



EuP preparatory study, TREN/D1/40-2005, Lot 3, Task 1

Intermediate step report 1 for EuP study, Lot 3, Task 1

Contractor

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Introduction

This report refers to directive 2005/32/EC of the European parliament and of the council of 6 July 2005 with the main objective to establish a framework for the setting of eco-design requirements for energy-using products.

To get a better knowledge about energy using products, and their environmental performance, and to prepare the coming implementing measures, there was a call for tender from the commission for preparatory studies in September 2005. These studies cover different product groups. The objective of the studies is to find out whether and which eco-design requirements could improve the environmental performance throughout the life cycle of the products relevant to that study.

This is the first draft report within the EuP preparatory study, Lot 3, Personal Computers (desktops and laptops) and Computer Monitors. The objective of this part of the study and the report is to describe the definitions and the background of the assessment that will be carried out in subsequent parts of the study. The methodology developed by VHK for the European Commission (MEEUP 2005) is followed. A large corpus of information has been collected. The most important parts of it are described in this report. Since the project is ongoing, and some important background information may change, this part of the study may also be subject to changes. Please feel free to comment on this report to e-mail address: ecocomputer@ivf.se

For more information about the study, please refer to www.ecocomputer.org

Summary

In task 1 of this study the products within the study have been defined by looking at how personal computers and monitors are defined and categorized in trade statistics, relevant standards and voluntary initiatives. Also the existing legislation and its impact on the product categories have been studied.

Based on this information collection, a questionnaire was developed in cooperation with stakeholders in the study. Industry and other stakeholders answered this questionnaire at the end of august 2006. Some important information regarding product definition, market figures, etc. was gathered from that survey.

One of the most important initiatives regarding personal computers, monitors and energy consumption is Energy Star. The product definition used in this study takes its starting point in the name of Lot 3, *Personal Computers (desktops and laptops) and Computer Monitors* and uses the Energy Star definitions of computers and monitors. Within the scope of this study are desktops, integrated computers, laptops and computer monitors. Note that workstations, desktop-



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derived, mid-range and large servers, game consoles, thin clients/blade PCs, handhelds and PDAs are out of the scope of this study.

When using Life Cycle Assessment, LCA, to stimulate the development of environmentally superior products, the calculations should ideally yield environmental impact per some important unit of performance called the functional unit. This would drive development towards products with the same (or better) performance with less environmental impact. However, since personal computers are used to fulfil so many different needs, it seems impossible to find one technical performance measure that could represent all these needs in a good way.

In this study, all calculations for computers (desktops and laptops) will initially be performed on the functional unit 1 computer (desktops and laptops). The possible use “Euros of computer” or “computer years” as a secondary functional unit will be further investigated and discussed.

For computer monitors, the functional unit used in this study will be Environmental impact per Mpixel, and the secondary performance parameter will be related to screen area, (cm²)

Regarding test standards, the ones used by most of the labelling schemes and initiatives for computers and monitors will be used. Energy consumption will be assessed in off, sleep and on (idle) modes according to the coming *ENERGY STAR Computer Test Method (Version 4.0)*, effective July 19, 2007 for computers and the *ENERGY STAR Program Requirements for Computer Monitors Eligibility Criteria (Version 4.1)* for monitors. ISO 7779 will be followed for noise.

The most important legislation regarding personal computers and monitors is the European WEEE and RoHs directives. These and similar regulations are being applied in countries outside the European Union as well. The small differences in that respect are not relevant for this study.



Product definition

To delimit the “playing field” of eco-design there is a need to define what is included in *personal computers and computer monitors*. The product definition that will be used in this study and is described in this section takes its starting point in the name of Lot 3, “*Personal Computers (desktops and laptops) and Computer Monitors*”.

Historic perspective

Personal computers and computer monitors are quite new products in society. They first started to come out on the market in the eighties. Since the introduction of personal computers, there has been a tremendous development of the products. Moores law, which is a prediction made by Gordon E. Moore in the sixties that the processor speed will double every 18th month, still holds true.

One reason for the rapid development of the personal computer is that a PC has always been made with standard components developed mainly by sub-suppliers and sold by retailers. This has created a very dynamic sector because there are business opportunities for many different actors.

The fast development of the product group could, from an Eco-design perspective be both a threat and an opportunity. The threat is that so much development is done in a short time, and people are so eager to find new fancy solutions, that the consequences of the development might not be enough scrutinized. The great opportunity is that the products are not yet fixed by too much tradition, thus giving product design a major playing field in functionality and implementations. Already today, personal computers are combined with mobile phones, home media centres and other kind of products. Monitors can also be a TV-set or perhaps in the future the new wall painting?

There is no universally accepted definition of the term personal computer. Most people seem to agree that a personal computer is relatively cheap, multi-purpose, based on microprocessors, designed as a single-user system and usually very flexible regarding which operating system, hardware and application platform it can be fitted with.

Market data definitions

Eurostat

The basic information available in Eurostat gives rough numbers for production, import and export, which then makes it possible to calculate the net numbers of new equipment brought into use by taking $\text{new} = \text{production} + \text{import} - \text{export}$. To



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calculate the installed base, the average life-time in use must be estimated (the manufacturers have been asked for estimates).

In Eurostat, there are two registers (data-sets), which basically contain similar data, PRODCOM and COMEXT. PRODCOM is the most important for this study, since COMEXT has no data on production. The data in PRODCOM is organised according to product codes. Some of the codes have changed over time, which makes it necessary to use the data as the union (sum) of data on several codes.

In the Eurostat (Prodcom/comext) statistics, computers and monitors are classified as follows:

1. 30021200 Laptop PCs and palm-top organisers
2. 30021300 Desktop PCs (including integrated computers)
3. 30021400 Digital data processing machines: presented in the form of systems
4. 32302083 Black and white or other monochrome video monitors
5. 32302045 Colour video monitors with cathode-ray tube (CRT)
6. 32302049 Flat panel video monitor, LCD or plasma, etc., without tuner (colour video monitors) (excl. with cathode-ray tube)

Market data and base cases

The VHK-methodology states that the product categories to be assessed in base cases must be possible to identify in the market figures. This complicates the study, since the VHK-methodology also point out Eurostat as the source for market information, and Eurostat has very poor categorisation and market information for this kind of products.

The main weaknesses of the data in PRODCOM are:

1. Data for the different countries are only available from their entry into EU
2. For countries with few manufacturers, the production figures are hidden due to rules within Eurostat (competitive secrecy). This means that some countries show negative values for new equipment. An application to get hold of the hidden data was sent to Eurostat, through their Swedish representative (SCB), but it was denied.

Since there are weaknesses in the EUROSTAT information, industry has been asked to provide the project with complementary data and data sources. These sources and data will be evaluated and reported in subsequent tasks.



Energy star definitions

Energy Star is one of the most important voluntary initiatives regarding products covered by this study. It is widely used both in the USA and the EU, it is agreed upon within a wide group of stakeholders, and the definitions are well developed. More information about the Energy Star initiative will follow in the chapter called “Voluntary agreements” in this report. The definitions used by Energy Star are:

Computers

The Energy Star Program Requirements for Computers, draft 3, version 4,0

A device which performs logical operations and processes data. Computers are composed of, at a minimum: (1) a central processing unit (CPU) to perform operations; (2) user input devices such as a keyboard, mouse, digitizer or game controller; and (3) a display screen to output information. For the purposes of this specification, computers include both stationary and portable units, including desktop computers, gaming consoles, integrated computers, notebook computers, tablet PCs, desktop-derived servers and workstations.

The computers in the Energy Star program are divided into the following type definitions:

1. ***Desktop Computer***

A computer where the main unit is intended to be located in a permanent location, often on a desk or on the floor. Desktops are not designed for portability and utilize an external monitor, keyboard and mouse. Desktops are designed for a broad range of home and office applications including, email, web browsing, word processing, standard graphics applications, gaming, etc.

2. ***Desktop-derived server***

A desktop-derived server is a computer that typically uses desktop components in a tower form factor, but is designed explicitly to be a host for other computers or applications. For the purposes of this specification, a computer must be marketed as a server.

3. ***Game consoles***

Stand alone computers whose primary use is to play video games. For the purposes of this specification, game consoles must use a hardware architecture based on typical computer components (e.g. processors, system memory, video architecture, optical and/or hard drives etc.) The primary input from game consoles are special hand held controllers rather than the mouse and keyboard used by conventional computer types. Game consoles are also equipped with audiovisual outputs for use with televisions as the primary display, rather than an external monitor or integrated display. These devices do not typically use a conventional



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operating system, but often perform a variety of multimedia functions such as DVD/CD playback, digital picture viewing, and digital music playback.

4. *Integrated Computer*

A desktop system in which the computer and display function as a single unit, which receives its ac power through a single cable. Integrated computers come in one of two possible forms: (1) a system where the display and computer are physically combined into a single unit; or (2) a system packaged as a single system where the display is separate but is connected to the main chassis by a dc power cord and both the computer and display are powered from a single power supply. As a subset of desktop computers, integrated computers are typically designed to provide similar functionality as desktop systems.

5. *Notebook and Tablet computers*

A computer designed specifically for portability and to be operated for extended periods of time without a direct connection to an ac power source. Notebooks and tablets must utilize an integrated monitor and be capable of operation off an integrated battery or other portable power source. In addition, most notebooks and tablets use an external power supply and have an integrated keyboard and pointing device, though tablets use touch sensitive screens. Notebook and tablet computers are typically designed to provide similar functionality to desktops except within a portable device. For the purposes of this specification, docking stations are considered accessories and therefore, the performance levels associated with notebooks do not include them.

6. *Workstations*

For the purposes of this specification, to qualify as a workstation, a computer must:

- a. Be marketed as a workstation
- b. Have a mean time between failures (MTBF) or at least 15,000 hours based on Bellcore TR-NWT-000332, issue 6, 12/97; and
- c. Support error-correcting code (ECC) and/or buffered memory
- d. In addition, a workstation must meet three of the following six optional characteristics:
 - i. Have supplemental power support for high end graphics (i.e. PCI-E 6 pin 12 V supplemental power feed)
 - ii. System is wired for 4x or 8x PCI-E on motherboard in addition to graphics slot(s) and/or PCI-X support
 - iii. Does not support Uniform Memory Access (UMA) graphics:



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- iv. Include 5 or more PCI, PCIe, PCI-X slots;
- v. Capable of multi-processor support for two or more processors (must support physically separate processor packages/sockets, i.e, not met with support for a single multi core processor)

and/or

- vi. Be qualified by at least 2 Independent Software Vendor (ISV) product certifications; these certifications can be in process, but must be completed within 3 months of qualification.

Product groups not covered by Energy Star include mid-range and large servers, thin clients/blade PCs, handhelds and palm-top organisers.

Definitions of different categories of desktops

For the purposes of determining Idle state levels, desktops and integrated computers must qualify under Categories A, B or C as defined below.

Category A: All desktop computers that do not meet the definition of either Category B or category C below are under Category A for Energy Star qualification

Category B: To qualify under category B desktops must have:

- Multi-core processor(s) or greater than 1 discrete processor; and
- Minimum of 1 gigabyte of system memory

Category C: To qualify under Category C desktops must have:

- Multi-core processor(s) or greater than 1 discrete processor; and
- A GPU with greater than 128 megabytes of dedicated, non-shared memory.

In addition to the requirements above, models qualifying under Category C must be configured with a minimum of two of the following three characteristics:

- Minimum of 2 gigabytes of system memory
- TV tunder and/or video capture capability with hight definition support; and/or
- Minimum of 2 hard disk drives



Computer monitors

Definition of computer monitors from the *Energy Star Requirements for Computer Monitors Eligibility Criteria (version 4.1)*

Computer Monitor (also referred to as "Monitor")

A commercially-available, electronic product with a display screen and its associated electronics encased in a single housing that is capable of display output information from a computer via one or more inputs, such as VGA, DVI, and/or IEEE 1394. The monitor usually relies upon a cathode-ray tube (CRT), liquid crystal display (LCD) or other display device. This definition is intended primarily to cover standard monitors designed for use with computers. To qualify, the computer monitor must have a viewable diagonal screen size greater than 12 inches and must be capable of being powered by a separate AC wall outlet or a battery unit that is sold with an AC adapter. Computer monitors with a tuner/receiver may qualify as ENERGY STAR under this specification as long as they are marketed and sold to consumers as computer monitors (i.e., focusing on computer monitor as the primary function) or as dual function computer monitors and televisions. However, products with a tuner/receiver and computer capability that are marketed and sold as televisions are not included in this specification.

Operational Modes

Computer modes

The Energy Star Program Requirements for computers, draft 3 defines three computer operational modes: idle, sleep and stand-by. These are described below.

Idle State

For purposes of testing and qualifying computers under this specification, this is the state in which the operating system and other software have completed loading, the machine is not asleep, and activity is limited to those basic applications that the system starts by default.

Sleep mode

A low power state that the computer is capable of entering automatically after a period of inactivity or by manual selection. A computer with sleep capability can quickly "wake" in response to network connections or user interface devices. For the purposes of this specification, Sleep mode correlates to ACPI System Level S3 (suspend to RAM) state, where applicable.



Standby level (Off Mode)

The power consumption level in the lowest power mode which cannot be switched off (influenced) by the user and that may persist for an indefinite time when the appliance is connected to the main electricity supply and used in accordance with the manufacturer's instructions. For purposes of this specification, standby correlates to ACPI System Level S4 or S5 states, where applicable.

Computer monitor modes

The Energy star Program requirements for Computer Monitors, Eligibility Criteria (version 4.1) defines the five operational modes for monitors described below.

On Mode/Active Power

The product is connected to a power source and produces an image. The power requirements in this mode is typically greater than the power requirement in sleep and off modes

Sleep Mode/Low Power

The reduced power state that the computer monitor enters after receiving instructions from a computer or via other function. A blank screen and reduction in power consumption characterize this mode. The computer monitor returns to On Mode with full operational capability upon sensing a request from a user/computer (e.g., user moves the mouse or presses a key on the keyboard)

Off Mode/Standby Power

The lowest power consumption mode which cannot be switched off (influenced) by the user and that may persist for an indefinite time when a computer monitor is connected to the main electricity supply and used in accordance with the manufacturer's instructions. For purposes of this specification, Off Mode is defined as the power state when the product is connected to a power source, produces no images, and is waiting to be switched to On Mode by a direct signal from a user/computer (e.g., user pushes power switch)

Hard Off Mode

A condition where the product is still plugged into the mains, but has been disconnected from an external power source. This mode is usually engaged by the consumer via a "hard off switch". While in this mode, a product will not draw any electricity and will usually measure 0 watts when metered.



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Disconnect

The product has been unplugged from the mains and therefore is disconnected from all external power sources.

Energy Star definitions and this study

The scope of energy star is slightly different from the scope of this study. Energy star covers “all” computers and monitors, and the Eup preparatory study is limited to “personal computers” and monitors. The definitions used by Energy Star are nevertheless very useful for this study. They are agreed upon within approximately the same stakeholder group as this study, and they do aim at a larger group of products within which the products of this study are a part, and the same kind of impact (energy and/or environment). At the stakeholder workshop for the Lot 3 study in May 2006, the Energy Star was also agreed upon as one of the most important voluntary agreements for this study.

Some of the products within the Energy Star definitions are out of the scope of this preparatory study, such as Desktop derived server, Game consoles and Work stations.

Regarding the Desktop differentiation categorisations A, B and C, they might be of interest when deciding the base cases, but there are some difficulties with their potential use. The VHK methodology requires market data and usage pattern divided to the different products, which so far was impossible to find related to the categorisations A, B and C. The base definition of base case will be done in task 5 of this study.

The operational modes defined in Energy Star will be used for the definition of operational modes when looking into the consumer behavior (task3) and test procedures, since they are applicable to our study, and are agreed upon by the stakeholders.

Proposed product definitions

For the purpose of this study, the following product definition is suggested for *personal computers*:

A device which performs logical operations and processes data. Personal computers are composed of, at a minimum: (1) a central processing unit (CPU) to perform operations; (2) user input devices such as a keyboard, mouse, digitizer or game controller; and (3) a display screen to output information. For the purposes of this study, personal computers include both stationary and portable units, including desktop computers, integrated computers, notebook computers and tablet PCs. For further definitions of these computer categories, the Energy Star definitions are applicable.



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Note that workstations, desktop-derived, mid-range and large servers, game consoles, thin clients/blade PCs, handhelds and PDAs are not included in this product definition of personal computers, and will therefore not be covered by this study.

For the purpose of this study, the following product definition is suggested for *computer monitors*:

A commercially-available, electronic product with a display screen and its associated electronics encased in a single housing that is capable of display output information from a computer via one or more inputs, such as VGA, DVI, and/or IEEE 1394. The monitor usually relies upon a cathode-ray tube (CRT), liquid crystal display (LCD) or other display device. This definition is intended primarily to cover standard monitors designed for use with computers. To qualify, the computer monitor must have a viewable diagonal screen size greater than 12 inches and must be capable of being powered by a separate AC wall outlet or a battery unit that is sold with an AC adapter. Computer monitors with a tuner/receiver may be covered by this study as long as they are marketed and sold to consumers as computer monitors (i.e., focusing on computer monitor as the primary function) or as dual function computer monitors and televisions. However, products with a tuner/receiver and computer capability that are marketed and sold as televisions are not included in the scope of this study.

Product group performance and functional Unit

There are several benchmarking methods for computers, often used by computer magazines, where they test the performance in different type of applications, often specifically games. Unfortunately they do not really work to find out the performance of a product in a broader view, since the use of computers is so differentiated!

When using life cycle assessment, LCA, to stimulate the development of environmentally superior products, the calculations should ideally yield environmental impact per some important unit of performance. This would drive development towards products with the same (or better) performance with less environmental impact during the whole life cycle of the product.

Functional unit for personal computers

Since personal computers are used to fulfil so many different needs, it is impossible to find one technical performance measure that could represent all these needs in a good way. This issue was also discussed during the 30 May workshop and it was concluded that personal computers are used for such a variety of reasons that there is not one technical performance parameter that stand out enough to merit being used as the functional unit in an LCA.



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Most LCA of personal computers, such as EPIC-ICT (2006), (Fujitsu 2003) and Atlantic Consultings (1998) study for the Ecolabel Unit of the European Commission, use “1 computer” as the functional unit. The EIPRO study (2006) uses “Euros of computer”. Compared to “1 computer”, “Euros of computer” reflects to an extent the technical performance, since there normally is a relation between price and technical performance. Reporting environmental impact per euro computer should in theory stimulate the development of expensive computers with low environmental impact. If one could in advance determine how many years each computer will be used, “computer year” is another possibility that also to a degree reflects the technical performance.

In this study, all calculations for computers (desktops and laptops) will initially be performed on the functional unit 1 computer (desktops and laptops). The possible use of other functional units, such as “Euros of computer” or “computer years” will be further investigated and discussed. The end results can easily be recalculated. However, one should be aware of that none of these alternatives is a perfect functional unit. Their use could possibly lead to conclusions that could stifle the development of more efficient computers.

Functional unit for computer monitors

The functional unit for a Computer monitor used by the ENERGY STAR Program Requirements for Computer Monitors Eligibility Criteria (Version 4.1), is Environmental impact per Mpixel. Some statistics for TCO-labelled monitors, shows that the energy consumption of computer monitors are proportional to the size of the screen (cm²). This study will therefore use the environmental impact per Mpixel as the functional unit and as a secondary performance parameter use the environmental impact related to the size of the screen.



Test standards and voluntary agreements

The general objective of this task is to describe test standards and voluntary labels related to the product categories within the scope of this study.

Test standards

Electrical safety standards

The electrical safety standards most commonly in use are IEC 60950, (Safety of information technology equipment), EN 60950 and the American standard UL 60950. They are all very similar and can be considered harmonized.

The safety standards have demands on electrical shock prevention and fire resistance that makes the choice of materials in the design of the computer somewhat restricted.

Electromagnetic Compatibility, EMC, standards

The EMC standards most commonly in use for computers are EN 55022, (Radiated emissions), EN 55024, (Immunity), and IEC 61000-2-2 and IEC 61000-3-3, (Disturbances on the low voltage main power supply). In the US, the FCC Part 15B class B standard is in use. The EMC standards also influence what is possible to do or not when designing a computer.

EN 62018 Power consumption for information technology equipment (ITE) – Measurement methods (2004)

This standard is adapted from IEC 62018 (2003) standard of the same name. The standard specifies methods of measurement of electrical power consumption in different modes of the use phase of ITE. It specifies the following conditions:

- configuration of the tested equipment,
- environment,
- power supply
- supply-voltage waveform
- power measurement accuracy
- testing instrumentation
- time of measurement
- test procedure.

Scope: Information Technology Equipment identified in more details in the



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standard IEC 60950-1 named "Information technology equipment – Safety "

Noise standards

Test standards for noise used in this study will be ISO 7779 in operator position.

Test standards within Energy Star, TCO and other voluntary agreements are described under the "Voluntary agreement" headline.

Voluntary agreements

There are many different voluntary (and mandatory) environmental performance labels and declarations. The International Organization for Standardization (ISO) has identified three broad types of voluntary labels.

- Type I (ISO 14024) a voluntary, multiple criteria-based, third party program that awards a license that authorises the use of environmental labels on products indicating overall environmental preferability of a product within a particular product category based on life cycle considerations
- Type II (ISO 14021) informative environmental self-declaration claims
- Type III (ISO/TR 14025) environmental product declaration, EPD, voluntary programs that provide "quantified environmental data for a product with pre-set categories of parameters based on the ISO 14040 series of standards, but not excluding additional environmental information"

Type I Eco-labels

"Eco-labelling" is a voluntary method of environmental performance certification and labelling that is practised around the world. An "eco-label" is a label which identifies overall environmental preference of a product or service within a specific product/service category based on life cycle considerations. In contrast to "green" symbols or claim statements developed by manufacturers and service providers, an eco-label is awarded by an impartial third-party in relation to certain products or services that are independently determined to meet environmental leadership criteria. In Europe there are several national eco-labels, and other labelling schemes of which some are described below.

The European Union Eco-label, the Flower

<http://europa.eu.int>

www.eco-label.com

The European Union Eco-label, the Flower, was started in 1992 and can be found throughout the European Union as well as in Norway, Lichtenstein and Iceland. The European Union Eco-labelling Board (EUEB) develops ecological criteria for product groups in close collaboration with the Commission.



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Today there are no computers or monitors labelled.

Standards: *Desktops 2005/341/EC / Notebooks 2005/343/EC*
Effective 2005.

The criterion regulates the energy consumption of Personal computers, Desktops/Notebooks in Sleep mode, Off mode, and the energy consumption of the external power supply when it is connected to the electricity supply but is not connected to the computer.

Computer	Mode	Power Allowance
PC	Sleep	5W
	Off	2W
Note Book	Sleep	5W
	Off	2W

Power supply	Not connected to the computer	0.75W
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Noise

Desktops

Measures according to ISO 7779 and declares in A-weighted sound power level (LWAd) according to ISO 9296 in dBel. (dB)

Noise levels must not exceed:

4.0 B(A) in the idle operating mode (equivalent to 40 dB(A))

4.5 B(A) when accessing a hard-disk drive (equivalent to 45 dB(A)).

Notebooks

Noise levels must not exceed:

Idling mode: 3.5 B (A).

When accessing a hard-disk drive: 4.0 B (A)

Energy star

For US: www.energystar.gov

For EU: www.eu-energystar.org

In 1992, US Environmental Protection Agency (EPA) introduced Energy Star as a voluntary labelling program designed to identify and promote energy-efficient products to reduce greenhouse gas emissions. Personal computers and monitors are products within the scope of Energy star.

The European Union made an agreement with the US government to coordinate the energy-efficiency labelling programs some years ago. The labelling scheme for computers is right now (August 2006) under revision, which will be finished



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during the EuP preparatory study time, and therefore this report will be updated with the new information.

Standard: *Computer Memorandum of Understanding (Version 3.0)*. Effective in 1999. Applies to computers and integrated computer systems. The ENERGY STAR Program Requirements for computers, DRAFT 3 is currently under revision. A Final Draft Specification will be released that incorporates any revisions to the performance levels and other specification requirements, based on stakeholder comments, autumn 2006. Definitions used in this draft, are described in the product definition part of this report.

The now (read August 2006) valid criteria regulate the energy consumption in sleep mode in relation to the power consumption rated for the computer.

Maximum Continuous Power Rating of Power Supply	Watts in sleep mode
$\leq 200W$	$\leq 15W$
$> 200W \leq 300W$	$\leq 20W$
$> 300W \leq 350W$	$\leq 25W$
$> 350W \leq 400W$	$\leq 30W$
$> 400W$	$\leq 35W$

Of all labelling schemes, Energy Star has by far the best market coverage for computers. The European Energy Star programme today qualifies 268 PC models.

Energy Star Computer Test Method (Version 4)

Test configuration

Power consumption of a computer shall be measured and tested from an AC source to the system.

Test conditions

Line Impedance: < 0.25 ohm

Total Harmonic Distortion: $< 5\%$

Ambient Temperature: 25 deg. C +/- 3 deg. C

For products to be qualified in markets using 100V/120V input:

- Input AC Voltage¹: 115 VAC RMS +/- 5V RMS
- Input AC Frequency¹: 60 Hz +/- 3 Hz

For products to be qualified in markets using 230 V input:

- Input AC Voltage¹: 230 VAC RMS +/- 5V RMS
- Input AC Frequency¹: 50 Hz +/- 3 Hz



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Testing equipment

A true RMS wattmeter with sufficient crest factor and frequency response, and a resolution of at least 0.1 W is needed.

Standard: Program Requirements for Computer Monitors Eligibility Criteria (Version 4.1)

Effective in 2006. Applies to computers monitors.

The standard prescribes measurement of the monitor power consumption in Sleep, Off and Active mode. In Active mode particular luminance adjustments are stipulated.

Energy criteria for Monitors

Sleep	2W
Off	1W
Active mode	<p>$X < 1$ mega pixel, then $Y = 23$; if $X > 1$ mega pixel, then $Y = 28X$. Y is expressed in watts and rounded up to the nearest whole number and X is the number of mega pixels in decimal form</p> <p>X= Mega pixels Y= Allowed power consumption</p>

Test Conditions:

General Criteria

Supply Voltage*:	North America: Europe: Australia/New Zealand: Japan:	115 (± 1%) Volts AC, 60 Hz (± 1%) 230 (± 1%) Volts AC, 50 Hz (± 1%) 230 (± 1%) Volts AC, 50 Hz (± 1%) 100 (± 1%) Volts AC, 50 Hz (± 1%)/60 Hz (± 1%)
Total Harmonic Distortion (Voltage):	< 2% THD	
Ambient Temperature:	20°C ± 5°C	
Relative Humidity:	30 – 80 %	
Line Impedance:	< 0.25 ohm	

The measurements shall be performed with a RMS power meter
The RMS power meter shall have a crest factor of at least five.

The standard has had and has a very important impact in the reduction of power consumption on computer monitors.



TCO Development ,TCO label

www.tcodevelopment.com

The TCO label is global – the certificate has no geographical limitations and the label is present in markets in many parts of the world with the strongest base in the northern part of Europe. The TCO labelling started in 1992 and does not only cover environmental issues, but also addresses other issues regarding the work environment, such as image quality, visual and work load ergonomics, noise, electromagnetic- and chemical emissions.

Today about 50 % of all computer displays in the world are TCO-labelled (about 3500 models). About 20 computers are TCO-labelled.

Standards: *TCO'05 Desktop computers, version.1.0 /*

TCO'05 Notebook computers, version 2.0

Effective 2005.

The criteria regulate the energy consumption of Personal computers, Desktops/Notebooks in Sleep mode and Off mode.

Computer	Mode	Power Allowance
PC	Sleep	5W
	Off	2W
Notebook	Sleep	4W
	Off	2W

Noise

Measures according to ISO 7779 and declares in A-weighted sound power level (LWAd) according to ISO 9296 in Bel. (B)

Noise levels must not exceed:

Operating mode: 3.9 B

Idling mode: 3.5B

If the product does not emit prominent discrete tones according to procedures specified in ECMA 74 Annex D a higher declared A-weighted sound power level (LWAd) is accepted but shall not exceed:

Operating mode: 4.2B

Idling mode: 3.8B

If noise emission measurement is carried out on one appliance only, the declared sound power level LWAd" shall be LWA + 0.3 B.

Standard: TCO'03 Displays, Flat Panel Displays Ver 3.0

Effective 2005-10-19



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The standard prescribes measurement of the monitor power consumption in Sleep, Off and Active mode. In Active mode particular luminance adjustments are stipulated.

The power consumption criteria and the measurement methods is harmonised with the criteria in Energy Stars, Program Requirements for Computer Monitors Eligibility Criteria (Version 4.1) Tier 2.

The standard and its predecessors have had a decisive impact on the power consumption for computer monitors.

Standard: TCO'03 Displays, CRT Displays Ver. 3.0

The standard prescribes measurement of the monitor's power consumption in Sleep and Off mode.

Energy criteria for Monitors

Sleep mode	$\leq 4\text{W}$
Off mode	$\leq 3\text{ W}$

Test conditions

AC mains voltage* 230 VAC RMS, tolerance $\pm 1\%$

AC mains frequency* 50 Hz, tolerance $\pm 0.5\text{ Hz}$

Line impedance 0.25 Ω

Total harmonic distortion $< 2\%$

Test room temperature $23\pm 3\text{ }^{\circ}\text{C}$ [1]

Humidity 20-75 % RH (non-condensing) [2]

Refresh rate 85 Hz [3]

* – or other voltage and frequency combination specified by the client based the market in which the VDU will be sold.

The measurements shall be performed with a RMS power meter
The RMS power meter shall have a crest factor of at least five.

Nordic Ecolabelling: The Swan

www.svanen.nu

The Swan is the official Nordic eco-label, introduced by the Nordic Council of Ministers in 1989. Today about 5 computer displays and 24 computers are labelled with the Swan.

Standard: *Personal computers Ver. 4.1*
Effective 2005.



EuP preparatory study, TREN/D1/40-2005, Lot 3, Task 1

The criterion regulates the energy consumption of Personal computers, Desktops/Notebooks in Sleep mode, Off mode, and the energy consumption of the external power supply when it is connected to the electricity supply but is not connected to the computer.

Computer	Mode	Power Allowance
PC	Sleep	5W
	Off	2W
Note Book	Sleep	5W
	Off	2W

Power supply	Not connected to the computer	0.75W
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Noise

Measures according to ISO 7779 and declares in A-weighted sound power level (LWAd) according to ISO 9296 in Bel. (B)

Noise levels must not exceed:

Desktop computers,,: Operating mode: 5,0 B (A), Idling mode: 4,5 B (A)
 Deskside computers, Operating mode: 5,3 B (A) Idling mode: 4,8 B (A)
 Portable computers, Operating mode: 4,5 B (A)) Idling mode: 4,0 B (A)

The Blue Angel

www.blauer-engel.de

The Blue Angel was created in 1977 on the initiative of the German Federal Minister of the Interior and approved by the Ministers of the Environment of the national government and the federal states. Today about 7 computer displays and 63 computers are labelled with the Blue Angel.

Standards: *Computers RAL-UZ-78*
 Effective 2006.

The criterion regulates the energy consumption of Personal computers, Desktops/Notebooks in Sleep mode, Off mode, and the energy consumption of the external power supply when it is connected to the electricity supply but is not connected to the computer.

Computer	Mode	Power Allowance
PC	ON (ACPI S3)	<4,5 W
	Off without wake up	< 2,5 W
	Off with wake up function	< 3,5 W
Note Book	ON (ACPI S3)	<3,5 W
	Off	< 2 W
Monitors	ON <1 megapixels	23 W



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	On \geq 1 megapixels	28*pixels
	Sleep	2 W
	Off	1 W

Noise

Measures according to ISO 7779 and declares in A-weighted sound power level (LWAd) according to ISO 9296 in dBel. (dB)

Noise levels must not exceed:

Idle mode max 44 dB(A)

If noise emission measurement is carried out on one appliance only, the declared sound power level LWAd" shall be LWA +3dB.

Group for Energy Efficient Appliances

<http://www.gealabel.org>

Standard: *Product Sheet, Personal Computers (system units)*

Reference: *IT01-280601*

Effective 2006.

The criterion regulates the energy consumption of Personal computers, Desktops/Notebooks in Sleep mode, Off mode and On mode. External power supply, if any, shall comply with EU "Code of Conduct on Energy Efficiency of External Power Supplies" version 2, phase 2

Computer	Mode	Power Allowance
PC	Sleep	5W
	Off	2W
	On (Idle)	70W

Power supply	Not connected to the computer	0.3 – 0.5W
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The Top Runner System, Japan

http://www.eccj.or.jp/top_runner/index.html

The Top Runner System uses, as a base value, the value of the product with the highest energy consumption efficiency on the market at the time of the standard establishment process and sets standard values by considering potential technological improvements added as efficiency improvements. The target standard values are extremely high. For achievement evaluation, manufacturers can achieve target values by exceeding target values by weighted average values using shipment volume, the same as the average standard value system.



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Under this system, designated machinery and equipment products are required to achieve a weighted average value by the target fiscal year right now year 2007, using each manufacturer's shipment volumes by category. Under this method, if demand is high for a product whose manufacturer emphasises other functionalities over energy consumption efficiency, the manufacturer can ship the equipment even if the energy consumption efficiency is lower than the target value. That is, the manufacturer can achieve the target value on an average basis by shipping a product with higher efficiency in the same category. The system functions well to facilitate manufacturers' voluntary activities.

Top runner Computer classifications

The top runner classification method gives several different classes based on:

1. Classifications based on product characteristics.

Computers are largely classified in terms of the nature of their usage and necessary functions into server-side computers (mainframe computers, mid-range computers, etc.) and client-side computers (workstations, desktop PCs, etc.). Client-side computers are further divided into desktop computers (non-battery-driven) and notebook PCs (battery-driven).

2. Classification based on performance characteristics such as number of I/O signal transmission paths (I/O) and memory size.

Top runner Energy consumption efficiency measurement method

Energy consumption efficiency is calculated by the following formula.

$$E = [(W_1 + W_2) / 2] / Q$$

In this formula, E , W_1 , W_2 and Q represent the following values.

E : Energy consumption efficiency (unit: watts/million calculations)

$(W_1 + W_2) / 2$: Power consumption (unit: watts)

W_1 : Power consumption in idle state (unit: watts)

The power consumption of the idle state (hereinafter "idle state") is when operation is possible without resetting the initial programs and in the states before operating in low power mode such as standby mode and suspended mode in accordance with the ACPI standards.

W_2 : Power consumption in low power mode (unit: watts)

The power consumption of low power mode is the low power mode of standby mode and suspended mode in ACPI standards (however, limited to states in which program and data are store in the main memory). Concerning server-side computers and client-side computers that do not have low power modes, the value of W_1 is used for W_2 .

Q : Composite theoretical performance (CTP) (unit: millions of calculations)

W_1 is expressed in watt units for values measured by the method below.



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1. Ambient temperature between 16°C and 32°C.
2. Power supply voltage in $\pm 10\%$ specified input voltage. However, for items with specified input voltage of 100 volts, it is $\pm 10\%$ of 100 volts.
3. Power supply frequency at standard frequency.
4. Without losing the computer's basic functionality, measurements are done with the maximum configuration on a scope that removes I/O control equipment, communications control equipment, HDDs, etc. that can be disconnected from the computer. For items to which the number of processors can be expanded, measurements shall be done with the minimum configuration of processors. For items other than battery-driven types among client-side computers, measurements can be done with the power supply to the graphic display turned off.

W_2 is expressed in watt units for values measured by the method below.

1. Ambient temperature shall be 16 to 32°C.
2. The power supply voltage shall be within the range of the rated input voltage $\pm 10\%$. If a computer has a rated input voltage of 100 volts, the power voltage shall be within the range of 100 volts $\pm 10\%$.
3. The power supply frequency shall be the rated frequency.
4. The measurement shall be made using a system configuration which retains a maximum of basic computer functions while the I/O control unit, communication control unit, magnetic disk drive unit and other removable units disconnected from the computer. However, if the computer is of a type that allows more processors to be installed, the measurement shall be performed using the number of processors required for a minimum configuration.

HDDs (Hard Disk Drives)

Top runner does also have energy consumption efficiency targets and measuring methods for HDD divided in several classes, due to disk size and number of discs.

Comparison of criteria for Desktops within different eco-labelling systems

This information is just an overview and is not complete. For the detailed information please consult the criteria documents (available at the websites of the different eco-labels).

The comparison is made between:

- TCO'05 Desktops, Version 1.0 2005-06-29
www.tcodevelopment.com. International labelling.
- Swan labelling of Personal computers, Version 4.1 June 2005 – 18 June 2008
www.svanen.nu. Nordic labelling
- Blue Angel. *Computers RAL-UZ-78* Effective 2006.
www.blauer-engel.de. German labelling.
- EU-flower. Ecological criteria and the related assessment and verification requirements for the award of the Community eco-label to personal computers (2005/341/EC),
11 April 2005 www.eco-label.com. European labelling.



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- Energy Star. Computer Memorandum of Understanding (Version 3.0). Effective in 1999.

Criteria for Desktops	TCO'05	The Swan	Blue angel	EU-flower
Visual Ergonomics	X			
Work load ergonomics	X			
Electromagnetic Emissions	X	X ¹	X ¹	X ¹
Acoustic Noise	X	X	X	X
Energy ²	X	X	X	X
Ecology	X	X	X	X

¹ The requirements in TCO'05 are stricter.

² See separate comparison.



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Criteria for Desktops	TCO'05	The Swan	Blue angel	EU-flower
Ecology				
Environmental Responsibility				
Company's environmental responsibility	X	X		
Environmental hazards				
Mercury, cadmium, and lead	X	X	X	X
Flame retardants	X	X	X	X
Chlorinated plastics	X	X	X	
Preparation for Recycling				
Material coding of plastics	X	X	X	X
Variety of plastics	X	X	X	X
Metallization of plastics	X	X	X	X
Material recovery of plastics and metals		X	X	X
Design for recycling - Mercury lamps	X	X	X	X
Easy to dismantle		X	X	X
Recycling information for customers	X	X	X	X
Guarantee and spare parts				
Guarantee		X	X	
Supply of spare parts		X	X	
Upgradeability/performance expansion		X	X	X
Packaging				
Requirements regarding packaging materials			X	X



Energy criteria for Desktops	The Swan Jun 2005	EU-Flower April 2005	TCO'05 Jul 2005	GEEA* 2006 ?	Blue Angel 2006	Energy Star 1999
Sleep	4W	4W	5W	5W	4,5W	15-35*
Off	2W	2W	2W	2W	2,5W	
On idle	-	-	-	70 W	-	
Labelled products	20	-	- (16 TCO'99)	? latest update 2002	60	268

Energy Star requirements for sleep is related to the power consumption rated for the computer

Comparison of criteria for Notebooks within different eco-labelling systems

This information is just an overview and is not complete. For the detailed information please consult the criteria documents (available at the websites of the different eco-labels).

The comparison is made between:

- TCO'05 Notebooks, Version 2.0 2005-09-21
www.tcodevelopment.com. International labelling.
- Swan labelling of Personal computers, Version 4.1 June 2005 – 18 June 2008
www.svanen.nu. Nordic labelling
- Blue Angel. *Computers RAL-UZ-78* Effective 2006.
www.blauer-engel.de. German labelling.
- EU-flower. Ecological criteria and the related assessment and verification requirements for the award of the Community eco-label to portable computers (2005/343/EC),
11 April 2005 www.eco-label.com. European labelling.



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Criteria for Notebooks	TCO'05	The Swan	Blue angel	EU-flower
Visual Ergonomics	X	X ¹	X ¹	
Work load ergonomics	X			
Electromagnetic Emissions	X	X ¹	X ¹	X ¹
Acoustic Noise	X	X	X	X
Energy ²	X	X	X	X
Ecology	X	X	X	X

¹ The requirements in TCO'05 are stricter.

² See separate comparison.

Criteria for Notebooks	TCO'05	The Swan	Blue angel	EU-flower
Ecology				
Environmental Responsibility				
Company's environmental responsibility	X	X		
Environmental hazards				
Mercury, cadmium, and lead	X	X	X	X
Flame retardants	X	X	X	X
Chlorinated plastics	X	X	X	
Preparation for Recycling				
Material coding of plastics	X	X	X	X
Variety of plastics	X	X	X	X
Material recovery of plastics and metals		X	X	X
Mercury lamps	X	X	X	X
Easy to dismantle		X	X	X
Recycling information for customers	X	X	X	X
Guarantee and spare parts				
Guarantee		X	X	
Supply of spare parts		X	X	
Upgradability/performance expansion		X	X	X
Packaging				
Requirements regarding packaging materials			X	X



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Energy Criteria for Laptops	The Swan Jun 2005	EU-flower Apr 2005	TCO`05 Jul 2005	GEEA 2006?	Blue Angel 2006
Sleep	3W	3W	4W	5W	3,5W
Off	2W	2W	2W	2W	2W
Power supply	0.75W	0.75W	-	-	-
Labelled products	-	-	- (4 TCO`99)	-	-

Comparison of criteria for Monitors within different eco-labelling systems

This information is just an overview and is not complete. For the detailed information please consult the criteria documents (available at the websites of the different eco-labels).

The comparison is made between:

- TCO`03 Displays FPD/CRT, Version 3.0 2005-10-19
www.tcodevelopment.com. International labelling.
- Swan labelling of Personal computers, Version 4.1 10 June 2005 – 18 June 2008 www.svanen.nu. Nordic labelling
- Blue Angel. *Computers RAL-UZ-78* Effective 2006.
www.blauer-engel.de. German labelling.
- EU-flower. Ecological criteria and the related assessment and verification requirements for the award of the Community eco-label to personal computers (2005/341/EC),
11 April 2005 www.eco-label.com. European labelling.

Criteria for Monitors	TCO`03	The Swan	Blue angel	EU-flower
Visual Ergonomics	X	X ¹	X ¹	
Work load ergonomics	X			
Emissions	X	X ¹	X ¹	X ¹
Energy ²	X	X	X	X
Ecology	X	X	X	X

¹ The requirements in TCO`03 are stricter.

² See separate comparison.



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Criteria for Monitors	TCO'03	The Swan	Blue angel	EU-flower
Ecology				
Environmental Responsibility				
Company's environmental responsibility	X	X		
Environmental hazards				
Mercury, cadmium, and lead	X	X	X	X
Flame retardants	X	X	X	X
Chlorinated plastics	X	X	X	
Preparation for Recycling				
Material coding of plastics	X	X	X	X
Variety of plastics	X	X	X	X
Metallization of plastics	X	X	X	X
Material recovery of plastics and metals		X	X	X
Design for recycling - Mercury lamps	X	X	X	X
Easy to dismantle		X	X	X
Recycling information for customers	X	X	X	X
Guarantee and spare parts				
Guarantee		X	X	
Supply of spare parts		X	X	
Packaging				
Requirements regarding packaging materials			X	X

Energy criteria for Monitors	Energy Star Jan 2006	GEEA 2006	TCO'03 Jan 2006	The Swan Jun 2005	EU-flower Apr 2005	Blue Angel 2006
Sleep	2W	* With USB 2.3 W	*	*	*	*
Off	1W	*	*	*	*	*
Active mode	(1)	*	*	*	*	*
Labelled products	464	?	717 (3000 TCO'99)	5	-	3



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(1) $X < 1$ megapixel, then $Y = 23$; if $X > 1$ megapixel, then $Y = 28X$. Y is expressed in watts and rounded up to the nearest whole number and X is the number of megapixels in decimal form

$X =$ Mega pixels

$Y =$ Allowed power consumption

* Same requirement as Energy Star

Type II Self-declaration

The IT-Ecodeclaration

www.itecodeclaration.org

The IT-Ecodeclaration is a self-declaration, which was launched in 1996 by IT-företagen in Sweden. IT-företagen is an industry organisation, which supports IT companies in Sweden. It has become a self-declaration used in the Nordic countries. The environmental criteria are the questions that need to be answered when purchasing a product. Among other things, this includes:

- environmental cable systems
- construction
- sound properties
- emissions
- safety
- materials of consumption
- packaging
- recycling

Also legal and ethical questions are included in the IT Ecodeclaration.

ECMA TR70

www.ecma-international.org

The Ecma Technical Report TR/70 presents the terms and format of the Ecma Product-related Environmental Declaration and is a self-declaration mainly used in Europe.

Ecma International is an industry association founded in 1961 and dedicated to the standardisation of Information and Communication Technology (ICT) and Consumer Electronics (CE).

Suppliers use this standardised format to declare environmental attributes of products to customers. The TR/70 identifies and describes environmental attributes and associated measurement methods related to information and communication technology and consumer electronic products according to known regulations, standards, guidelines and currently accepted practices. The report is also applicable to products used as subassemblies, components, accessories and/or optional parts. The report addresses product-related attributes, not the



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manufacturing processes and logistic aspects. The environmental attributes include, but are not limited to, data on:

- power consumption
- emissions
- materials
- product packaging
- batteries
- end of life management

Note: ECMA do also have a working group working on computer performance and energy consumption in order to make a standard on energy efficiency, perhaps for use within the EuP. It might become important to the outcome of the EuP regulations for products within the scope of this study. But the ECMA working group have recently started, and aim at finishing their work late 2007, and their results will therefore not be a part of this preparatory study. [ECMA 2006]

Harmonisation between Ecma TR70 and the IT Eco Declaration

Work to harmonise the Ecma's technical report TR70 and the IT Eco Declaration is currently on-going. The goal is to achieve full content harmonisation between Ecma TR70 and the IT Eco Declaration.

EPEAT

www.epeat.net

EPEAT, the "Electronic Product Environmental Assessment Tool," is a procurement tool designed to help institutional purchasers in the public and private sectors in the USA to evaluate, compare and select desktop computers, laptops and monitors based on their environmental attributes. The system will be available to manufacturers for registering their products in late May of 2006, and the product registry will be viewable and searchable by purchasers in June of 2006.

EPEAT is a system in which manufacturers declare their products' conformance to a comprehensive set of environmental criteria in eight environmental performance categories:

- Reduction/Elimination of Environmentally Sensitive Materials
- Material Selection
- Design for End of Life
- Product Longevity/ Life Cycle Extension
- Energy Conservation
- End of Life Management
- Corporate Performance
- Packaging



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EPEAT evaluates electronic products according to three tiers of environmental performance – Bronze, Silver and Gold. To achieve the bronze level, the product shall conform to all of the 23 required environmental criteria in IEEE 1680 (Standard for Environmental Assessment of Personal Computer Products, Including Laptop Personal Computers, Desktop Personal Computers, and Personal Computer Monitors). To achieve the silver level, the product shall conform to all of the required criteria plus at least 50% of the 28 optional criteria, and to achieve the gold level the product shall conform to all the required criteria and at least 75% of the optional criteria.

Type III

The EPD[®] system

www.environdec.com

An environmental product declaration, EPD, is defined as "quantified environmental data for a product with pre-set categories of parameters based on the ISO 14040 series of standards on life cycle assessment, but not excluding additional environmental information". The EPD[®] system is a programme for Type III environmental declarations with an international applicability. EPDs, which are always based on a life cycle assessment, are primarily intended for use in business-to-business communication, but their use in business-to-consumer communication is not precluded.

The EPD[®] system is operated by an independent so-called programme operator, the Swedish Environmental Management Council, SEMC. SEMC is responsible for providing general guidelines which describe the overall aim, methodological structure and elements of the EPD[®] system.

The EPD[®] system is one of other available EPD programmes, however being the only programme at present aiming at an international applicability.

There is today one make of LCD-modules but no personal computer with an EPD registered in the EPD[®] system.

Test standards and voluntary agreements and this study

There are several voluntary initiatives working on improvement of the environmental performance of the products within the scope of this study. Some of them are of more importance than others. For this study, the most important voluntary initiatives are Energy Star and the TCO labelling schemes, since they are most widely used, and also since they are regularly updated with more tight requirements to keep stimulating improved environmental performance.

The results of energy consumption measurements are totally dependent on how the different testing standards have chosen to set up the unit under test, especially in the Active/Idle mode. It is therefore often very difficult to compare results from tests being performed according to different testing standards. Regarding test standards within this study, the ones used by most of the labelling schemes and



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initiatives for computers and monitors will be used. Energy consumption will be assessed in off, sleep and on (idle) modes according to the coming *ENERGY STAR Computer Test Method (Version 4.0)*, effective July 19, 2007 for computers and the *ENERGY STAR Program Requirements for Computer Monitors Eligibility Criteria (Version 4.1)* for monitors. *ISO 7779* will be used for noise.



Existing legislation

The main objective with describing the existing legislation is to guarantee that suggestions and proposed activities follow the existing legislation. Since the legal documents are often very large, attempts to summarize the most important parts of them are made here. To get the full details, please look into the full documents.

Legislation and Agreements at EU-Level

WEEE Directive for Waste of Electric and Electronic Equipment 2002/96/EEC (february 2003)

http://ec.europa.eu/environment/waste/weee_index.htm

An important conclusion from the 30 May workshop was that declarations prepared for complying with the WEEE-directive are very suitable as bill of materials. In other words, it will be relatively easy for industry to supply the LCA data needed thanks to WEEE.

Product design

Member States shall encourage the design and production of electrical and electronic equipment which take into account and facilitate dismantling and recovery, in particular the reuse and recycling of WEEE, their components and materials. In this context, Member States shall take appropriate measures so that producers do not prevent, through specific design features or manufacturing processes, WEEE from being reused, unless such specific design features or manufacturing processes present overriding advantages, for example, with regard to the protection of the environment and/or safety requirements.

Separate collection

1. Member States shall adopt appropriate measures in order to minimise the disposal of WEEE as unsorted municipal waste and to achieve a high level of separate collection of WEEE.
2. For WEEE from private households, Member States shall ensure that by the 13 August 2005:
 - (a) systems are set up allowing final holders and distributors to return such waste at least free of charge. Member States shall ensure the availability and accessibility of the necessary collection facilities, taking into account in particular the population density;
 - (b) when supplying a new product, distributors shall be responsible for ensuring that such waste can be returned to the distributor at least free of charge on a one-



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to-one basis as long as the equipment is of equivalent type and has fulfilled the same functions as the supplied equipment. Member States may depart from this provision provided they ensure that returning the WEEE is not thereby made more difficult for the final holder and provided that these systems remain free of charge for the final holder. Member States making use of this provision shall inform the Commission thereof;

(c) without prejudice to the provisions of (a) and (b), producers are allowed to set up and operate individual and/or collective take-back systems for WEEE from private households provided that these are in line with the objectives of this Directive;

(d) having regard to national and Community health and safety standards, WEEE that presents a health and safety risk to personnel because of contamination may be refused for return under (a) and (b). Member States shall make specific arrangements for such WEEE.

Implementation of WEEE

The implementation of WEEE directive in the member states is ongoing.

RoHs Restriction of Hazardous substances

The RoHs directive, 2002/95/EC, dictates that Member States shall ensure that, from 1 July 2006, new electrical and electronic equipment put on the market does not contain lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB) or polybrominated diphenyl ethers (PBDE). National measures restricting or prohibiting the use of these substances in electrical and electronic equipment which were adopted in line with Community legislation before the adoption of this Directive may be maintained until 1 July 2006.

EMC

The EMC directive, 89/336/EEC (to be replaced by 2004/108/EC) set restrictions on the emission of electromagnetic radiation and on the immunity against electromagnetic radiation for electronic products. Countries outside the EU have similar regulations although the detailed requirements differ. In some countries there are, for instance, no restrictions on immunity.

In addition to the general EMC directive more detailed standards exist for certain products such as computers.

From the perspective of this study the EMC directive is not critical.

Legislation at Member State level

Since legislation at member state level follows the European directives, there appears to be no other particular legislation at member state with relevance for



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this study. As an example, the Swedish legislation is described below. The main differences between the European countries are the time schedules for implementing the European directives.

In Sweden *Förordning om förbud mm i vissa fall i samband med hantering, införsel och utförsel av kemiska produkter*, [SFS 1998:944](#), contains the restrictions from the RoHS directive for use of cadmium, mercury, lead, chromium and some other chemicals in electric and electronic products. The WEEE directive is mainly implemented in *Förordningen om producentansvar för elektriska och elektroniska produkter*, [SFS 2005:209](#). While SFS 1998:944 and SFS 2005:209, concerns the computer manufacturer, *Avfallsförordning*, [SFS 2001:1063](#), stipulates that the computer user should separate computer waste from the normal waste stream.

Miljöbalken, the environmental framework law in Sweden, stipulates in the 5th general principle about Housekeeping and materials circulation that everybody should “5 §. Economize with resources and energy and use renewable energy as a first priority.” This principle has however not yet been tried in the context of manufacturing and use of personal computers.

In short, Sweden has implemented the RoHs and WEEE directives and has, in practice, no separate national restrictions regarding the manufacturing and use of computers.

Third Country Legislation

The European legislation WEEE and RoHs is spreading to countries outside the EU. In most cases the national legislation is similar to the European, but there are some differences. The most important ones are described below.

China

The Chinese RoHs, called “Administrative Measures on the Control of Pollution Caused by Electronic Information Products” will start to take effect from the 1st January 2007. It is very similar to EU RoHs regarding substances. The difference is that all products have to be tested in an authorised laboratory before they can be sold in China. The legislation is not covering export from China.

California

California follows RoHs strictly. An exemption must be decided by EU, which the industry find difficult. It also sets targets for recyclability and improvement targets for recycling.



Korea

Korea follows RoHs and WEEE, with the difference that the Korean law covers both electronics and automotives in the same legislation.

Existing legislation and this study

The most important legislations according to our analysis are the RoHS and the WEEE directives. One important reason is that there might be conflicts between energy consumption and chemical content and/or end-of-life treatment. The VHK-methodology also prescribes a “past WEEE and RoHs-situation” for the calculations in the study. Other legislation might have an impact on this study regarding options for improvement. It is essential that the suggestions either follows the existing legislation, or point out which changes in legislation might be needed to reach the improvements suggested.



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