Project no.

513673 (SSPI)

Project acronym

EPIC-ICT

Project title

Development of Environmental Performance Indicators for ICT Products on the example of Personal Computers

Instrument: STREP

Thematic Priority: 8.1.B.1.5, task 6

Publishable final activity report

Start date of project: 1 November 2004 Duration: 18 months

1 Project execution

1.1 Project objectives

Within the scope of the European Commission's proposal for a framework directive for setting eco-design requirements for energy-using products (EuP), mechanisms for rapid, efficient and participatory decision-making are required. One mechanism to address decision-makers in product design as well as in politics is the application of "Environmental Performance Indicators".

Against this background, the project consortium of EPIC-ICT ("Development of Environmental Performance Indicators for ICT products on the example of Personal Computer") developed a method to define environmental performance indicators for ICT products. These indicators relate to easy to define technical product properties. Based on Life Cycle Assessment (LCA), relevant environmental indicators are defined to support and enhance eco-design requirements for the respective decision-makers.

The main objective of this project was to develop an applicable method for identifying Environmental Performance Indicators for ICT products on the example of a personal computer (PC) and other information and communication technology (ICT) products based on a "life cycle thinking" approach.

The indicators based on a thorough assessment of environmental impacts caused by a PC over the whole life cycle and relate to measurable and understandable technical and physical units. The EPIC-ICT method considers all life cycle phases and all relevant environmental aspects from the viewpoints of manufacturers and regulators. The project has been carried out with a stakeholder process, taking concerns of industry, the Commission, environmental NGOs and other stakeholders of society into account.

Summarized, the main outcomes of the EPIC-ICT project are:

- Environmental Performance Indicators allow using and working with LCA results for eco-design of complex products, without carrying out a study for every single product
- Applying the EPIC-ICT method identifies eco-design priorities of ICT products on general and specific product level (e.g. life cycle phase or component level)
- The EPIC-ICT method provides a systematic and flexible approach which combines environmental issues and the producers' constraints and translates environmental aspects into specific design options

1.2 Contractors involved

In order to combine scientific soundness, practical applicability and public acceptance, the consortium consists of partners from industry, consultancy and research: LBP (former IKP, University of Stuttgart), Motorola, Philips, Dell, Ambiente Italia and PE Europe.

LBP (former IKP, University of Stuttgart), project manager of the EPIC-ICT project, carried out tasks on the Life Cycle Assessment studies (LCA), was involved in setting up the EPIC-ICT methodology, applied the methodology on the case studies, collected most data and organized the workshops.

Motorola's main tasks were in providing environmental assessment expertise on electronics and in ensuring feasibility and practicability from industry perspective. Motorola carried out an extensive disassembly and material contribution study on the assessed baseline study of a personal computer (carried out in Motorola’s REAL: Rapid environmental assessment lab).

Philips supplied major environmental assessment expertise on electronics, especially on supplied materials to the PC business and ensured applicability of the methodology. Life cycle based data was provided on several components, parts and products. Experience with own ecodesign methods was shared.

Ambiente Italia was mainly responsible for the environmental evaluation and interpretation of the life cycle assessments of the considered products. The interpretation of results included contribution analyses to identify the ecodesign priorities for the products. Additionally, Ambiente contributed to the methodology, with special focus on the environmental aspects to be considered and energy related issues.

Dell provided information on the functions, customer demands, the design and assembly of personal computers and monitors. Dell contributed to the setting up of the EPIC-ICT methodology, from a technical perspective and provided knowledge on product development processes and design. Ensuring the applicability of results from the EPIC-ICT method was of special interest for Dell.

PE Europe ensured feasibility and practicability of the method. Support to the project was given with applying LCA software and data and long-year eco-design experience in the ICT sector. PE Europe contributed with LCA modelling, method definition and dissemination of knowledge.

1.3 Brief description of the methodology and approaches

One main result of the project is the EPIC-ICT method. The second main result is the list of derived Environmental Performance Indicators. figure 1 illustrates the EPIC-ICT method.

The EPIC-ICT method consists of four steps to conduct. Simplified, these four steps can be described as

Step 1: Defining the product under consideration properly

Step 2: Building up a model and analyzing the environmental impacts of the product

Step 3: Evaluate the main environmental drivers in an understandable way

Step 4: Consider which of these environmental drivers can be influenced practically

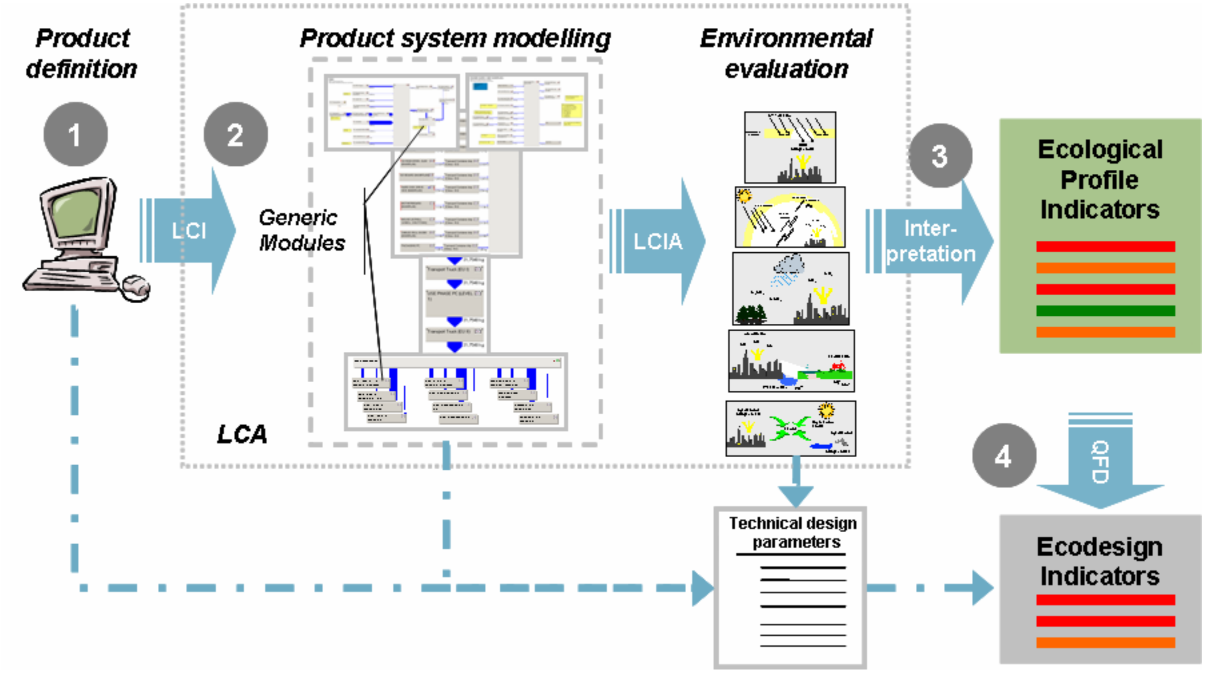

figure 1: Overview on the EPIC-ICT Method

As said before, one main result of the method is the list of "Environmental Performance Indicators" for the personal computer. They consist of two sets of indicators, the "Ecological Profile Indicators" and the "Eco-Design Indicators". The reason to generate two different indicators is the insight that two kinds of results are desirable:

- Indicators that reflect the environmental profile of the product ("Ecological Profile Indicators") and
- Indicators that additionally consider if such an indicator can practically be changed or not ("Eco-Design Indicator")

In the following, the four steps are described shortly. In deliverable 5, they are explained in detail including the example of a personal computer.

Step 1: Product definition phase

- Clearly defines the product under consideration by taking the customer demands and respective required functions into account
- Defines the product from the product designer's perspective and in the designer's "language"
- Results in product definition: Main assemblies of product to fulfil required functions / customer demands

Step 2: Life Cycle Assessment study

- Only one comprehensive full LCA study per product (group) is carried out, which needs to be updated regularly, e.g. every 3 years, depending on product (group) and product development cycles, has to include sensitivity analyses (ensures representativity of study = validity of indicators)
- Main assemblies are broken down into sub-assemblies and components
- Sub-assemblies are modelled with "Generic Modules": Parameterized, flexible, reliable and consistent partial LCA models, which already include design options

- Flexible and adaptable environmental evaluation based on Life Cycle Impact Assessment categories (e.g. Global Warming Potential) and certain Life Cycle Inventory results (e.g. flows of heavy metals)
- Results in “Ecological product profile”: Detailed full scale LCA result, which is needed for an adequate definition of environmental performance indicators of complex products

Step 3: Environmental interpretation

- Identifies stepwise environmentally relevant sub-assemblies and components of the product using contribution analyses
- Results in “Ecological profile indicators”: Reliable, measurable and scientific sound physical product specific environmental performance indicators

Step 4: Eco-design parameters indication

- Combines information from product design (technical specifications and improvement design parameters) and environmental evaluation results from step 3 with adapted QFD approach
- Results in “Eco-design indicators”: Directly usable performance indicators for eco-design of products

This method was derived in an iterative process during the project. For the office PC with CRT monitor as described, the Ecological Profile Indicators and the Ecodesign Indicators according to the EPIC-ICT method were identified (see Deliverable 6) and the five main **Ecodesign Indicators** for an office PC are (here sorted by relevance):

1) **PC Use phase: MIN mode [kW power x hours MIN mode]**
2) **Connectors on mainboard: Gold plating [kg Gold]**
3) **Mainboard: size of the FR4 PWB [m2 FR4]**
4) **Mainboard silver content**
5) **Housing: ABS content [kg]**

1.4 Work performed

The work performed in the EPIC-ICT project was partitioned into six work packages (see figure 2):

- Work package 1: Definition phase
- Work package 2: Technical characterisation
- Work package 3: Environmental evaluation
- Work package 4: Indication phase
- Work package 5: Examination, exploitation and dissemination
- Work package 6: Project management

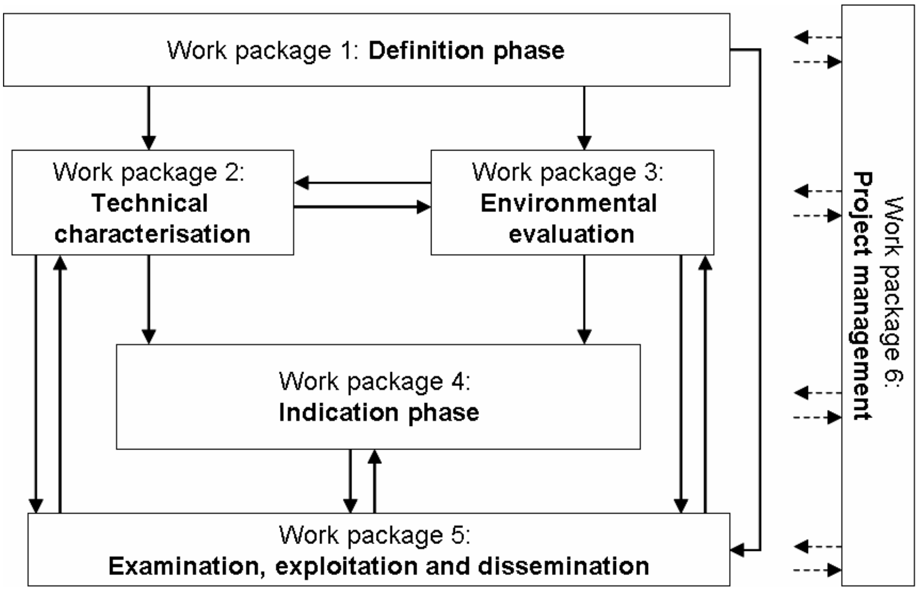

figure 2: Work packages and their interdependencies of the EPIC-ICT project

The procedure was set up achieve the project goals within the given time frame by allowing iteration steps in the final definition of the EPIC-ICT methodology at the same time.

The following paragraphs on the work packages gives back the work that has been carried out to derive the EPIC-ICT method and the indicators for the personal computer.

WP 1: Definition phase

This phase set the boundary conditions and the scope of the project. The product, on which the methodology has been developed, was defined regarding its customer demands and its main technical functions. The main assemblies of the personal computer, its sub-assemblies and components were listed and the availability of data on their environmental performance was examined. Therefore, a pre-study of the LCA of a simplified personal computer was conducted and a literature study performed, in which more than 81 different sources were reviewed.

figure 3: The baseline study product: Dell GX280 personal computer

The pre-study delivered information on two main issues: Data (availability of qualitative and representative data and data gaps) and environmentally relevant product parts and life cycle aspects. The project phase resulted in deliverable 1, an internal report “Definition of functions, customer demands, components and life cycle properties, LCA of a simplified PC”

The primary customer demands on a personal computer were defined as follows:

- Internet Access
- E-Mail

- Office tasks / productivity applications
- Multimedia
- Gaming
- VoIP

The main technical functions of the PC and the main assemblies and technical life cycle aspects were defined and the respective main assemblies and life cycle aspects listed (see table 1).

Main technical functions of a PC:

- Motherboard:
- Central processing unit (CPU)
- Hard Disk Drive (HDD)
- Random access memory (RAM)
- Graphics card
- Sound card
- Drives: CD, DVD or Floppy
- Ports
- Chassis
- Power Supply Unit (PSU)
- Cooling system

Table 1: General technical functions of a PC as defined and main assemblies / technical life cycle aspects of the baseline study "personal computer, office type"

Life cycle phases	Technical functions	Main assemblies / technical life cycle aspects
Production	Motherboard with CPU	On-board system, processor: P4 2.8GHz
	Random access memory	256MB RAM
	Hard Disk Drive	40GB HDD
	Graphic card	On board graphic card
	Sound card	On board sound card
	Cables and ports	Power and data cables including plugs
	Drives: CD, DVD or Floppy	CD-ROM (slim)
	Chassis	Small Mini-tower (SMT)
	Power Supply Unit	PSU
	Monitor	Monitor: 17" CRT monitor
	Mouse / Keyboard	Entry level mouse & keyboard
	Cooling system	Fan (included in mainboard)
Distribution	Transport from manufacturer to consumer	Shipping within Europe (1000 km - Ireland)
Use	Power consumption over life time	Years of use: 4 Max mode: 152 W PC / 85 W monitor Min mode: 80 W PC / 45 W monitor Sleep mode: 1,4 W PC / 2,2 W monitor Off mode: 1 W PC / 1 W monitor
End of Life	 Incineration Landfill Recycling	WEEE Scenario: 16,75 % to incineration 18,25 % to landfill 65 % to recycling

WP 2: Technical characterisation

The second phase of the project based on the results of the first phase and dealt with several tasks:

- Break down the technical functions into product specific technical characteristics (e.g. components)
- Define a method to link the customer demands with the technical characterisation
- Adapt the methodology of QFD to link aspects of the design phase (expressed in the technical characterisation) with the environmental effects (dependencies and change potential)
- Implementation and handling of technology shifts in the EPIC-ICT method

In deliverable 2, the report on "Methodology to translate definitions to technical characteristics, application of QFD to technical characterisation, Implementation/handling of technology shifts" the main elements and their respective outcomes of the EPIC-ICT method were defined (see figure 4).

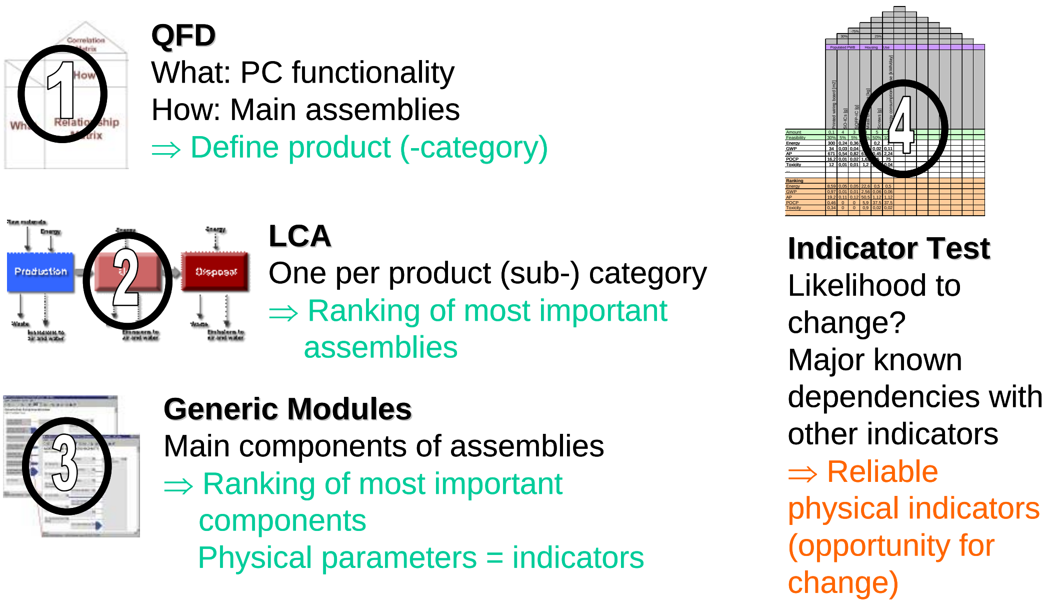

figure 4: Overview of the main elements of the EPIC-ICT method

The proper definition of the product by means of defining the customer demands, the product's functionalities and its main assemblies is the first step. Secondly, carrying out an LCA of the defined product, results in the ranking of the environmentally most important assemblies. Using the LCA modelling approach of "Generic Modules", supports to derive the ranking of the most important physically measurable product parameters on very low product level. Finally, by means of using an adapted QFD method to integrate designers' constraints, reliable physical indicators derive which are directly applicable for ecodesign.

These main elements later lead to the overall EPIC-ICT method, which was finally defined in work package 4.

How to handle and implement technology shifts into the method was first discussed in this project phase and later described in the methodology report (Deliverable 5).

WP 3: Environmental evaluation

Work package 3 mainly dealt with the LCA of the personal computer, its variations and scenarios. Therefore, the personal computer was modelled in detail, including all components and product parts. All partners contributed to build up a consistent life cycle model. The modelling approach of Generic Modules has been used. This allows efficient and flexible modelling and supports the interpretation of results into physical and measurable indicators. Deliverable 5 of the project (report) includes a manual for this approach.

A thorough environmental impact assessment has been carried out (full scale LCA) which served several objectives:

- Definition of the environmental impact categories and inventory results for the environmental indication phase (work package 4)
- Identification of the environmental product profile and identification of the most relevant product parts (main and sub-assemblies) and life cycle aspects (ecodesign priorities)
- Sensitivity analyses and validation of the model

The detailed LCIA carried out within this work package allowed deriving a series of conclusions. First of all, the most relevant environmental product parts on main assembly level are identified. For the baseline study these are:

Manufacturing:

- CRT monitor
- Motherboard
- Housing
- Power supply unit
- Hard disk drive
- Transports of manufactured main assemblies to PC / monitor assembly line (Asia – Europe)

Use phase:

- Power consumption

End of Life:

- Recycling CRT monitor
- Recycling PC

These results were the basis for further and deeper going analysis: The identification of environmental profile indicators. Next step was – according to the EPIC-ICT method – the identification of environmental most relevant sub-assemblies and components. This work was thoroughly done in work package 4: Indication phase.

WP 4: Indication phase

This project phase was very strong connected with the previous phase and had overlaps in defining the most relevant environmental product parts and life cycle aspects. Deliverables resulting from this phase were the EPIC-ICT Methodology report (Deliverable 5[1]) and the Technical report on case studies and samples (Deliverable 6[2]).

This project phase mainly contained the application and the fine-tuning of the definition of the EPIC-ICT method. The indication phase covered to identify the list of Ecological Profile Indicators for the PC and the list of Ecodesign Indicators.

The work has been carried out for several variations of the product itself and for another ICT product, a mobile phone. The variations were:

- Different housing design
- Gamer PC
- Laptop
- TFT monitor

All indicators (Ecological Profile Indicators and Ecodesign Indicators) are listed in Deliverable 6.

Summarising the case studies it can be seen, that the application of the EPIC-ICT method leads to reasonable results and provides reliable Ecological Profile Indicators and Ecodesign Indicators at complex electronic products such as ICT products.

Very important is the base for the Ecodesign Indicators, which are the Ecological profile indicators. These do base on objective and representative LCA modelling and therefore reflect an objective result. Due to the high complexity of the selected ICT products the reduction of the Ecological Profile Indicators to a reasonable amount from hundreds down to some important ones (at least 5 main contributing modules) is the most important result. The application of the method shows, that it is possible to reduce the efforts in environmental assessment of very complex products without loosing important aspects.

This simplification of LCA or ecodesign is not done by applying a cut off criteria on base of e.g. mass, which can lead to wrong results. In principle it is done by environmental relevance. This is very much important, specifically at ICT products, of which environmental effects from manufacture of components relate to impacts from processes and not only from material provision, such as at IC manufacture or FR4 print and etch processes.

The Ecological Profile Indicators for a PC with a CRT monitor are listed in table 2 and 3. As for the usage of TFT monitors, the lists differs for the manufacturing, as can seen in table 4.

For the PC, without monitor, the following Ecodesign Indicators were identified:

1) **PC Use phase: MIN mode [kW power x hours MIN mode]**
2) **Connectors on mainboard: Gold plating [kg Gold]**
3) **Mainboard: size of the FR4 PWB [m2 FR4]**
4) **Mainboard silver content**
5) **Housing: ABS content [kg]**

[1] Deliverable public available at http://www.epic-ict.org
[2] Deliverable public available at http://www.epic-ict.org

Table 3: Ecological Profile Indicators for the manufacturing phase of the office PC with CRT monitor

Office PC			
A	B	C	D
CRT MONITOR 17"	CRT MANUFACTURING*	Power grid mix	kWh electricity
		TUBE_CRT*	kg glass
	ENCASING CRT*	Power grid mix	kWh electricity
		Acrylonitrile-butadiene-styrene gran. (ABS)*	kg ABS
		Polycarbonate granulate (PC) mix*	kg PC
	PWB CRT MONITOR*	CHASSIS	various
	WIRING CRT	Connector	kg Connector
MOTHERBOARD (MAINPLAN)	PWB MAINBOARD	PWB FR4 (6l; 2s; AuNi Finishing)	m2 PWB
		AMD Athlon uOPGA Barton CPU 4,4g*	mainly: kWh electricity
		(Magnet)*	
		Capacitor Al capacitor	
		Oscillator SMD	
		LiMn cell*	
	Silver mix*		kg Silver
	CONNECTOR*	Gold	kg gold
		Polybutylene terephthalate granulate (PBT)	kg PBT
		Shielding (EMS)	kg Shielding sheet
		Copper (99.999%; electrolyte copper) mix	kg copper
		(Power grid mix)*	
		(Phosphor bronze (CuSn5Zn5))*	
	MEMORY 256 MB DDR*	PWB FR4 (6l; 2s; AuNi Finishing)	m2 PWB
		4x64M DDR ICs with 60 FBGA packaging*	mainly: kWh electricity
		(Capacitor SMD ceramic)*	
		(Gold)*	
	PROCESSOR INTEL P4 2800 L	Power grid mix	kWh electricity
		Copper (99.999%; electrolyte copper) mix	kg copper
		Gold	kg Gold
		(Silicon mix)*	
		(Zinc)*	
	(CHIPSET HEATSINKS)		
	(PROCESSOR COOLING)		
CRT Monitor Transport	Crude oil mix		l fuel consumption
	Container ship/approx. 27500 dwt /high sea		various emissions
HARD DISK DRIVE HDD*	ARRAY SUBASSEMBLY	DATADISK	mainly: kWh electricity and kg F
		ARRAY MOTOR SUBASSEMBLY*	mainly: kg Al
		(Aluminum mix)*	kg Al
	MAIN PWB SUBASSEMBLY*	HDD MAIN PWB COMPONENTS MIXER	mainly: m2 PWB
		2,54mm Pitch connector, IDE 40pin male	kg Connector
	CASING SUBASSEMBLY*	Aluminum (C-AlSi7Mg)	kg Al
		Shielding (EMS)	kg Shielding sheet
HOUSING PC (MAINPLAN)*	PLASTIC PART (HOUSING)	Power grid mix	kWh electricity
		Polycarbonate granulate (PC) mix*	kg PC
		Acrylonitrile-butadiene-styrene gran. (ABS) mi	kg ABS
		(Glass fibers)*	
	STEEL FRAME (HOUSING)*	Steel cold rolled	kg Steel
		(Power grid mix)*	
	PWB 2 (HOUSING)*	PWB FR4 (2l; 2s)	m2 PWB
		(IC SO/SIL (average))*	
		(Coil SMD chip coil)*	
		(Capacitor Al capacitor)*	
	(PWB 1 (HOUSING))*		

Table 2: Ecological Profile Indicators for the use phase of the office PC with CRT monitor

A	B	C	D
Electricity consumption PC	Min mode	n.a.	kW power demand Hours of use
	Max mode	n.a.	
	Sleep mode	n.a.	
	Off mode	n.a.	
Electricity consumption monitor	Min mode	n.a.	kW power demand Hours of use
	Max mode	n.a.	
	Sleep mode	n.a.	
	Off mode	n.a.	

Table 4: Ecological Profile Indicators for the manufacturing phase of the office PC with TFT monitor

Office PC with TFT			
A	B	C	D
MONITOR TFT 15" - Flat Panel	LCD PANEL	Power grid mix	kWh electricity
		Monoethyl amine (MEA)	kg MEA usage
	Use phase MIN Mode	Power grid mix	kWh electricity
	Back light (Monitor)	PMMA part	kWh electricity for inj. moulding
			kg PMMA
		Polyester part*	
		(Steel part)	
	Stand (Monitor)*	ABS part	kWh electricity for inj. moulding
			kg ABS
		Steel part*	kg steel
			(kWh power)*
	(Other parts (Monitor))*		
	(Power supply (Monitor))*		
	(Rear Cover (Monitor))*		
MOTHERBOARD (MAINPLAN)	PWB MAINBOARD	PWB FR4 (6l; 2s; AuNi Finishing)	m2 PWB
		AMD Athlon uOPGA Barton CPU 4,4g*	mainly: kWh electricity
		(Magnet)*	
		Capacitor Al capacitor	
		Oscillator SMD	
		LiMn cell*	
	Silver mix*		kg Silver
	CONNECTOR*	Gold	kg gold
		Polybutylene terephthalate granulate (PBT)	kg PBT
		Shielding (EMS)	kg Shielding sheet
		Copper (99.999%; electrolyte copper) mix	kg copper
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		(Phosphor bronze (CuSn5Zn5))*	
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		(Glass fibers)*	
	STEEL FRAME (HOUSING)*	Steel cold rolled	kg Steel
		(Power grid mix)*	
	PWB 2 (HOUSING)*	PWB FR4 (2l; 2s)	m2 PWB
		(IC SO/SIL (average))*	
		(Coil SMD chip coil)*	
		(Capacitor Al capacitor)*	
	(PWB 1 (HOUSING))*		

WP 5: Examination, exploitation and dissemination

The EPIC-ICT project disseminated its preliminary results, its developed methodology and its final results during the entire project run. This was carried out through

- a project website with download sections
- newsletters sent to a broad audience of interested stakeholders
- two workshops with interested stakeholder
- meetings with the project's Advisory Board
- various publications, presentations and posters on conferences and workshops

- participation at meetings of related projects, standardization or other activities (e.g. ORGALIME, EICTA, ECMA, and BITKOM meetings)
- meetings and conference calls with interested industry representatives
- internal workshops within the industry partners' organisations
- dissemination and announcement over external newsletters (AeA Europe)
- meeting with policy developers at the Commission
- dissemination of a methodology flyer

Presentations, method description, newsletters and workshop reports can be downloaded from the project website (www.epic-ict.org).

During the project's run, the results were used to pronounce the possibilities of application of LCA in the ICT sector. Standardization organization showed big interest in suggesting an eco-design standard, taking EPIC-ICT into account. Some external industry representatives contacted the coordinators in order to launch follow-up projects to apply the method for other products.

Besides that, an important task in this work package was to examine the required efforts and data demands of using and applying the EPIC-ICT method and its results. Outcome of this examination is documented in the Deliverable 4 report, which is available on the website.

To ensure the applicability for other ICT products, the method has been applied to a mobile phone, a laptop and a TFT monitor as well. For the mobile phone, a list of Ecological Profile Indicators and Ecodesign Indicators has been identified (see Deliverable 6). The EPIC-ICT Ecodesign Indicators for a mobile phone as defined in Deliverable 6 (*Motorola C363*) are

1) **Use phase: Electric power consumption for charging [kWh]**
2) **Main PWB: FR4 substrate [m2]**
3) **Recycling: PWB, gold content [kg]**
4) **Energy consumption PWB assembly line [kWh]**
5) **Mass of battery [kg]**

As an end result of the project, a **report on the EPIC-ICT methodology** was completed. This report can be downloaded from the project website (Deliverable 5). It contains a detailed methodology description on the example of a personal computer.

Additionally, a study on the application of the MEEuP Methodology study (Methodology study for Ecodesign of Energy-using Products) on the example of a personal computer and comparison with results derived from the EPIC-ICT project was performed. This study is addressing the differences between two different methods used within the scope of assessing environmental performance of energy-using products: MEEUP and EPIC-ICT (Development of Environmental Performance Indicators for ICT Products on the Example of Personal Computer).

WP 6: Project management

The project was coordinated by LBP (former IKP), University of Stuttgart (Anna Braune and Niels Warburg). A Steering group was established, consisting of all participating partners: Dell, Motorola, Philips, PE Europe and Ambiente Italia. Several project meetings and at least monthly conference calls were held. Several meetings were arranged with the Commission and the Advisory Board (project management structure see figure 5).

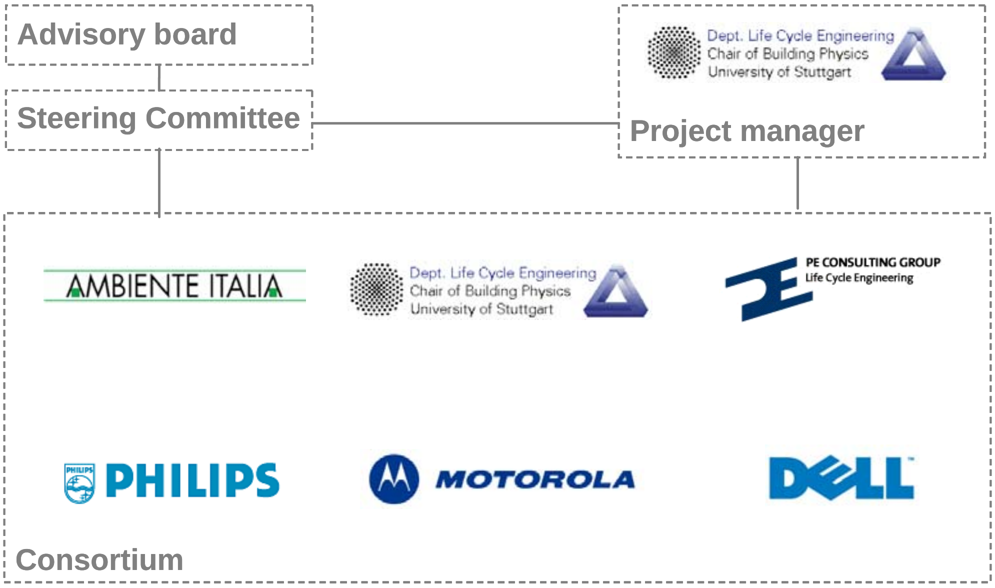

figure 5: Project management and structure

All partners contributed to the project with high motivation. The interdisciplinary partners and the representation of industry, research and consultancy in the project team added great value to achieve the objectives. This allowed developing an approach that combines scientific robustness of the assessment basis and applicability of the method in industry, general system thinking, environmental analyses and ecodesign know-how with expert knowledge in the ICT field and energy-efficiency.

All reports (deliverables), presentations and publications were all agreed amongst the partners. Publishable reports can be downloaded at the website or requested from the project coordinator.

The milestones (see table 5) were all achieved in full degree. The end results were reached as planned, providing a methodology to define Environmental Performance Indicators for ICT products and a list of these indicators for the example of a personal computer.

Table 5: Milestones of the EPIC-ICT project

Milestone No	**Milestone**	**Date (month #)**
M1	LCA of simplified PC conducted, main technical function, customer demands, components and life cycle properties defined	5
M2	Mid-Term Assessment positive, characterisation phase carried out successfully	9
M3	Environmental evaluation with Generic Modules delivers appropriate results	12
M4	Indicators ready-to-use, project goals reached	17

1.5 Achievements of the project to the state of the art and expected impacts

Currently Life Cycle Assessment (LCA) studies with a varying level of detail are used to assess and demonstrate the environmental performance of electronic products. Detailed LCA are, especially in the ICT sector, sometimes still time and cost intensive. Gathering all data to assess all life cycle impacts of single components and parts completely is very difficult, which only expert can cope with. This often results at many companies in considering only single life cycle phases or single impacts. Short innovation cycles and rapid change of products and components often result in acquiring very detailed data on special issues, without the knowledge of their environmental relevance.

Expertise on LCA, on Environmental Performance Indicators, on the technical specifications and the design of ICT products like PCs has been typically broadly distributed among academia, consultants, industry environmental experts and designers. Within the EPIC-ICT project however, experts in LCA, on environmental aspects of electronics and on PC design and manufacturing brought in their expertise. Therefore this is the first time experts from all these fields provided the relevant know-how on materials, processes, components and environmental aspects to ensure the right and relevant choice of representative indicators.

The life cycle model of a PC that has been established during the project run can be considered as one of the most detailed model with the most consistent and up to date data base ever made. This is due to the highly motivated contributions of all partners, be it providing data on the product, components and sub-assemblies or verifying the model and the environmental assessment by comparisons and extensive checks.

Although the concept of using Environmental Performance Indicators for ecodesign purposes, no structured framework and detailed methodology description was available. This project filled this gap and demonstrated the applicability of such indicators.

1.6 Expected impacts of the project on its industry and research sector

Reducing the environmental impacts of products throughout their life cycle is the key mission of the Community’s development of an Integrated Product Policy (IPP). The proposed directives on the management of waste from electrical and electronic equipment (WEEE) and for the restriction of the use of certain hazardous substances during its manufacturing (RoHS) are first steps toward this goal for EEE. At this point in time, the proposed draft framework Directive on the ecodesign of energy using products (EuP) is expected to be the key driver in achieving the goal of reducing environmental impacts of products throughout their life cycle.

The EPIC-ICT method and the identified indicators were developed under consideration of:

- take into account all relevant life cycle phases and environmental impacts
- contribute to reduction of environmental impacts as foreseen in IPP and with this promote the sustainability of these products
- establish a practical basis for the implementation of the EuP directive
- consider the viewpoints of manufacturers and regulators

The project has been carried out on the example of personal computers. This product group is a widely disseminated consumer product with a considerable growth potential. The project’s results will also be adaptable to and representative for other products in the Information and Communication Technology (ICT) sector.

During the project run, the method has been proven to be applicable for variations of the personal computer, for a laptop, for a TFT monitor and for another ICT product: a mobile phone. It has been proven that ecodesign can be based on LCA results without carrying out LCAs for each product.

The underlying method and the environmental profile reflect the complexity of ICT products. Complex products need an adequate assessment method which requires an appropriate information basis. But still, a modus for providing representative information in a verifiable and efficient way needs to be found and agreed upon on a broad basis. Quality assurance systems like used for EPDs might be an option. Working with the EPIC-ICT method in consortia or carrying out studies centrally reduces the effort for the single producers. The issue of providing data and who is carrying out the studies needs further discussion and agreements amongst industry and policy.

In industry, the “Ecodesign Indicators” can directly be applied to set specific and measurable design objectives on very detailed product level to improve the environmental performance (e.g. reduction of the min-mode power consumption of a personal computer). Results on higher product level (e.g. on main assembly or product life cycle phase level derived from “Ecological Profile Indicators”) serve to set environmental objectives (e.g. reduce environmental impacts of the monitor production). The identification of the indicators should be carried out with joint forces to reduce the effort for single producers. When setting the boundary conditions of the study right, the indicators can also be identified for product groups / families.

For policy makers, the EPIC-ICT method can be applied as a tool for setting generic eco-design requirements for products. In this case, no strict limit values for particular environmental aspects are set. Such requirements could be e.g. “improve the overall environmental profile in the next product development cycle by applying the list of “Ecological Profile Indicators” or “Eco-design Indicators” provided by the EC”. This insures flexibility for the producers to decide how exactly to enhance their products’ environmental performance.

Summarized, the main outcomes of the EPIC-ICT project are:

- Environmental Performance Indicators allow using and working with LCA results for eco-design of complex products, without carrying out a study for every single product
- Applying the EPIC-ICT method identifies eco-design priorities of ICT products on general and specific product level (e.g. life cycle phase or component level)
- The EPIC-ICT method provides a systematic and flexible approach which combines environmental issues and the producers’ constraints and translates environmental aspects into specific design options

1.7 Contact and further information on the project

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2 Dissemination and use

The main results of EPIC-ICT are publicly available in the public version of Deliverable 3 as well as the full versions of Deliverables 4, 5 and 6. All these reports can be downloaded at http://www.epic-ict.org

The two main results of EPIC-ICT are:

1. The EPIC-ICT method

The method is developed to define environmental performance indicators for ICT products. These indicators will relate to easy to define technical product properties. Based on Life Cycle Assessment (LCA), relevant environmental indicators are defined to support and enhance eco-design requirements for the respective decision-makers.

This method combines

- Life Cycle Assessment (LCA), a scientifically established approach to analyse environmental impacts quantitatively throughout all life cycle phases of products
- Quality Function Deployment (QFD), a method that translates customer interests of product features into technical specifications
- Generic Modules, parameterized flexible and reliable partial LCA models of electronic parts and sub-assemblies with a minimum effort.

Generally, all partners contribute to the development of the method. The partners involved in the setting up the method are Motorola, LBP, PE Europe and Dell.
It can be used by policy decision makers for setting implementing measures and internally for product improvement (DfE).

The resulting method has been described detailed in the public available Deliverables 5 (e.g. downloadable from http://www.epic-ict.org)

2. The environmental indicators for PCs

The developed methodology (see above) was applied at the example of PCs. In order to assure adequate stakeholder involvement workshops, meetings, conference calls and presentations have been conducted.
Besides all project partners, other interested groups were asked and delivered very valuable input: AMD, Intel, Fujitsu-Siemens, EICTA, BitKomm etc.

The indicators can be used by policy decision makers for setting implementing measures, internally for product improvement (DfE) of PCs.

The resulting indicators have been described detailed in the public available Deliverable 6 (e.g. downloadable from http://www.epic-ict.org)