PC	510		1
PET	380		1
PET bottle grade	390	used for bottles	3
PP	330		1
PS (GPPS)	370	general purposes	3
PS (HIPS)	360	high impact	1
PS (EPS)	360	expandable	3
PUR energy absorbing	490		3
PUR flexible block foam	480	for furniture, bedding, clothing	3
PUR hardfoam	420	used in white goods, insulation, construction material	1
PUR semi rigid foam	480		3
PVC high impact	280	Without metal stabilizer (Pb or Ba) and without plasticizer (see under Chemicals)	1
PVC (rigid)	270	rigid PVC with 10% plasticizers (crude estimate)	1
PVC flexible	240	Flexible PVC with 50% plasticizers (crude estimate)	1
PVDC	440	for thin coatings	3

Processing of plastics (in millipoints)

Process	Indicator	Description	
Blow foil extrusion PE	2,1	per kg PE granulate, but without production of PE. Foil to be used for bags	2
Calandering PVC foil	3,7	per kg PVC granulate, but without production of PVC	2
Injection moulding – 1	21	per kg PE, PP, PS, ABS, without production of material	4
Injection moulding – 2	44	per kg PVC, PC, without production of material	4
Milling,turning,drilling	6,4	per dm3 machined material, without production of lost material	4
Pressure forming	6,4	per kg	4
React.Inj.Moulding-PUR	12	per kg, without production of PUR and possible other components	4
Ultrasonic welding	0,098	per m welded length	4
Vacuum-forming	9,1	per kg material, but without production of material	4

Production of rubbers (in millipoints per kg)

Material	Indicator	Description	
EPDM rubber	360	Vulcanised with 44% carbon, including moulding	1

Production of packaging materials (in millipoints per kg)

Material	Indicator	Description	
Packaging carton	69	CO_2 absorption in growth stage disregarded	1
Paper	96	Containing 65% waste paper, CO_2 absorption in growth stage disregarded	1
Glass (brown)	50	Packaging glass containing 61% recycled glass	2
Glass (green)	51	Packaging glass containing 99% recycled glass	2
Glass (white)	58	Packaging glass containing 55% recycled glass	2

Production of chemicals and others (in millipoints per kg)

Material	Indicatdor	Description	
Ammonia	160	NH_3	1
Argon	7,8	Inert gas, used in light bulbs, welding of reactive metals like aluminium	1
Bentonite	13	Used in cat litter, porcelain etc.	1
Carbon black	180	Used for colouring and as filler	1
Chemicals inorganic	53	Average value for production of inorganic chemicals	1
Chemicals organic	99	Average value for production of organic chemicals	1
Chlorine	38	Cl_2 Produced with diaphragm production process (modern technology)	1
Dimethyl p-phthalate	190	Used as plasticizer for softening PVC	1
Ethylene oxide/glycol	330	Used as industrial solvent and cleaning agent	1
Fuel oil	180	Production of fuel only. Combustion excluded!	1
Fuel petrol unleaded	210	Production of fuel only. Combustion excluded!	1
Fuel diesel	180	Production of fuel only. Combustion excluded!	1
H_2	830	Hydrogen gas. Used for reduction processes	1
H_2SO_4	22	Sulphuric acid. Used for cleaning and staining	1
HCl	39	Hydrochloric acid, used for processing of metals and cleaning	1
HF	140	Fluoric acid	1
N_2	12	Nitrogen gas. Used as an inert atmosphere	1
NaCl	6,6	Sodium chloride	1
NaOH	38	Caustic soda	1
Nitric acid	55	HNO_3. Used for staining metals	1
O_2	12	Oxygen gas.	1
Phosphoric acid	99	H_3PO_4 Used in preparation of fertiliser	1
Propylene glycol	200	Used as an anti-freeze, and as solvent	1
R134a (coolant)	150	Production of R134a only! Emission of 1 kg R134a to air gives 7300 mPt	1
R22 (coolant)	240	Production of R22 only! Emission of 1 kg R22 to air gives 8400 mPt	1
Silicate (waterglass)	60	Used in the manufacture of silica gel, detergent manufacture and metal cleaning	1
Soda	45	Na_2CO_3. Used in detergents	1
Ureum	130	Used in fertilisers	1
Water decarbonized	0,0026	Processing only; effects on groundwater table (if any) disregarded	1
Water demineralized	0,026	Processing only; effects on groundwater table (if any) disregarded	1
Zeolite	160	Used for absorption processes and in detergents	1

Production of building material (in millipoints per kg)

Material	Indicator	Description	
Alkyd varnish	520	Production + emissions during use of varnish, containing 55% solvents	5
Cement	20	Portland cement	1
Ceramics	28	Bricks etc.	1
Concrete not reinforced	3,8	Concrete with a density of 2200 kg/m3	1
Float glass coated	51	Used for windows, Tin, Silver and Nickel coating (77 g/m2)	1
Float glass uncoated	49	Used for windows	1
Gypsum	9,9	Selenite. Used as filler.	1
Gravel	0,84	Extraction and transport	1
Lime (burnt)	28	CaO. Used for production of cement and concrete. Can also be used as strong base	1
Lime (hydrated)	21	$Ca(OH)_2$. Used for production of mortar	1
Mineral wool	61	Used for insulation	1
Massive building	1500	Rough estimate of a (concrete) building per m3 volume (capital goods)	1
Metal construction building	4300	Rough estimate of a building per m3 volume (capital goods)	1
Sand	0,82	Extraction and transport	1
Wood board	39	European wood (FSC criteria); CO_2 absorption in growth stage disregarded	1
Wood massive	6,6	European wood (FSC criteria); CO_2 absorption in growth stage disregarded	1
Land-use	45	Occupation as urban land per m2 yr	1

Heat (in millipoints per MJ)

Material	Indicator	Description (Including fuel production)	
Heat coal briquette (stove)	4,6	Combustion of coal in a 5-15 kW furnace	1
Heat coal (industrial furnace)	4,2	Combustion of coal in a industrial furnace (1-10MW)	1
Heat lignite briquet	3,2	Combustion of lignite in a 5-15kW furnace	1
Heat gas (boiler)	5,4	Combustion of gas in an atmospheric boiler (<100kW) with low NOx	1
Heat gas (industrial furnace)	5,3	Combustion of gas in an industrial furnace (>100kW) with low NOx	1
Heat oil (boiler)	5,6	Combustion of oil in a 10kW furnace	1
Heat oil (industrial furnace)	11	Combustion of oil in an industrial furnace	1
Heat wood	1,6	Combustion of wood; CO_2 absorption and emission disregarded	1

Solar energy (in millipoints per kWh)

Type	Indicator	Description	
Electricity facade m-Si	9,7	Small installation (3kWp) with monocrystaline cells, used on building façade	1
Electricity facade p-Si	14	Small installation (3kWp) with polycrystaline cells, used on building facade	1
Electricity roof m-Si	7,2	Small installation (3kWp) with monocrystaline cells, used on building roof	1
Electricity roof p-Si	10	Small installation (3kWp) with polycrystaline cells, used on building roof	1

Electricity (in millipoints per kWh)

Type of electricity	Indicator	Description (Including fuel production)	
Electr. HV Europe (UCPTE)	22	High voltage (> 24 kVolt)	1
Electr. MV Europe (UCPTE)	22	Medium voltage (1 kV – 24 kVolt)	1
Electr. LV Europe (UCPTE)	26	Low voltage (< 1000Volt)	1
Electricity LV Austria	18	Low voltage (< 1000Volt)	1
Electricity LV Belgium	22	Low voltage (< 1000Volt)	1
Electricity LV Switzerland	8,4	Low voltage (< 1000Volt)	1
Electricity LV Great Britain	33	Low voltage (< 1000Volt)	1
Electricity LV France	8,9	Low voltage (< 1000Volt)	1
Electricity LV Greece	61	Low voltage (< 1000Volt)	1
Electricity LV Italy	47	Low voltage (< 1000Volt)	1
Electricity LV the Netherlands	37	Low voltage (< 1000Volt)	1
Electricity LV Portugal	46	Low voltage (< 1000Volt)	1

Transport (in millipoints per tkm)

Type of transport	Indicator	Description (Including fuel production)	
Delivery van <3.5t	140	Road transport with 30% load, 33% petrol unleaded, 38% petrol leaded, 29% diesel (38% without catalyst) (European average including return)	1
Truck 16t	34	Road transport with 40% load (European average including return)	1
Truck 28t	22	Road transport with 40% load (European average including return)	1
Truck 28t (volume)	8	Road transport per m3km. Use when volume in stead of load is limiting factor	1
Truck 40t	15	Road transport with 50% load (European average including return)	1
Passenger car W-Europe	29	Road transport per km	1
Rail transport	3,9	Rail transport, 20% diesel and 80% electric trains	1
Tanker inland	5	Water transport with 65% load (European average including return)	1
Tanker oceanic	0,8	Water transport with 54% load (European average including return)	1
Freighter inland	5,1	Water transport with 70% load (European average including return)	1
Freighter oceanic	1,1	Water transport with 70% load (European average including return)	1
Average air transport	78	Air transport with 78% load (Average of all flights)	6
Continental air transport	120	Air transport in a Boeing 737 with 62% load (Average of all flights)	6
Intercontinental air transport	80	Air transport in a Boeing 747 with 78% load (Average of all flights)	6
Intercontinental air transport	72	Air transport in a Boeing 767 or MD 11 with 71% load (Average of all flights)	6

Recycling of waste (in millipoints per kg)

Material	Indicator			Description (values of recycling of primary material.)	
	Total	Process	Avoided product		
Recycling PE	-240	86	-330	if not mixed with other plastics	7
Recycling PP	-210	86	-300	if not mixed with other plastics	7
Recycling PS	-240	86	-330	if not mixed with other plastics	7
Recycling PVC	-170	86	-250	if not mixed with other plastics	7
Recycling Paper	-1,2	32	-33	Recycling avoids virgin paper production	2
Recycling Cardboard	-8,3	41	-50	Recycling avoids virgin cardboard production	2
Recycling Glass	-15	51	-66	Recycling avoids virgin glass production	2
Recycling Aluminium	-720	60	-780	Recycling avoids primary aluminium.	1
Recycling Ferro metals	-70	24	-94	Recycling avoids primary steel production	1

Waste treatment (in millipoints per kg)

	Indicator	Descriptión	
Incineration		Incineration in a waste incineration plant in Europe. Average scenario for energy recovery. 22% of municipal waste in Europe is incinerated	
Incineration PE	-19	Indicator can be used for both HDPE and LDPE	2
Incineration PP	-13		2
Incineration PUR	2,8	Indicator can be used for all types of PUR	2
Incineration PET	-6,3		2
Incineration PS	-5,3	Relatively low energy yield, can also be used for ABS, HIPS, GPPS, EPS	2
Incineration Nylon	1,1	Relatively low energy yield	2
Incineration PVC	37	Relatively low energy yield	2
Incineration PVDC	66	Relatively low energy yield	2
Incineration Paper	-12	High energy yield CO_2 emission disregarded	2
Incineration Cardboard	-12	High energy yield CO_2 emission disregarded	2
Incineration Steel	-32	40% magnetic separation for recycling, avoiding crude iron (European average)	2
Incineration Aluminium	-110	15% magnetic separation for recycling, avoiding primary aluminium	2
Incineration Glass	5,1	Almost inert material, indicator can be used for other inert materials	2
Landfill		Controlled landfill site. 78% of municipal waste in Europe is landfilled	
Landfill PE	3,9		2
Landfill PP	3,5		2
Landfill PET	3,1		2
Landfill PS	4,1	Indicator can also be used for landfill of ABS	2
Landfill EPS foam	7,4	PS foam, 40 kg/m3, large volume	2
Landfill foam 20kg/m3	9,7	Landfill of foam like PUR with 20kg/m3	2
Landfill foam 100kg/m3	4,3	Landfill of foam like PUR with 100kg/m3	2
Landfill Nylon	3,6		2
Landfill PVC	2,8	Excluding leaching of metal stabilizer	2
Landfill PVDC	2,2		2
Landfill Paper	4,3	CO_2 and methane emission disregarded	2
Landfill Cardboard	4,2	CO_2 and methane emission disregarded	2
Landfill Glass	1,4	Almost inert material, indicator can also be used for other inert materials	2
Landfill Steel	1,4	Almost inert material on landfill, indicator can be used for ferro metals	2
Landfill Aluminium	1,4	Almost inert material on landfill, indicator is valid for primary and recycled alu.	2
Landfill of 1 m3 volume	140	Landfill of volume per m3, use for voluminous waste, like foam and products	2
Municipal waste		In Europe, 22% of municipal waste is incinerated, 78% is landfilled. Indicator is not valid for voluminous waste and secondary materials	
Municipal waste PE	-1,1		2
Municipal waste PP	-0,13		2
Municipal waste PET	1		2
Municipal waste PS	2	Not valid for foam products	2
Municipal waste Nylon	3,1		2
Municipal waste PVC	10		2
Municipal waste PVDC	16		2
Municipal waste Paper	0,71		2
Municipal waste Cardboard	0,64		2
Municipal waste ECCS steel	-5,9	Valid for primary steel only!	2
Municipal waste Aluminium	-23	Valid for primary aluminium only!	2
Municipal waste Glass	2,2		2
Household waste		Separation by consumers of waste for recycling (average European scenario)	
Paper	-0,13	44% separation by consumers	2
Cardboard	-3,3	44% separation by consumers	2
Glass	-6,9	52% separation by consumers	2

Product or component	Project
Date	Author
Notes and conclusions	

Production (Materials, process & transport).

Material or process	Quantity	Indicator	Result
Total			

Use (Transport, energy & auxiliary materials).

Material or process	Quantity	Indicator	Result
Total			

Disposal (For each type of material).

Material & type of processing	Quantity	Indicator	Result
Total			

TOTAL (all phases)	

Product or component	Project
Date	Author
Notes and conclusions	

Production (Materials, process & transport).

Material or process	Quantity	Indicator	Result
Total			

Use (Transport, energy & auxiliary materials).

Material or process	Quantity	Indicator	Result
Total			

Disposal (For each type of material).

Material & type of processing	Quantity	Indicator	Result
Total			

TOTAL (all phases)	

5.6. Notes on the process data

The last column of the indicator list contains a code,referring to the origin of the process data, like the emissions, extracted resources and land-uses. InChapter 5 of the Manual for Designers we refer to this as the data collected under "Step 1".

Below the data sources are briefly described. In all cases the data has been entered into LCA software (SimaPro) and then evaluated with the Eco-indicator 99 methodology.

1. By far most data have been taken directly from the ESU-ETH database Ökoinventare für Energiesystemen (Environmental data on energysystems), the third edition, produced by ETH inZurich. This very comprehensive database includes capital goods (i.e. concrete for hydroelectric dams and copper for the distribution of electricity) and items like exploration drilling (exploration drilling) for energy systems. Also for transport, capital goods and infrastructure (maintenance and construction of roads, railways and harbours) are included. For material production capital goods are not included. Finally it is important to note that land-use is taken into account in all processes.
2. The Swiss ministry of Environment (BUWAL) has developed a database on packaging materials with the above-mentioned ESU-ETH database as the starting point. However, in this database all capital goods are left out. For the Eco-indicator 99 project we used the data on waste disposal and a few specific packaging materials. For disposal data we made a number of recalculations to include the "positive" effects form reusing material (recycling) or energy (waste incineration). Next to this we used the [OECD 1997] compendium to generate waste scenarios for municipal and household waste for Europe. An important difference with the Eco-indicator 95 is that now we use European in stead of Dutch scenario data. [BUWAL 250-1998]
3. The European Plastics industry (APME) has collected state of the art data for average environmental load for many plastics. As far as possible we used the ESU-ETH version (see 1), as this combines the APME data with much better detailed energy and transport data. The data marked with a 3 are thus the original data, but as they use rather simplified energy and transport data, they can deviate approximately 10 % from the other indicators [APME/PWMI]
4. Processing data has mostly been taken form the Eco-indicator 95 project. In virtually all cases only the primary energy consumption has been taken into account. Material loss and additional materials as lubricants are not included. It should be noted that the energy consumption of a process is very much determined by the type of equipment, the geometry of a product and the scale of operation. Therefore we suggest to take these indicators only as a rough estimate and to calculate more specific data by determining the exact energy consumption in a particular case and to use the indicator for electricity consumption to find a better value. Experience shows that mechanical processing contributes relatively little to the environmental load over the lifecycle.This means the crude nature of the data does not really have to be a big problem. [Kemna 1982]
5. Data on alkyd paint production have been added on the basis of a somewhat older study of AKZO.
6. The KLM environmental annual report was the basis for the data on air transport. This data includes the handling of planes on the ground.[KLM 1999]
7. Data for recycling of plastics are taken from an extensive study of the Centre of Energy Conservation and Clean Technology [CE 1994]

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