



EuP preparatory study, TREN/D1/40-2005, Lot 3, Task 2

Intermediate step report 2 for EuP study, Lot 3, Task _2

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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 second 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 make an economic and market analysis to use within the subsequent tasks of this 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
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2. Economic and market analysis

2.1. Generic Economic Data

2.1.1. Task and Procedure

To determine the volumes and values of the product categories “ personal computers and monitors” within the total of EU industry and trade policy, the following generic economic data will be researched:

- EU-production
- Extra-EU trade
- Intra-EU trade
- Apparent consumption

To present some indication of the installed base of equipment, indicative data on medium expected lifetime for the different types of equipment covered in the report are taken from the answers from industry, supplied in the survey[2006].

To make the data coherent with official EU data, the statistical information is derived from Eurostat, the official statistical office of EU.

Since the data from Eurostat has some limitations we will include, later in the report, trade-data given by the industry, as a comparison.

The most appropriate dataset in Eurostat, for our purposes, is the dataset PRODCOM, which gives production and trade data for a very large number of product-groups (more than 7000).

The following PRODCOM codes are applicable to the investigated product groups.

Table 1: PRODCOM classification applicable to PC, Laptops and Desktops

PRODCOM-Code	Code Description
30021200	Laptop PCs and palm-top organisers
30021300	Desk top PCs
30021400	Digital data processing mach//systems
32302045	Colour video monitors wit//de-ray tube
32302049	Flat panel video monitor//de-ray tube)
32302083	Black and white or other monochrome monitors

Apart from PRODCOM, Eurostat also provides a dataset on EU-25 trade statistics, (Comext). This dataset, which does not contain any production data but purely trade data, is based on CN codes (Combined Nomenclature). The relations between PRODCOM codes and CN



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codes for relevant equipment are presented below in Table 2. The use of CN codes for computers and monitors is highly complicated due to the fact that there have been numerous changes in the CN coding scheme during the years of interest. The table below shows these changes to the best of our ability.

Table 2: PRODCOM classifications and corresponding CN-codes applicable to PC, Laptops and Desktops

PRODCOM-Code	Code Description	Corresponding CN-code	Code Description	From	To
30021200	Laptop PCs and palm	84713000		01/01/1996	31/12/1997
30021200	Laptop PCs and palm	84713010	Laptop computers, notebooks whether or not incorporating multi media kit	01/01/1998	31/12/1999
30021200	Laptop PCs and palm	84713091	84713090 Other, portable digital automatic data processing machines, weighing not more than 10 kg Other digital automatic data processing machines, comprising in the same housing at least a central processing unit, a keyboard and a display.	01/01/1998	31/12/1999
30021200	Laptop PCs and palm	84713099		01/01/1998	31/12/1999
30021200	Laptop PCs and palm	84713000		01/01/2000	31/12/2005
30021300	Desk top PCs	84714110	Other digital automatic data processing machines, comprising in the same housing at least a central processing unit, a keyboard and a display (main frame)	01/01/1996	31/12/2005
30021300	Desk top PCs	84714130		01/01/1998	31/12/1999
30021300	Desk top PCs	84714190	Other digital automatic data processing machines (other than main frame)	01/01/1996	31/12/1997
30021300	Desk top PCs	84714190		01/01/2000	31/12/2005
30021300	Desk top PCs	84714191		01/01/1998	31/12/1999
30021300	Desk top PCs	84714199		01/01/1998	31/12/1999
30021400	Digital automatic data processing machines presented in the form of systems	84714910	Other digital automatic data processing machines, presented in the form of systems, Pcs (personal computers) whether or not incorporating multi media kits	01/01/1996	31/12/2005
30021400	Digital automatic data processing machines presented in the form of systems	84714930		01/01/1998	31/12/1999
30021400	Digital automatic data processing machines presented in the form of systems	84714990	Other digital automatic data processing machines, presented in the form of systems	01/01/1996	31/12/1997
30021400	Digital automatic data processing machines presented in the form of systems	84714990		01/01/2000	31/12/2005
30021400	Digital automatic data processing machines presented in the form of systems	84714991		01/01/1998	31/12/1999
30021400	Digital automatic data processing machines presented in the form of systems	84714999		01/01/1998	31/12/1999
32302045	Colour video monitors with cathode-ray tube	85281031			01/01/1993
32302045	Colour video monitors with cathode	85281041		01/01/1993	31/12/1995
32302045	Colour video monitors with cathode	85281043		01/01/1993	31/12/1995
32302049	Flat panel video monitor, LCD or plasma, etc., without tuner (colour video monitors) (excl. with cathode-ray tube)	85281049		01/01/1993	31/12/1995
32302083	Black and white or other monochrome video monitors	85282020		01/01/1993	31/12/1995



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Since both the PRODCOM codes and the CN-coding scheme have evolved over time, neither of the datasets are distinctive and clear enough to provide ideal data for this investigation. Apart from changes in coding over the years, the product definitions are in several cases dubious in the sense that it is not clear what parts of equipment are included. This can later be seen especially in the case of Desktops, where it is not clearly stated whether a monitor is included or not, and if it is included, it is not indicated what type of monitor.

The quality of data seems to be very dependant on the distinctness of the coding, as can be seen later in the report. The data on Laptops, which is probably the most distinct code, seem to be much more “reliable” (no disruptive changes) as compared to the data on Desktops, for which the definition is less obvious. On the other hand, the code for laptops also includes palmtops, which are to be left out of the study, thus making the data from Eurostat quite inappropriate for the study. This has been solved by using data from other sources, EITO and answers from an industry survey, to compile a more correct picture of the sales figures on laptops.



2.1.2 Results

2.1.2.1. Production of Desktops, laptops and monitors in EU-25

The following tables, 3a and 3b contain the data provided by PRODCOM for domestic production in 2004. The data have lots of empty spaces, which are either due to data not reported by the country or, due to confidentiality reasons. When data are incomplete, Eurostat does not publish an EU summary.

The Eurostat reasons for missing data are explained in Williams [2003] by the following paragraphs:

Availability of data

There are two reasons why expected data might not be found in Europroms:

The data is confidential. If only a small number of enterprises produce a product in the reporting country, there is a risk that information regarding an individual enterprise might be revealed. If the enterprise does not agree to this the reporting country declares the production figures confidential. They are transmitted to Eurostat but not published.

However if several countries declare their production for a heading to be confidential, an EU total can be published because the data for an individual country cannot be inferred.

The data is missing. There are a number of reasons why data might be missing: the reporting country does not survey the heading; the reporting country has reason to doubt the accuracy of the data and suppresses it; or the reporting country uses the wrong volume unit or the wrong production type, which means that the data is not comparable with other countries and is suppressed by Eurostat.

If data is missing for one or more Member States the corresponding EU total cannot be calculated and is also marked as missing.

Europroms stands for the combined data from PRODCOM and Comext, published in PRODCOM. In the continued text, PRODCOM will be stated as the source also for Europroms.

In the tables produced by PRODCOM, countries negotiating for EU membership are also included. Their values are not included in the EU25 totals.



Table 3a: Personal computers EU25, domestic production in 2004 (PRODCOM statistics)

2004	Laptop PCs and palm-top organisers		Desktop PCs		Digital data processing systems	
	VOLUME	VALUE	VOLUME	VALUE	VOLUME	VALUE
	(1000 Units)	(M EURO)	(1000 Units)	(M EURO)	(1000 Units)	(M EURO)
France	407	392			47	
Netherlands					10	52
Germany	3332	2642	627	383	2517	1497
Italy	36	37	66	104	12	14
United Kingdom	104	135		174	665	536
Ireland						
Denmark	0	0	2	2	3	8
Greece						
Portugal			99	63		
Spain	94	99	48	30	257	140
Belgium			98	46		
Luxemburg						
Iceland						
Norway						
Sweden					25	44
Finland	0	1	40	45	2	2
Austria	262	221				
Malta						
Estonia			61	28		
Latvia			7	3		
Lituania			37	24		
Poland	67	37	176	42		
Czech Republic						
Slovakia						
Hungary					3436	1031
Romania			72	35		0
Bulgaria				3	1	1
Slovenia			25	13		0
Croatia			25	10	3	12
Cyprus						
EU15TOTALS						
EU25TOTALS				2112	13143	9593



Table 3b: Monitors EU25, domestic production in 2004 (PRODCOM statistics)

2004	Colour video monitors cathode-ray tube		Flat panel video monitor		Black and white or other monochrome monitors	
	VOLUME	VALUE	VOLUME	VALUE	VOLUME	VALUE
	(1000 Units)	(M EURO)	(1000 Units)	(M EURO)	(1000 Units)	(M EURO)
France						
Netherlands						
Germany						5
Italy	1299	121	2	4	289	45
United Kingdom		20				
Ireland						
Denmark		0			3	1
Greece						
Portugal						
Spain	8	4				
Belgium						
Luxemburg						
Iceland						
Norway						
Sweden						
Finland						
Austria						
Malta						
Estonia						
Latvia						
Lituania						
Poland						
Czech Republic						
Slovakia						
Hungary						
Romania						
Bulgaria						
Slovenia						
Croatia						
Cyprus						
EU15TOTALS					468	
EU25TOTALS			36		468	



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During summer 2006, PRODCOM data for 2005 were published and it was decided to include these tables too. The reliability of data seems not to have improved, since there are many empty spaces due to countries not reporting and due to the limitations mentioned earlier. For reasons not explained in Eurostat, Ireland is not yet present in the production statistics of 2005 (September 2006), neither is data for the United Kingdom.

Table 3c: Personal computers EU25, domestic production in 2005 (PRODCOM statistics)

	Laptop PCs and palm-top organisers		Desktop PCs		Digital data processing mach//systems	
	VOLUME (1000 Units)	VALUE (M EURO)	VOLUME (1000 Units)	VALUE (M EURO)	VOLUME (1000 Units)	VALUE (M EURO)
France	70	39	251	168	20	732
Netherlands						85
Germany	6192	4334	736	388	3125	1551
Italy	32	25	45	54	6	8
Denmark	0	0	2	4	3	7
Greece						
Portugal			82	51		
Spain	105	90	59	32	384	135
Belgium			55	45		
Luxemburg						
Iceland						
Norway						
Sweden					34	55
Finland	3	2	23	26	1	1
Austria	141	101				
Malta						
Estonia	3	3	68	27		
Latvia			4	2		
Lituania	0	0	34	16		
Poland	142	91	242	78	5	
Czech Republic						
Slovakia						
Hungary					3338	1253
Romania			98	48	0	1
Bulgaria	0	0	22	3	1	1
Slovenia			18	10		
Croatia			42	15	5	19
Cyprus						
EU15TOTALS						
EU25TOTALS			2732		14285	8838



Table 3d: Monitors EU25, domestic production in 2005 (PRODCOM statistics)

2005	Colour video monitors cathode-ray tube		Flat panel video monitor		Black and white or other monochrome monitors	
	VOLUME	VALUE	VOLUME	VALUE	VOLUME	VALUE
	(1000 Units)	(M EURO)	(1000 Units)	(M EURO)	(1000 Units)	(M EURO)
France						
Netherlands						
Germany			67			5
Italy	1210	110	2	2	222	38
Denmark		0			4	1
Greece						
Portugal						
Spain	8	4				
Belgium						
Luxemburg						
Iceland						
Norway						
Sweden						
Finland						
Austria						
Malta						
Estonia						
Latvia						
Lituania			0	0		
Poland						
Czech Republic						
Slovakia						
Hungary						
Romania						
Bulgaria						
Slovenia						
Croatia						
Cyprus						
EU15TOTALS					437	
EU25TOTALS	1341	154	361	190	437	

To be able to show more realistic production data, the project team applied to Eurostat to have the restrictions on confidential data lifted for the purpose of this assignment, but the request was denied. According to Williams [2003], the confidentiality policy is explained the following way:

Confidentiality in PRODCOM

Some national PRODCOM data and EU aggregates are confidential. Confidential data is suppressed and is only available for the PRODCOM staff or researchers or other officials associated with PRODCOM according to the Eurostat Rules of protection of confidential data.



Important producers like Ireland are because of these restrictions totally misrepresented in the statistics.

Later in the report, data on production taken from other sources will be introduced. Data which are considered more correct than the production data from PRODCOM, due to less restrictions from competition issues.

2.1.2.2. Computers and monitors total EU trade (import and export)

The data on trade published in PRODCOM are derived from the database COMEXT, and are much more complete than data on production. The confidentiality issues may affect some of the national figures, according to Williams[2003], but all relevant data are included in the EU totals. For the investigation the data from COMEXT were also compiled and found to be an exact match to the data from PRODCOM. The data from PRODCOM have been chosen, to avoid the issue of changing coding-schemes in COMEXT between different years in the presentation.

Table 4: EU-25 Total trade (import-export) (PRODCOM data)

Product	PERIOD	VOLUMES (1000 UNITS)		Value (M Euro)	
		EXPORTS	IMPORTS	EXPORTS	IMPORTS
Laptop PCs and palm-top organisers	2003	1605	11401	1284	7201
	2004	2118	14413	1378	9176
	2005	3704	21325	2271	11499
Desk top PCs	2003	1084	2255	574	820
	2004	1995	3373	730	823
	2005	2125	4181	957	657
Digital data processing mach//systems	2003	1922	6066	1477	1490
	2004	3516	5578	1406	1004
	2005	3382	2405	1215	955
Colour video monitors with cathode-ray tube	2003	135	151	33	46
	2004	93	197	39	53
	2005	95	204	24	55
Flat panel video monitor	2003	242	1157	79	420
	2004	427	1718	146	652
	2005	477	5602	214	1550
Black and white or other monochrome monitors	2003	44	809	13	35
	2004	154	794	10	33
	2005	108	1002	18	34



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The figures above show that EU is a large net importer of Laptops, a ratio of import 7 times higher than export. The locations for production outside EU are not investigated in detail. Through the survey to the producers it was obvious that relocations by the multinationals to South East Asian production sites is an ongoing move. It will later be covered in more detail.

For Desktop PCs and systems, the figures are much more in balance: imports are about twice the export. Especially for systems, EU seems to have a higher added value, since the value of export and import is almost equal while the number of imported units is twice the exported units.

For monitors, EU is a growing net importer of the more modern flat panel monitors, in 2003 the relation import/export was 4 to 1, but had grown to more than 10 to 1 in 2005. It can also be noted that flat panel monitors represent a very large expansion in trade volume; the import has grown 5 times in 3 years, while the other products have had a much more moderate growth in volume.

2.1.2.3 Computers and monitors domestic trade (import and export)

In the following two tables the domestic trade data for EU-25 countries in 2004 are presented. The data say little about the net consumption in EU, since production cannot be deduced from the data, but they give information on for which countries computers and monitors are important export products.

The tables show that very few of the EU countries are net exporters of any type of computers. The only two net exporters of pure equipment are the Netherlands and Ireland. For systems, with a higher added value, the numbers are different with quite a number of net exporters, which is in line with the need for a knowledge-based industry in Europe.

(The data of Luxemburg seem to be very doubtful, probably a mistake between number of units and the value.)

For monitors, none of the EU-25 countries is a net exporter of any significance, and the huge imbalance between export and import of flat panel monitors can be noted here as well.



Table 5a: Domestic trade of computers 2004 (PRODCOM data)

	Laptop PCs and palm-top organisers		Desktop PCs		Digital data processing mach//systems	
	EXPORTS	IMPORTS	EXPORTS	IMPORTS	EXPORTS	IMPORTS
	1000 units		1000 units		1000 units	
France	510	3142	189	1645	1536	1792
Netherlands	9497	7230	747	550	1139	771
Germany	4567	6446	210	318	642	398
Italy	69	2309	114	938	37	396
United Kingdom	1183	6162	517	4106	589	796
Ireland	2420	3035	1744	382	309	34
Denmark	100	579	67	98	7	100
Greece	4	331	1	19	0	38
Portugal	20	315	17	23	3	22
Spain	187	1963	204	501	77	303
Belgium	642	1356	143	79	59	263
Luxemburg	3	3047	81	84829	8	15
Iceland	:	:	:	:	:	:
Norway	:	:	:	:	:	:
Sweden	234	771	30	83	120	125
Finland	107	433	6	23	12	41
Austria	91	474	91	121	92	140
Malta		8	0	1	1	2
Estonia	1	40	1	7	0	2
Latvia	4	33	0	7	0	43
Lithuania	35	90	11	20	2	9
Poland	7	536	13	333	4	35
Czech Republic	187	443	3079	398	2285	2097
Slovakia	13	76	6	135	1	7
Hungary	81	181	101	177	9	18
Romania	0	0	0	0	0	0
Bulgaria	0	49	3	24	5	47
Slovenia	2	62	2	15	84	9
Croatia	5	58	2	32	2	8
Cyprus	0	16	0	3	0	1
EU25TOTALS	3704	21325	2125	4181	3382	2405



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Table 5b: Domestic trade of monitors 2004 (PRODCOM data)

	Colour video monitors cathode-ray tube		Flat panel video monitor		Black and white or other monochrome monitors	
	EXPORTS	IMPORTS	EXPORTS	IMPORTS	EXPORTS	IMPORTS
	1000 units		1000 units		1000 units	
France	19	63	57	425	8	60
Netherlands	82	97	951	1775	49	45
Germany	38	56	186	468	46	157
Italy	28	22	157	919	113	610
United Kingdom	78	150	2379	2435	26	120
Ireland	1	3	41	59	0	1
Denmark	0	2	25	119	1	2
Greece	0	2	2	94	0	18
Portugal	10	2	30	80	6	22
Spain	4	30	149	607	38	81
Belgium	13	26	173	424	28	41
Luxemburg	0	1	1	7	0	1
Iceland	:	:	:	:	:	:
Norway	:	:	:	:	:	:
Sweden	9	4	31	127	0	13
Finland	1	2	7	30	1	3
Austria	3	6	11	31	1	5
Malta	0	1	0	2	18	1
Estonia	0	1	6	13	0	0
Latvia	0	2	4	17	0	2
Lithuania	0	1	3	3	0	1
Poland	0	4	12	92	0	8
Czech Republic	0	5	29	59		5
Slovakia	0	1	19	47	0	2
Hungary	0	4	5	19	0	2
Romania	0	1	0	5	0	1
Bulgaria	0	1	0	2	0	0
Slovenia	0	1	2	7	1	1
Croatia	1	4	1	7	0	3
Cyprus	0	0	0	1	0	1
EU25TOTALS	95	204	477	5602	108	1002



2.1.2.4. Apparent EU-consumption

Due to the unreliable data on production, the task of calculating the apparent consumption is quite difficult, introducing a high degree of uncertainty. The apparent consumption is to be calculated by taking “imports + production – export”, and due to the misrepresentations in production data, quite a large number of countries are represented as having a negative consumption, which is of course unrealistic.

In the course of the task, a first try was made to plot all data of all countries, in order to find some patterns which could help generating a complete picture. The intention was to find out if some specific figures were wrong for specific years which could then be corrected. This proved not to be the case, no obvious patterns were found.

The next line of thought was to search for consumption of important computer parts, like CPUs in PRODCOM, and look for a statistical correlation between that consumption and the production of computers. The coding scheme proved not to be explicit enough, so no correlation could be found.

Instead other sources were contacted, to get what data were available. The first source of data was EITO (a European cooperation between the producers). Then the producers were asked to give as much information as possible on market figures in the industry survey [2006]. The producers were also asked to supply information on which data provider they would use for sales statistics. They all pointed to Gartner Group and IDC, which are commercial data providers, and far too costly to be relevant for this assignment.

Not to overburden the responders, the producers were only asked for data on EU-25 and on some of the larger countries. The subsequent answers did only provide figures of EU25.

Since both EITO and the producers, record sales data instead of data on import and export, for the countries and for EU as a total, the procedure for calculation of apparent consumption was changed, to be equal to the volume of sales. This has the advantage of reducing the impact of stock, which has to be taken into account when using the formula based on export, import and production.

In the survey was included a request for prognoses for quite a long horizon. EITO provides prognoses up to 2007, on Laptops and Desktops. The producers were quite restricted in answers on the future.

Tables 6a-6c show the apparent consumption of the major countries as calculated on data from PRODCOM and EITO. This information was provided in the survey, to get comments from the respondents.



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Table 6a: Apparent consumption, Desktops, for major countries.
Data from PRODCOM (2000 – 2004), EITO (2005-2007)

YEAR	Ireland	Italy	France	Germany	Poland	Spain	UK
2000, desktop	-478.004	1.396.677	184.431	787.690	-	101.234	1.838.547
2001, desktop	-2.536.664	1.118.344	195.681	563.335	-	25.297	1.535.429
2002, desktop	-2.743.536	510.066	1.197.920	904.982	203.992	98.435	1099.408
2003, desktop	87.162	2.399.222	3.199.424	4.773.481	213.983	858.860	4.307.948
2004, desktop	114.792	2.490.392	3.436.181	4.673.238	428.079	893.214	4.566.424
2005, desktop	164.754	2.590.315	3.881.697	4.979.217	-	935.968	4.780.247
Prognoses							
2006, desktop	206.079	2.667.797	4.025.116	4.901.330	-	988.879	4.888.657
2007, desktop	241.811	2.765.386	4.093.822	4.755.861	-	1.004.970	4.915.409

Table 6b: Apparent consumption, Laptops, for major countries.
Data from PRODCOM (2000 – 2004), EITO (2005-2007)

YEAR	Ireland	Italy	France	Germany	Poland	Spain	UK
2000, laptop	868.786	495.433	1.326.373	4.101.971	-	430.009	4.452.755
2001, laptop	549.841	568.088	1.124.608	3.412.759	-	383.801	1.439.322
2002, laptop	570.375	668.377	1.453.383	3.650.046	134.357	550.204	2.370.032
2003, laptop	87.162	1.119.686	1.454.485	2.523.278	172.269	575.320	1.987.743
2004, laptop	114.792	1.390.650	1.841.378	3.154.098	313.801	772.655	2.419.083
2005, laptop	164.754	1.844.044	2.474.567	3.832.705	-	999.558	3.075.689
Prognoses							
2006, laptop	206.079	2.216.222	2.916.323	4.451.002	-	1.166.091	3.584.735
2007, laptop	241.811	2.515.151	3.265.896	5.017.909	-	1.402.871	4.095.955



Table 6c: Apparent consumption, data from PRODCOM (2000 – 2004), EITO (2005-2007), for major countries. Monitors

YEAR	Ireland	Italy	France	Germany	Poland	Spain	UK
2000, monitor	6.445	729.447	421.802	59.969	-	49.256	84.391
2001, monitor	11.965	1.003.271	520.782	88.171	-	35.957	42.923
2002, monitor	9.362	1.156.981	431.288	81.301	8.683	117.537	-3.102.706
2003, monitor	4.078	2.029.832	257.953	152.826	6.640	169.575	-1.163.988
2004, monitor	14.682	1.908.639	330.660	215.052	25.490	441.990	16.583
2005, monitor	-	-	-	-	-	-	-

The production and sales data part of the questionnaire was answered by a few of the suppliers. Not to show the exact numbers from each respondent, due confidentiality agreements, the mean values of the answers are provided as a value from the industry as a group. The deviations between the different answers were less than 5%, thus implicating that the mean value represents for the industry opinion well.

The respondents did choose to answer on EU-25, for all years, but with the indication that data from some of the former Russian countries are not included.

None of the respondents gave any answers on individual countries.

In Table 7, the mean value of the respondents` answers are presented in bold letters, while the figures in normal text represent the data calculated from official sources, PRODCOM and EITO.



Table 7: Apparent consumption of computers and monitors, survey answers compared to data from PRODCOM and EITO

	Year	Desktop		Year	Laptop		Year	Monitor
EU15	2000, desktop	2.054.521		2000, laptop	5.938.319		2000, monitor	193.841
	SURVEY	24 100 000		SURVEY	6 100 000		SURVEY	
EU15	2001, desktop	1.270.287		2001, laptop	12.743.295		2001, monitor	1.097.577
	SURVEY	22 400 000		SURVEY	6 800 000		SURVEY	
EU15	2002, desktop	3.390.633		2002, laptop	11.586.060		2002, monitor	560.211
	SURVEY	21 700 000		SURVEY	8 000 000		SURVEY	
EU25	2003, desktop	19.739.653		2003, laptop	9.875.074		2003, monitor	2.403.206
	SURVEY	24 000 000		SURVEY	11 400 000		SURVEY	
EU25	2004, desktop	20.424.397		2004, laptop	12.231.536		2004, monitor	1.430.935
	SURVEY	26 200 000		SURVEY	15 000 000		SURVEY	
EU25	2005, desktop	21.898.231		2005, laptop	15.617.607		2005, monitor	
	SURVEY	28 500 000		SURVEY	19 900 000		SURVEY	37 800 000
	Prognoses			Prognoses			Prognoses	
EU25	2006, desktop	22.021.866		2006, laptop	18.135.846		2006, monitor	
	SURVEY	28 100 000		SURVEY	23 900 000		SURVEY	
EU25	2007, desktop	21.927.681		2007, laptop	20.507.445		2007, monitor	
	SURVEY	29 100 000		SURVEY	27 800 000		SURVEY	
EU25	2008, desktop			2008, laptop			2008, monitor	
	SURVEY	29 900 000		SURVEY	31 400 000		SURVEY	
EU25	2015, desktop			2015, laptop			2015, monitor	
EU25	2020, desktop			2020, laptop			2020, monitor	

The table above shows that, there is a huge difference between the data found in open statistics (PRODCOM) and the data supplied by industry.

For Desktops, the error sources in official statistics have been identified (hidden data when few producers in one country) and we have chosen to trust the data from industry for the coming calculations.



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For Laptops, the PRODCOM data are almost twice as high as the survey data for the years 2001 – 2002, while the data from the survey is much higher than PRODCOM for the following years. The reason for this is probably due to the fact that the code for Laptops in PRODCOM also includes Palmtops. The Laptop market has been growing four times since 2000, according to Industry, and we assume that the relation of market size between Laptops and Palmtops has changed, thus explaining the differences in numbers between the sources.

Looking into PRODCOM data when plotting graphically, Laptops/Palmtops seems to be better represented in the statistics (less Intra EU-production?) than Desktops. The figures show no disruptive changes as is often the case for Desktops.

For Monitors, survey data are only available for 2005. The figure supplied is 35 times higher than the number extracted from statistics. The interpretation is that monitors are included in the Desktops in Eurostat data, thus giving the apparent consumption of Monitors to be the number of Desktops + the number of individually represented Monitors. There is very little indication of the type of monitors for the earlier years in the interval. For the later years we can deduce from trade volumes that Flat panel monitors are dominating (5/1) compared to the other types. The ratio is growing very fast, which gives the impression that maybe 85% of the 37 M monitors sold in 2005 are Flat panel.

The results from collecting data from the different sources have given the following approximation of apparent consumption:



Table 8: Approximation of apparent consumption in EU-25, calculated mainly from figures from the industry survey, 2000 - 2008

	Desktops	Laptops	Cathode ray monitors	Flat panel monitors
	(millions)	(millions)	(millions)	(millions)
2000	24	6	24	
2001	22	6,5	20	2
2002	22	8	17	5
2003	24	11	10	15
2004	26	15	6	20
2005	28	20	4	26
2006	28	23	2	32
2007	29	28		36
2008	30	31		38

The figures for monitors are very rough approximations, based on the assumptions that all Desktops included a monitor and that the type of monitor is approximately reflected by the distribution of different types of monitors in the trade data.

As can be seen from the data (prognosis), the consumption of Desktops is flattening out to what seems to be a stable level, while the market for Laptops is expanding. The market Desktops can be considered more or less as a pure replacement market.

The distribution of the market for office use and for home use is not presented in official statistics, Eurostat. The survey included questions on this, but only a few of the producers could answer, and then only on the distribution of their own sales.

A recent German study on power consumption labelling [Schlomann, 2005] has produced some information on the distribution between home use and office use



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of Desktops and Laptops in Germany. According to the study, 30% of the Desktops are in office use and 70% in home use. For Laptops the distribution is the opposite, 60% of Laptops are used in office and 40% at home. Later in this report, the same distribution will be assumed true for Europe as a whole and used to calculate the distribution of the installed base.

2.2 Market and stock data

2.2.1 Task and procedure

The market and stock analyses serve two purposes, first to give the rationale for the base cases which will be defined later on in the assignment, secondly to provide basic economic datasets for the assessments of environmental significance for computers.

In this section estimates of the following will be provided:

- Annual sales data of the different types of equipment covered by lot 3
- Actual stock data, or with a more appropriate term “The installed base”
- Average economic lifetimes of the products

The data shall as far as possible give the situation in midterm horizon (past 2000) and forward (2010), as well as long term (2020), and references to the years 1990 and 1995 (Kyoto Protocol references).

Due to the unreliable quality of the official data on production, the significant data are supplied by the industry through the survey [2006].

For such a fast moving technology as computers, it is not possible to distinguish in statistics or other sources between equipment to any detail in performance. What was defined as a workstation 10 years ago could hardly be used for ordinary office purposes today. “Moore’s law” is still valid, giving an astonishing development speed, making all definitions in performance terms “moving targets”.

The “moving definitions” Desktop and Laptop have therefore been used for the computers, since it is the level to which the products can be traced in the statistics. For monitors the three definitions which can be found in Eurostat, Colour CRT, Monochrome and Flat panel monitors are used. The industry data from the survey[2006] contain very little information on monitors, thus forcing quite rough approximations to be made on the distribution of the different types. The final estimates have been reduced to approximations on CRT and Flatpanel.

For the forward looking information, the industry was asked for data and ideas on the developments in midterm horizon (2010), while other sources of “foresight character” have been used for the long term (2020) information.



2.2.2 Results

2.2.2.1 Calculation of installed base of computers and monitors

To calculate the approximate number of units in use, the average lifetime in use for the different equipments must be known. Especially for this type of equipment it must be noted that most computers are replaced, not because they are broken, but due to the fact that the performance is no longer valid. The prime driver for replacement is the software, both operating systems (OS) and application software. The specifications for new operating systems from Microsoft are very often above the performance of a large portion of the installed base.

In this situation, calculation of lifetime (economic) must be based on the producer's experiences. Some producers have done customer surveys and some have data from take-back systems in some countries. Data on age of computers taken back are however not a very good measurement, since it has been found, that most of the equipment going to the "scrap-yard" has been lying unused for some years before thrown away.

To get some indication on lifetimes, the suppliers were asked for their opinions in the survey. The table below shows the average economic lifetime, calculated as mean values of the answers. The deviations were quite high; ranging from 3.5 years to 7 years for Desktop in home use, so the averages should only be taken as some indications. The "second life" of computer in a second hand market, is not included in the figures. There have been indications that 20% of the equipment goes to a second use, thus adding 2 to 3 years to their lifetime.

Table 9: Average economic lifetimes, opinions of the suppliers, for the first life

Equipment	Years
<i>desktop office</i>	6,00
<i>home</i>	5,83
<i>Laptop office</i>	4,60
<i>Laptop home</i>	4,75
<i>CRT</i>	6,00
<i>LCD</i>	5,88
<i>workstation</i>	7,00

The deviation in the answers was quite high, especially on differences in life-time for office use and for home use. Some of the respondents claimed that the lifetime was longer in office use, some the opposite. Because of the uncertainties the estimated lifetimes have been simplified to whole years, and assumed the same for office use and home use. The following table shows the lifetimes used for further calculations:



Table 10: Average economic lifetimes, for calculation of installed base

Equipment	Average economic lifetime (years)
Desktop	6
Laptop	5
CRT	6
LCD	6

Integrating the data in Table 8 (apparent consumption), over the approximated lifetimes, the following very rough estimation of equipment in use is calculated (since the integration is to be made 6 years back, and there are no reliable data before 2000, the calculations are made from 2005 and forward). For laptops, the expected lifetime is shorter, thus making it possible to present an estimate also for 2004. For Flat panel-monitors, no sales were reported before 2001, thus allowing calculation of installed base from 2001 and forward.

Table 11: A very rough approximation over units in use in EU 25

	Desktops	Laptops	CRT-monitors	Flat panel monitors
	(millions)	(millions)	(millions)	(millions)
2004		46,5		42
2005	146	60,5	81	68
2006	150	77	59	100
2007	157	97	42	134
2008	165	117	25	167

Applying the distribution home-office taken from [Schlomann, 2003], the following table over installed base in office and home is produced:



Table 12: Approximate installed base of computers and monitors, in office and in home use.

	Desktops		Laptops		CRT-monitors		Flat panel monitors	
	(millions)		(millions)		(millions)		(millions)	
	Office	Home	Office	Home	Office	Home	Office	Home
2004			28	18,5			13	29
2005	44	102	36,5	24	24	57	20,5	47,5
2006	45	105	46	31	18	41	30	70
2007	47	110	58	39	13	29	40	94
2008	49	116	70	47	7,7	17,5	50	117

For CRT-monitors and Flat panel- monitors, the distribution between office and home use has been assumed to be the same as the distribution for Desktops.

2.2.2.2 Estimations of market and installed base 2010

The survey did not give any estimations of sales volumes after 2008, but as will be shown later, no major changes of the format of computers are expected in that time frame.

[Schlomann, 2003] gives some estimates on predicted German installed base in 2015. For the office, the number of computers is expected to increase by 10%, the expansion completely by Laptops. For home use a German expansion of 40% is expected until 2015, with a focus on Laptops.

Comparing this with the estimates for Europe as a whole until 2008 given in the survey, the survey indicates a bigger expansion. This can be explained by the high computer maturity in Germany and other West European countries, compared to the new member states, thus giving room for a bigger expansion.

With the available information the best estimates for 2010 are probably calculated by extrapolating the trends in Table 12 for another two years, giving the following:



Table 13: Rough approximation of installed base of computers and monitors, 2009 - 2010

	Desktops		Laptops		CRT-monitors		Flat panel monitors	
	(millions)		(millions)		(millions)		(millions)	
	Office	Home	Office	Home	Office	Home	Office	Home
2009	50	123	82	55	2	5	55	130
2010	51	130	94	63	1	1	60	140

The expansion rate of Flat panel-monitors has been reduced compared to the extrapolation, since the sales in the years preceding 2009 have consisted to a large part of replacements for old CRT-monitors. As indicated before, the major part of the expansion of the market is based on Laptops, while the Desktop market is a replacement market, except in the new member states.



2.2.2.3 Retrospect to 1995

For Kyoto references, relevant data for 1995 and 2000 are needed. The production data in Eurostat are very sparse, to such a level that it is not useful to present by nation. Laptops and flat panel monitors are not yet present in the statistics. Eurostat published data for the first time in 1995, thus not making any earlier data available, making it impossible to calculate the installed base.

In 1995, the computer was not yet a communication device to any large extent, Internet was breaking through, initiating a large expansion of the installed base.

Table 14: Production 1995, PRODCOM data

1995	Desktop PCs		Colour video monitors cathode-ray tube	
	VOLUME (1000 units)	VALUE IN (M EURO)	VOLUME (1000 units)	VALUE IN (M EURO)
EU15TOTALS	1683	4560	64	38

Table 15: Extra EU trade 1995, PRODCOM data

1995								
	Desktop PCs		Colour video monitors cathode-ray tube		Flat panel video monitor		Monochrome monitors	
	VOLUME (1000 units)	VALUE IN (M EURO)	VOLUME (1000 units)	VALUE IN (M EURO)	VOLUME (1000 units)	VALUE IN (M EURO)	VOLUME (1000 units)	VALUE IN (M EURO)
EU15-export	93077	2748	52	34	15	8	50	15
EU15-import	3857	2257	91	43	44	16	382	34

The quality of the data has obviously not yet been stabilized; the export volume is not in line with the value of the export. The best estimate possible from the figures supplied is that the market in EU15 was roughly 2 million Desktops in 1995.

2.2.2.4 Retrospect to 2000

In 2000, Eurostat was better established, giving more reliable data. Internet had made the breakthrough at least in office, thus generating a large expansion of the computer market.

Table 16: Production 2000, PRODCOM data

2000	Laptop PCs and palm-top organisers		Desktop PCs		Colour video monitors cathode-ray tube		Flat panel video monitor	
	(1000 units)	(M EURO)	(1000 units)	(M EURO)	(1000 units)	(M EURO)	(1000 units)	(M EURO)
EU15TOTALS	6844	9311	7442	7398	736	155	10	36



Table 17: Extra EU15 trade 2000, PRODCOM data

2000												
	Laptop PCs and palm-top organisers		Desktop PCs		Digital data processing mach//systems		Colour video monitors cathode-ray tube		Flat panel video monitor		Monochrome monitors	
	(1000)	(M EURO)	(1000)	(M EURO)	(1000)	(M EURO)	(1000)	(M EURO)	(1000)	(M EURO)	(1000)	(M EURO)
EU15-export	1234	1031	860	939	686	1092	59	38	59	26	57	15
EU15-import	7172	4924	2915	1009	830	939	182	76	120	75	729	46

According to the data from PRODCOM, the Desktop market was 9.6 M units, while the industry survey indicated a market of **24 M Desktops**. For Laptops, the data from PRODCOM include Palmtops, making the figures from the survey much more reliable, indicating a market of **6 M Laptops** for EU25.

The market data for monitors are obviously not yet reliable, and the survey did not give any information, thus generating the assumption that the market for **monitors** was roughly the same size as the market for Desktops, **24 M units**.

Calculations on the installed base in 2000 cannot be made on the existing data to any reasonable quality.

Comparing the data from 1995, 2000 and 2005 it can be noted that the external trade values (import + export) for Laptops have gone from 0 in 1995, to almost 14.000 M Euro in 2005. For Desktops, the trade values have gone from 5.005 M Euro to 1.614 M Euro in the same period. Apart from the very large expansion in sales volume on Laptops, a different production pattern may also explain the very large difference in the development; Desktops are often assembled close to the market thus not showing up in external trade.

Flat panel monitors have also evolved to a very large market in short time. In 1995 there was no noticeable trade and in 2005, the external trade represented a value of 1.760 M Euro.



2.3 Market trends

2.3.1 Consumer tests

2.3.1.1 Desktops and laptops

Stiftung Warentest is a German foundation that helps consumers by providing independent and objective tests of consumer products. In February 2006 they published a test of ten laptops and six Desktops where they tested the computers both within the group (Laptops/Desktops) and also between the two groups. The test is (as of 2006-10-12) available for purchase at. [Stiftung Warentest, 2006]

The tested laptops were:

- Benq Joybook R53 G16 (Best in test)
- Toshiba Satellite L20-120
- Acer Aspire 1652WLMi
- Samsung R50 WVM 1730
- Asus A6KM-Q002H
- Dell Inspiron 1300 Advanced
- Fujitsu Siemens Amilo A 1667 G
- Sony Vaio VGN-FS315M.G4
- Hewlett Packard Pavilion ze2356ea
- Maxdata NB ECO 4100IW DE

And the tested Desktops were:

- Dell Dimension 5150 Large (Best in test)
- Hewlett Packard Pavilion t3257.de (Best in test)
- Medion Multimedia PC Intel P4 640
- Acer Aspire E300
- Fujitsu Siemens Scaleo Pi
- Packard Bell iMedia 5191

When comparing Desktops vs. laptops they concluded that laptops have well enough computing capacity for “normal” use, and have the advantage of being portable. All computers tested, laptops and Desktops, were considered to be satisfying. On the other hand, if the user doesn’t need the portability, a Desktop is a better choice by the following reasons:

- Desktops have better computing power, especially valid for heavy uses such as video editing or gaming
- Desktops have larger hard drives
- Desktops are better equipped, they have for example more USB ports, memory card readers
- Desktops are more flexible, it is possible to exchange and add components such as hard drives, graphic cards and so on



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- Desktops have generally better ergonomics, it is easier to get good ergonomic working posture

The evaluations were based on the following criteria:

- Computing power (25% laptops, 40% Desktops)
Using benchmark applications for office, multimedia and games
- Handling (20%)
Evaluating documentation, recovery possibilities, day-to-day handling, laptop weight and Desktop build quality
- Screen (15% laptops)
Evaluating the screen quality and external display possibilities
- Battery (15% laptops)
Evaluating the battery operating time, battery drain warnings and the recharge times
- Versatility (10% laptops, 25 % Desktops)
Evaluated the enclosed software and hardware and communication and expansion capabilities
- Environmental characteristics (15%)
Evaluated the noise and power consumption in use, stand by and off mode

2.3.1.2 Monitors

Tom's Hardware Guide is a web site where they review and test hardware, mostly aimed for computer enthusiasts. They regularly test monitors, and in the end of March 2006 they compared eleven 19" LCD monitors. The test is (as of 2006-10-12) available at [Tom's Hardware]

The tested monitors are:

- BenQ FP91V+
- BenQ FP91V
- Hyundai Q90U
- NEC 1980Fxi/NEC 90GX2
- Samsung 960BF
- Samsung 970P
- Sony MFM-HT95
- ViewSonic VX922
- ViewSonic VP930
- Xerox Xa7-192i

All monitors share the same resolution of 1280*1024 pixels and have at least VGA and DVI connections while the specified contrast varies between 600:1 and 1000:1, the specified brightness varies between 250 and 450 nits and the specified response time varies between 2 and 18 ms.

The tested properties are design, ergonomics, connectivity, delta tracking, contrast, colour gamut, spatial uniformity, latency, overshoot and "In Use".



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They summarize the test with stating that the pace of monitor technology improvement is currently huge, as is the rate of getting new monitors to the market. One current trend is that the manufacturers design monitors for specific applications, such as office production, gaming or photo and graphic production. This makes it difficult to select a test winner since different monitors are suitable for different uses. However, they mention the ViewSonic VP930 as it is good in many respects, while the ViewSonic VX922 may be better suited for gamers and the Samsung 970P might be best among these monitors for photo retouching.

2.3.2 Production structure

In the discussions with the producers, the general characteristics of the production structure and supply chain were covered. The patterns seem to be similar for many of the producers:

The design is often a shared operation between Europe, US and South East Asia, thus getting customer preferences from several markets.

The Integrated circuits and other components are produced mainly in South East Asia.

For Laptops and Displays (LCD) the whole production is located to South East Asia, while Desktops due to the more modular design, very often are assembled close to the market in Europe, from parts produced in South East Asia.

2.3.3 Actual markets shares by producer

Detailed data on market shares and market penetration are only available through commercial data sources, therefore the producers were each asked for their own market shares. Since not all producers have answered the survey, the picture is not complete, but gives an indication on who are the major “players” in different market segments.

During the discussions with industry, they all pointed to the fact that around **10% - 35%**, of the market for Desktops is held by so called “**White boxes**”, that is more or less temporary suppliers operating without a brand, buying surplus details on the global market to compete in the low price segment. These suppliers are by nature very hard to reach for voluntary agreements concerning environmental performances. The White boxes are more common on the private market.

Due to the sensitive nature of the figures on market shares, the observations are limited to indications on who are the major players on the different markets.

The dominating suppliers of office Desktops seem to be Dell and HP. For Desktops in home use, Packard Bell has a market share similar in size with HP and Dell. Apple, Lenovo (former IBM), Acer and NEC are also present.



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For laptops, HP, Toshiba and Dell are dominating the office market, while the home market is shared between HP, Toshiba, Dell, Packard Bell and Sony. NEC has a relatively small market share.

For CRT-monitors, HP seems to dominate.

In the LCD-monitor market, Dell, Acer, Samsung and HP all have a market share above 10%. Philips, Fujitsu-Siemens and LG have market shares around 5% each.

The actual market shares are not shown in figures, since some of the suppliers opted not to give specific figures due to principle.

2.3.4 Prospect 2010, Market and features.

Taking the speed of development into account, it would be possible with major changes in system format and usage pattern. Higher technological performance, like processor speed and higher memory density could lead to a very fast move towards smaller devices, and a fast integration with the mobile phone.

In the survey to industry [2006], a number of questions along different possible directions of that kind were asked.

In the answers, the general impression delivered, that for the short term future (2010), the major trend will be to use new technology to enhance the performance in existing formats. The major driver for this is the coming introduction of the next OS (operating system) from Microsoft (Vista), which will demand as much performance as can be generated in the coming years. Market impact from Vista is expected to start in 2007, and an accelerated shift out of older equipment is expected. This is mainly reflected in the estimated market figures in earlier chapters.

The industry are foreseeing a breakthrough for connectivity in several steps, in short term by network technologies like WWAN and WIMAX, in longer term on more advanced technologies. This will put increased pressure on battery operation and longer running time on battery. More energy efficiency is expected in short term through more efficient components, but also gradually better batteries.

For laptops, the move for higher efficiency will be balanced by the need to make the devices thinner and less heavy in physical respect.

A change in display technology is expected, but it seems from the answers uncertain whether the technology with LED-backlights (a development of the older LCD technology, but environmental positive due to reduction of mercury) will be ready for market before 2010. This seems to be a rather conservative judgement since several other sources have indicated that the next technology OLED may come into market before 2010. The development of monitors is also continuously driven by accelerated demands from the users for better resolution and better performance for showing moving pictures. The producers of monitors



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also have to balance between demands for design and demands for workplace quality.

According to “Display search”, the average prices of Flat panel computer monitors are shrinking at an exponential rate, the cost per square meter display area has gone from 10.000\$ in 1999, to 2.000\$ in 2005, indicating a continued move to larger and cheaper displays.

New memory technology is expected to improve the speed of hard-drives in the near future. The very fast evolution of flash memories will offer short term possibilities for energy reduction by partly replacing hard discs.

In the case of home entertainment, the suppliers show quite different opinions whether the computer will move into the living room and become the centre device for digital TV, DVD and so on. Several of the respondents express the view, that the market will supply specialized equipment for this type of applications, while others believe the general computer will gradually take over from the TV.

Several of the answers point to a gradual need for a home server, continuously on, to serve as communication centre. They also point to the problem of wireless LANs which demand the computer to stay alive to keep the connection running, thus limiting the ability to go into energy saving mode.

In summary, for the short term (2010), the existing formats will prevail. A new wave of replacement sale will start around 2007. The numbers in previous sections point to a continued expansion of Laptop volume, while Desktops are levelling out to a steady volume of pure replacements. The sale of CRT-monitors is quickly declining in volume but with some indications for a continued demand in niche markets and niche applications.

2.3.5 Prospect 2020, Market and features

15 years in the future is a very long time, dealing with fast moving technology as ICT. According to the futurologist Ray Kurtzweil [2004] all Information Technologies double their power every year (price, performance, capacity and bandwidth). If this vision holds true, we are, when looking towards 2020, trying to understand how mankind will use technology 32.000 times as powerful as today’s (2 to the power of 15). It must be observed that not all experts agree on the validity of Moore law beyond 2015 and claim a slower expansion rate after that, but on the other hand many have done so before and the evolution has repeatedly proved them wrong and some are even arguing that the speed of Moore’s law is going up.

Based on such enormous developments, a fifteen year prediction can only be in the form of a discussion on early observed trend babies and key questions around them.



2.3.5.1 Will the current computer format prevail?

We already have the technology to make very small handheld devices with the full capacity of an ordinary PC - while at the same time having functionality as cell phone, GPS and camera. With new coming communication technologies it would be possible to be connected everywhere and every time through a palmtop/mobile phone with all necessary capacity for the kind of personal computing we are used to.

The limitations of this movement seem to be the user interface, before these kinds of devices can make the PC or Laptop redundant, completely new ways of interacting with the device must be invented. Technologies like speech recognition and displays in eyeglasses are tested but have yet to prove the usability before any major change of format can take place.

Anyhow the evolution of the mobile phone into a multipurpose device has shown that more and more daily tasks are executed on such devices. The phone will for certain be a computer, but so far with a very limited user interface.

One important possibility is that new short distance wireless technology will open new possibilities to use the phone as the computer, always carried with you, but connecting to wireless interface devices in the office or at home and in public places - thereby obtaining the interface of the computer.

2.3.5.2 Will the net takeover?

Some foresights (Cisco) [2006] are indicating a long term development where the network will be the computer, meaning giving lots of users the ability to “borrow computer power from each other when needed” thus reducing the need for local capacity. They also indicate that more and more applications will be accessible over the net (a development currently pursued by Google), reducing the need for local storage and local maintenance of software.

For some applications, this may be a commercial success, but computer power does not seem to be a limitation in the future.

The network capabilities will for certain change the ways we are working and the way we share information both locally (in the company and in the community), and globally. Nearly unlimited capacity for video-meetings and other ways of remote communication will give the opportunity to work from anywhere. One driver for such a development will probably also be the cost of energy and possible future limitations on travels (oil price).

2.3.5.3 Will advancements in technology be used for reducing prices instead of enlarging capacities?

For the short term, the industry has given a clear answer that the specifications for new operating systems will use all possible capacity (within reasonable price



limits), but with increasing capacity per unit, it is quite possible that the market, in the future, goes more definitely for lower prices instead. Since such a development would affect the revenues of the total industry, it is likely to meet commercial interests forcing an ever increasing need for capacity and consolidation of the companies in the business.

2.3.5.4 Will TV, DVD, CD be replaced by computers, to give more interactivity?

The introduction of digital TV, streaming video, massive supply of news over the Internet and other related developments, will increase the opportunities of using a computer as a “communication centre in the living room”. It is still under debate whether personal computers will be used or whether the media industry will provide other configurations of computerized equipment for such applications.

The development of network capacity and storage capacity will open for completely new services allowing much more of interactivity and personal choices.

The big question is whether the media industry and computer industry will amalgamate to one industry or if the now two industry branches will pursue different directions of development

2.3.5.5 Will voice on IP dominate, will the computer be a phone or vice versa?

Voice on IP is expanding rapidly, the direction of development on devices for connection is still under debate, IP-phones may be simple, but will not so far give the versatility of the computer for video, file interaction and so on. When voice on IP becomes the dominating tele-communication, it may become necessary or practical for every home to have a server always on, to manage the connection and the connectivity.

2.3.5.6 Will everything in the household be connected?

Some future studies see the need, desirability and possibility to make all household installation (like refrigerators, stoves, washing machines, the heating system and so on) computerized and connected. The need for such developments and the business potential are generally yet to be proven, but if there will be a market, the computing structure of the household may be effected quite a lot.

2.3.5.7 Will we have computer screens as art?

The cost of large screens is decreasing rapidly, so there might be other usage patterns than pure communication in the traditional sense. With decreased cost, we might use computer screens on the wall showing art, to fit the moment. We could even use computer screens to improve the reality, show a nice outside view instead of the boring backyard. The possibilities will be limitless, but what will the consumer’s desires and preferences be?



2.3.5.8 Carried Artificial Intelligence, improving our decision capacity everywhere?

The development of AI has not quite lived up to expectation yet. Still with much increased computing power and more agile user interfaces, AI may come to a daily use by everybody, improving the ability to take daily decision in a more informed and optimal way. In 15 years time, the technology might be here, but what would be the effects? What will be the impact on the perception of knowledge and the market value of education? It would surely be revolutionary, but is it desirable?

2.3.5.9 Conclusion 2020

It is now ten years since the breakthrough of the Internet. In those times information was more or less exclusively confined to paper. There were computers but they were heavy and clumsy and very often crashed. In fifteen years' time, the opportunities of applying and using computer technology will be huge. The speed of knowledge acquisition is exponential, most written text can be found in some form on the web, Google has effectively already copied all the world's known books. Music and movie industry are heavily affected. The futurist Kurzweil even claims computers will disappear from our sight by 2010. The directions for applications will be dependant both on what producers choose to develop and what will be accepted by the customers. The development speed makes predictions practically useless for such a long timeframe - but we will all be affected.

This chapter was included to give indications of possible multidirectional futures. The directions of applications will naturally affect industry and industry structure immensely.



2.4 Consumer expenditure database

2.4.1 Comparison of average unit prices 2003 – 2005

Since the capacity of especially Desktops and Laptops varies a lot between individual units, and even more over the years, it is almost impossible to make any relevant price comparisons at a detailed level. It can be observed in general that the market tends to decide a generally accepted price by the consumers for one physical unit, and then supply as much performance as is possible for that price. A closer study would probably reveal a pattern with different accepted prices for different consumer segments.

This observation is in general supported by the table below, where the average unit prices have been calculated, based on import volumes and values, taken from PRODCOM, over as many years as available in the statistics.

Table 18: Average unit prices, calculated from PRODCOM import data

Year	Laptop	Desktop	System	Colour CRT	Flat panel monitor	Monochrome monitors
	EURO	EURO	EURO	EURO	EURO	EURO
1995		585		480	369	91
2000	687	346	1131	420	627	64
2003	632	364	246	306	364	44
2004	637	244	180	273	380	43
2005	539	157	397	273	277	34

From the table, it is obvious that Laptops had a very stable price from 2000 to 2004, but that the price started to drop in 2005. The prices for Desktops have been shrinking continuously thus not supporting the theory above. All other unit prices have been falling in general. The clear exception is systems, but this is probably due to the wide variety of intellectual content and value added included under this code.

It must be noted that the prices in this calculation are not based on retail prices, but on the prices when passing the customs.

From the survey [2006], the following weighted mean retail prices for the most sold version of equipments from each producer have been calculated:



Table 19: Weighted mean value of retail prices, 2005, data from survey

Desktop office	Desktop home	Laptop office	Laptop home	CRT	LCD
Euro/unit	Euro/unit	Euro/unit	Euro/unit	Euro/unit	Euro/unit
620	520	1242	990	73	201

The bases for the calculations are: for Desktops office 3.3 M units, for Desktop home 1.1 M units, for Laptop office 1.6 M units, for Laptop home 0.8 M units, for CRT 0.7 M units and for LCD 1.3 m units.

It must also be noted that for computers, the real cost for the consumer also depends a lot on the software. In the figures in the table it is unlikely that any major part of the cost for software is included. Most computers have the major part of software installed by the retailers or by the users.



2.4.2 Electricity rates

The electricity rates do change over time. Since the study shall cover the year 2005, the [EUROSTAT] rates from 1 July 2005 will be used in the calculations in subsequent tasks.

Table 20: Household electricity rates. (Standard Consumer Dc, Yearly consumption 3500 kWh of which 1.300 kWh by night) July 2005 incl. all taxes.

Country	Electricity rate (€/kWh)	Tax share of price (%)
EU- 25 average	13,6	23,8
Austria (AT)	13,91	31,8
Belgium (BE)	14,29	23,0
Cyprus (CY)	12,03	14,6
Czech Republic (CZ)	8,71	16,0
Denmark (DK)	23,20	58,5
Estonia (EE)	7,13	15,2
Finland (FI)	10,38	25,2
France (FR)	11,94	24,2
Germany (DE)	18,01	25,2
Greece (EL)	6,94	8,2
Hungary (HU)	11,24	20,0
Ireland (IE)	14,36	16,6
Italy (IT)	20,10	24,8
Latvia (LV)	8,29	15,3
Lithuania (LT)	7,18	15,2
Luxembourg (LU)	15,02	12,7
Malta (MT)	7,69	4,9
Poland (PL)	9,35	23,2
Portugal (PT)	13,80	5,1



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Slovak Republic (SK)	13,30	16,1
Slovenia (SI)	10,49	16,7
Spain (ES)	10,97	18,0
Sweden (SE)	13,33	39,6
The Netherlands (NL)	19,6	43,5
United Kingdom (UK)	9,26	4,9

During 2005 the prices rose by 5% on average for households and by 16% for industrial consumers.

2.4.3 Repair and maintenance costs

Regarding the repair and maintenance cost, there are some different ways to handle this:

2.4.3.1 Service agreement

For the computer and monitor market, an often used way to handle repair and maintenance cost, is to buy a service agreement. An example of that is (from one of the companies answering our survey) if a company buys a 1000€ computer set (computer and monitor), they often pay about 200€ for a 3 year service agreement, where ALL repair and maintenance costs are included. The same kind of agreement is also available for private consumers who can pay approximately 120€/year for the same kind of service. The costs do differ from small to big customers and also depend on where the equipment is.

Quite often these service agreements are already included in the purchase prices.

2.4.3.2 Upgrading

Computers (but hardly monitors) can be upgraded to fulfil a better performance by changing processors, hard disk drives, graphics cards and other parts. This is an opportunity sometimes used by private consumers, but hardly by companies. The industry gave some figures saying approximately 2% of the customers use that opportunity. We assume that the cost for an upgrade is about 200€

2.4.3.3 Repair

Computers

Those who do not have a service agreement do repair their computers when they break. Most computers break somehow sometime. Figures on repair cost were



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very difficult to find, but contacts to a couple of computer repair companies gave some information. An ordinary repair cost is about 75€ for labour for identifying and changing some broken hardware, which have different costs, but often between 50 and 150€. We assume every computer need one repair at a cost of 125€ in its life time.

Monitors

Monitors do mostly have a three-year warranty, within which time broken monitors are repaired for free. The repair cost of a monitor is often about 120€ which is far too much to pay for a monitor of older age than 3 years, since a new one does not cost much more than that.

Software

A quite common repair and maintenance cost for computers is the cost to provide the computers with new or upgraded software. A study referred to by Tim Landeck [Total Cost of Ownership] says that the initial purchase price for hardware and software is approximately 16% of the Total Cost of Ownership of a computer.

The computer repair companies say that they do very often have to reinstall software, such as operating system at a cost of approximately 75 €

2.4.4 Disposal costs

Disposal costs for computers and monitors, come under the WEEE directive, which means that the producer has the responsibility to take care of the equipment after use. That means that in a past WEEE situation there will be no cost for the consumer related to the disposal of this equipment, except from the higher price the manufacturer might use due to their disposal costs. Today the situation differs very much from country to country, and even from region to region within the countries. The WEEE directive is working in Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, Germany, Greece, Hungary, Ireland, Luxembourg, The Netherlands, Portugal, Slovakia, Spain and Sweden. On the other hand WEEE system is not yet completed in Cyprus, France, Italy, Latvia, Lithuania, Malta, Poland, Slovenia and UK.

Since Sweden has a "producer responsibility" legislation since 2001, even before the WEEE directive, there might be of interest to highlight up some of the information from it:

2.4.4.1 Swedish example of disposal costs

"El-kretsen", the Swedish electric and electronic waste collection company, did collect 126 millions kg electronic waste 2005 (incl. refrigerators and freezers from. 13/8-2005). Without refrigerators and freezers: 112 million kg. Approximately 12% were computers and monitors. "El-kretsen" is collecting



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almost all electric and electronic waste in Sweden, but some of it comes to the recycling companies from other sources, perhaps 8-10%.

Since the introduction of producer responsibility 2001, the increase has been 15-20%/year, most of it last year, probably due to the WEEE- directive.

Table 21: Total cost for disposal 2005 Sweden, assumption

	kg	SEK/kg	M SEK	1000 Euro
Desktop computers	5,7 M	2,0	11,4	1140
Laptop computers	140 000	2,5	0,35	350
CRT monitors	10,2 M	4,0	40,8	4800
LCD monitors	96 000	3,5	0,33	330
total				6620

For a CRT of 17” and of 16 kg, it means a cost of approximately 6€

The costs for the manufacturers are calculated on their market shares to decide who should pay what. For example, if one company has 20% market shares of CRT, it would mean $0.2 \cdot 4800\ 000\ \text{€}$, which is about 960 000 €. That is independent of if they did really provide the products, which are physically sent to the end of life treatment. So even if a manufacturer is new to the market, they have to pay for end of life for “their” share of products.



2.4.5 Interest and inflation rates

The following table shows inflation and interest rates for the EU25 as published by Eurostat and the ECB. [2005]

Table 22: Interest rate EU25, 19 Jan 2006

Country	Inflation rates [%] ⁽¹⁾	Interest rates [%] ⁽²⁾
Belgium (BE)	2,8	3,4
Czech Republic (CZ)	1,9	:
Denmark (DK)	2,2	3,4
Germany (DE)	2,1	3,4
Estonia (EE)	3,6	-
Greece (EL)	3,5	3,6
Spain (ES)	3,7	3,4
France (FR)	1,8	3,4
Ireland (IE)	2,2	3,3
Italy (IT)	2,1	3,6
Cyprus (CY)	1,4	5,2
Latvia (LV)	7,1	3,5
Lithuania (LT)	3,0	3,7
Luxembourg (LU)	3,4	:
Hungary (HU)	3,3	6,6
Malta (MT)	3,4	4,6
The Netherlands (NL)	2,1	3,4
Austria (AT)	1,6	3,4
Poland (PL)	0,8	5,2
Portugal (PT)	2,5	3,4
Slovenia (SI)	2,4	3,8
Slovak Republic (SK)	3,9	3,5
Finland (FI)	1,1	3,4
Sweden (SE)	1,3	3,4
United Kingdom (UK)	2,0	4,5
EU 15	2,2 ⁽³⁾	3,42 ⁽³⁾
EU 25	2,1	3,9



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- *IVF industrial survey (2006)*

Several stakeholders did answer the questionnaire from IVF during the summer 2006. Due to secrecy agreements, they are not named here, but they do cover the main players for both computers and monitors, and also covering companies from Europe, The USA and Asia. The number of respondents to the questionnaire was 16.