JRC TECHNICAL REPORTS

Development of European Ecolabel and Green Public Procurement Criteria for Desktop PCs and Notebook PCs

Nicholas Dodd, Oliver Wolf (JRC-IPTS)
Kathrin Graulich, Rita Groß, Ran Liu, Andreas Manhart, Siddharth Prakash (Öko-Institut e.V. – Institute for Applied Ecology)

Joint Research Centre

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INTRODUCTION

This draft Task report is intended to provide the background information for the revision of the EU Ecolabel criteria for personal and notebook computers. The study has been carried out by the Joint Research Centre's Institute for Prospective Technological Studies (JRC-IPTS) with technical support from the Öko-Institut e.V. (OEKO). The work is being developed for the European Commission's Directorate General for the Environment.

This draft preliminary Task 2 report addresses the requirements of the Ecolabel Regulation No 66/2010 for technical evidence to inform the criteria revision. It consists of background information that forms a market analysis. Together with the description of the scope and legal framework (Task 1) and the technical analysis (Task 3) as well as input from stakeholders, the information will be used to analyse the improvement potential (Task 4), determine the focus for the revision process and present an initial set of criteria proposals (Task 5).

1. MARKET ANALYSIS

The aim of the Task 2 report is to update and/or collect key figures which will enable quantitative assessment of the economic relevance of the product group at micro and macro level, and to provide information on the functioning of the market for the product group both from the producer and consumer perspective in order to identify relevant trends, drivers, innovations, market segmentations and initiatives.
The following sections provide short summaries of the main characteristics of the computer market based on a collection and overview of existing data for the main products, technologies and their market shares. The key manufacturers are presented, supplemented by an analysis of the market penetration of computers with for energy standards and/or ecolabels. Finally, consumer aspects and future trends are compiled which might have an influence on the current and future potential for the market penetration of products bearing the EU Ecolabel.

1.1 Market data

For the purpose of this study, the revision of the European Ecolabel and Green Public Procurement criteria for computers, the current market situation, trends and forecast for the next years is presented in this section. The literature analysis revealed, however, that public available market data is generally only provided for worldwide trends and forecasts and not for EU-27[1]. Nevertheless, the major global trends are expected to be valid also for Europe so that general conclusions for this study can be drawn.

1.1.1 Desktop PCs / Notebook PCs / Tablet PCs

According to IDC[2], the total PC shipments indicate a 13.9% decline between the first quarter of 2013 and the same period of 2012.

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[1] Recognised and often cited independent IT sector analysts include, amongst others, Display Search and Gartner. Their reports and data are generally for the preserve of private clients, with their high cost reflecting the value of the market intelligence they contain.
[2] Source: http://prafulla.net/interesting-contents/world-interesting-contents/the-global-pc-market-is-collapsing-infographic/

In Western Europe, PC shipments totalled 13.6 million units in the second quarter of 2012, a 2.4 percent decline compared with the equivalent period in 2011, according to Gartner. While mobile PC shipments grew 4 percent, desk-based PC shipments declined 12.8 percent in the second quarter of 2012 in Western Europe.

The professional PC market declined 5.3 percent, while the consumer PC market was almost flat, with 0.4 percent growth.[3]

Figure 1 provides global shipment data for desktop PCs, notebook PCs, and tablets from 2010 to 2012 and also offers a forecast until 2017.[4] Figure 2 shows global shipment figures solely for tablet PCs.[5]

Currently, notebook PCs account for the highest proportion, but expected to be overtaken by tablet PCs from 2014. In 2010, around 19 million tablets were sold worldwide, while in 2012 the amount reached 128 million units, 6.7 times larger than 2010. It is predicted that the number of worldwide shipped tablet PCs will increase to 352 million by 2017.

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[3]   Source: http://www.gartner.com/newsroom/id/2112815

[4] Source: http://www.statista.com/statistics/183419/forecast-of-global-sales-of-pcs-by-category/

[5] Source: http://www.statista.com/statistics/165462/forecast-of-global-sales-of-media-tablets-by-2015/
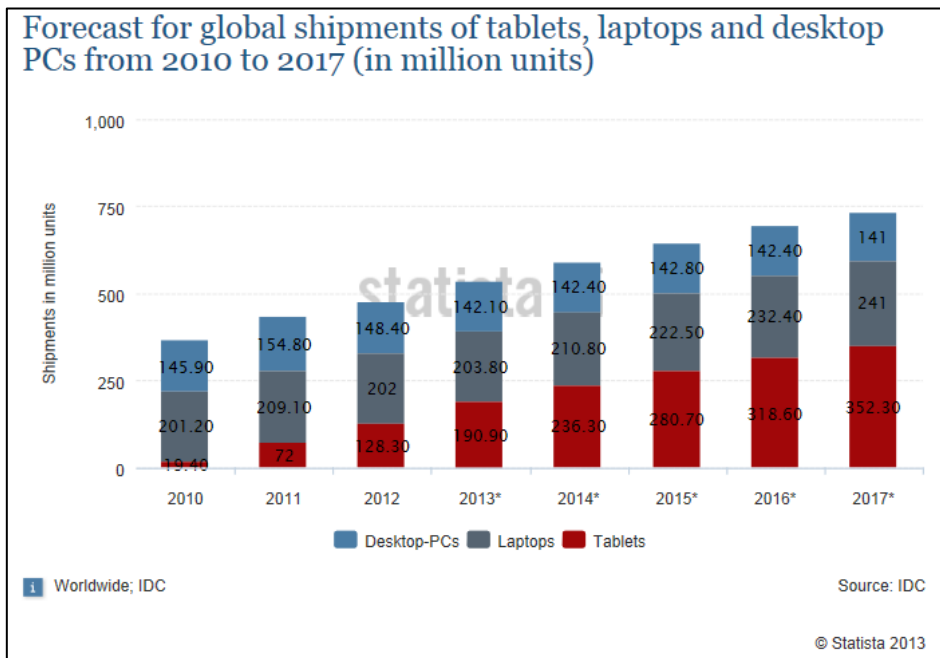
Figure 1: Forecast for global shipments of tablets, notebook PCs and desktop PCs from 2010 to 2017 (Source: Statista)
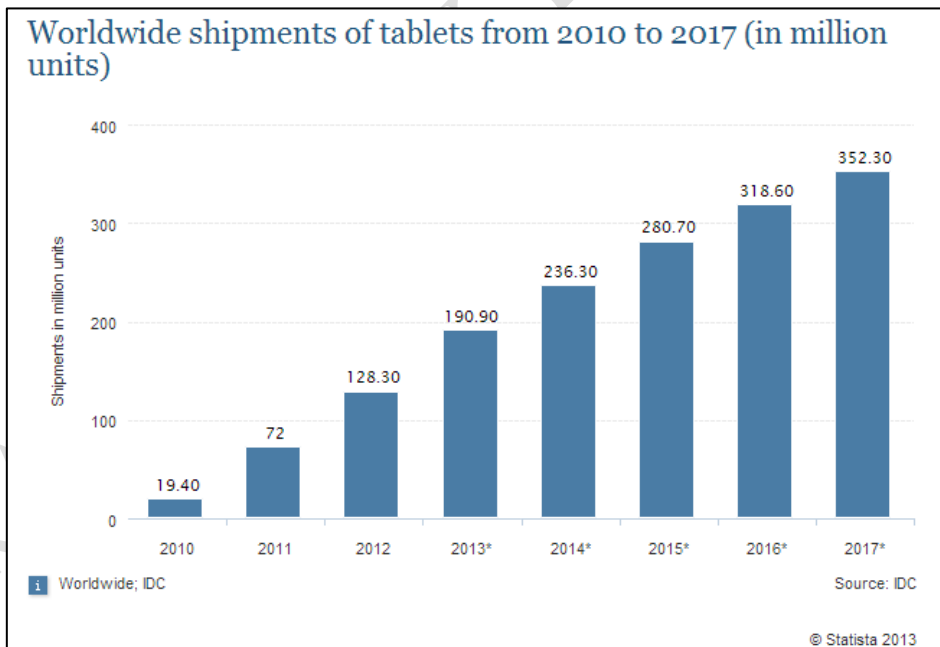
Figure 2: Forecast for global shipments of tablets from 2010 to 2017 (Source: Statista)

These global trends are mostly confirmed for Western Europe. According to GfK[6], sales of IT products in Europe's biggest countries, Germany, France, the UK, Italy, Spain and the Netherlands, dropped back 1.3 percent in the first six months of 2012. In particular, private consumers are now well equipped with computers and associated products, added to which, IT equipment is generally only replaced in 3-year or more cycles. Most affected are sales of desk computers and mobile PCs, the two major product groups, whilst niche products and innovative devices – especially media tablets – are still overtaking all the rest.

In Western Europe, sales of media **tablets** have recorded the most dynamic growth to rocket by 142 percent according to GfK[6]. Although it is mostly private customers who are buying these devices, they are also being increasingly bought by the corporates. In fact, in the first half of the year, businesses accounted for more than 13 percent of total sales of media tablets.

In the first half year of 2013, consumer demand is still focused on innovative products like media tablets and **ultra-thin notebooks**. These segments are continuing to show very positive growth rates in Western Europe (+36.7 percent in the first half of 2012) according to GfK[6,7]. As Gartner[3] states, today a lot of industry hope lies with the release of the new ultra-thin and light form factor for mobile PCs, which could bridge the gap between notebooks and tablets. The Ultrabook segment has attracted the interest of consumers and continues to grow, but volumes are still low. In France, for example, the ultraportable segment represented 9 percent of all mobile PCs shipped in the second quarter 2012.

According to NPD DisplaySearch[8], **all-in-one (AIO) PCs** historically amounted to no more than 2% of the total desktop display market. A former forecast until 2012 predicted the worldwide shipments of desktop PCs with built-in displays to be around

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[6] Source: http://www.gfk.com/Documents/Press-Releases/2012/20120829_gfk_it_ifa_2012_efin.pdf
[7] Source: http://www.gfk.com/Documents/Press-Releases/2013/20130827_GfK-TEMAX-WE-2-2013_efin.pdf
[8] Source: http://www.displaysearch.com/pdf/090407_increased_outlook_for_low_cost_all_in_one_lcd_pcs_not_enough_to_lift_lcd_desktop_display_market.pdf

8 million units which would be around 5% of the total number of desktop PCs based on the data given in Figure 1.

Figure 3 summaries data on the global revenue of desktop PCs, notebooks, tablets and servers worldwide from 2009 to 2015[9]. As this figure illustrates, notebook PCs account for the largest part of the market until 2014 from the revenue point of view. From 2015, the situation changes and tablets PCs would dominate the market. The revenue from desktop PCs and notebook PCs shows a continuous decrease. Only the revenue from tablets is expected to continue to climb. The revenue from servers is projected to remain the same in 2015 compared to 2012.
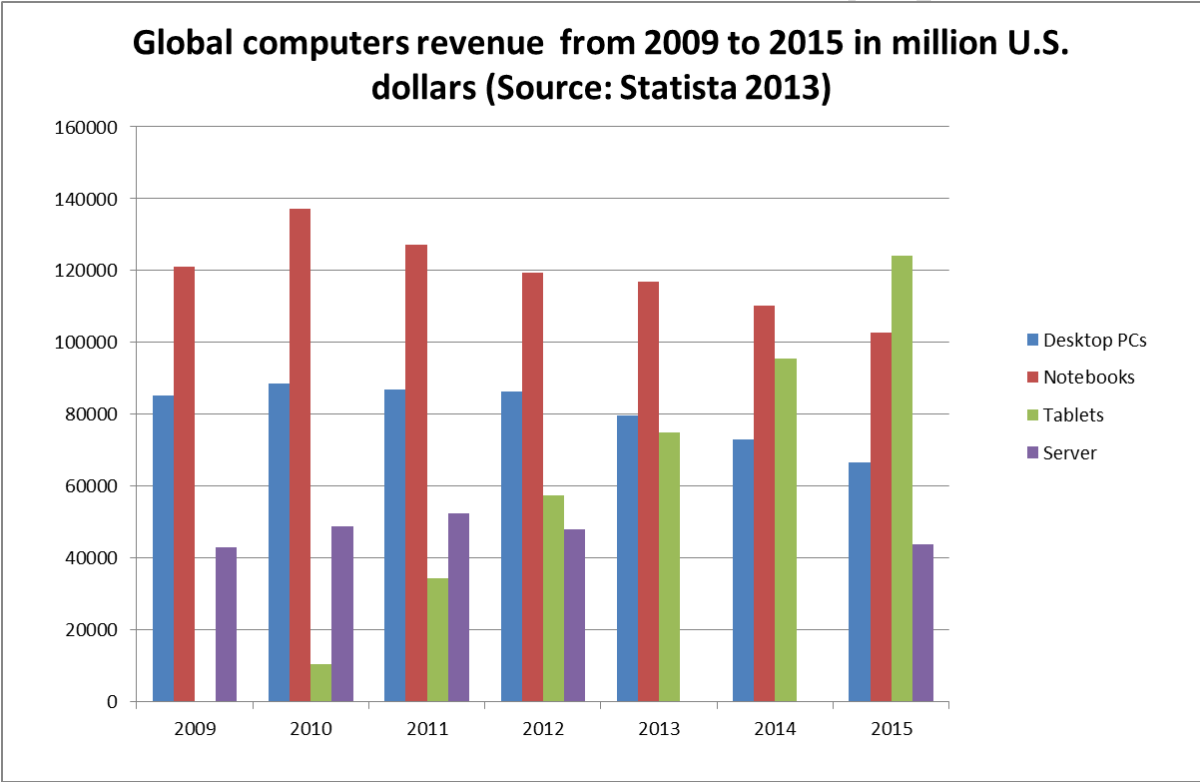
Figure 3: Global computers revenue from 2009 to 2015 (Source: Statista)

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[9] Source: Desktop PCs: http://www.statista.com/statistics/203825/global-revenue-of-desktop-pcs/, Notebook PCs: http://www.statista.com/statistics/203839/global-notebook-revenue-forecast/, tablets: http://www.statista.com/statistics/203857/global-revenue-of-tablets/, Server: http://www.statista.com/statistics/203382/global-server-market-forecast/

1.1.2   Thin clients

Dickinson[10] reported that in 2012 thin client shipments across the EMEA region (Europe, the Middle East and Africa) reached 1.7 million units, which represents an increase of 9.2% compared to the year before. The market is expected to remain growing, with shipments rising by 6.2% in 2013.

A study by IDC[11] shows that the enterprise thin client market grew by 13.8 % in 2011, and the growth is forecast to be even higher during the period 2012–2016.
In 2010, Vance[12] reported that according to Global Industry Analysts, the global thin client market will expand to 14.36 million units shipped worldwide by 2015 due to increasing interest in cloud computing.

Dickinson's report further noted that according to IDC publication standalone thin client models made up 96.2 % of total EMEA thin client shipments in 2012. IDC noted that all-in-one thin client models were becoming increasingly popular but remaining a niche category regarding their market volume.

1.1.3   Workstations

According to Statista / Jon Peddie Research[13], Figure 4 shows the number of workstation shipments worldwide from 3rd quarter 2008 to 3rd quarter 2012. About 2.5 million, 3.2 million and 3.8 million workstations were shipped worldwide in 2009, 2010 and 2011, respectively. This shows a continuous increase in shipment numbers, although the second and third quarter of 2012 showed a slight decrease compared to the same period of 2011. It is assumed that worldwide workstation shipments might reach 3.500 million units in 2012.

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[10] Source: http://www.misco.co.uk/blog/news/00795/emea-shipments-of-enterprise-thin-clients-rise-9-point-2-percent-in-2012

[11] Source: http://www.idc.com/getdoc.jsp?containerId=235691

[12] Source: http://www.datamation.com/datbus/article.php/3877221/Top-Five-Thin-Client-Hardware-Vendors.htm

[13] Source: http://www.statista.com/statistics/157940/workstation-shipments-worldwide-since-the-3rd-quarter-2008/

It is expected that in contrast to the market for PCs for consumer or office work, suffering a major decline in volume due to the trend towards tablet PCs, workstations for professional computing don't seem to have followed this downward trend[14].
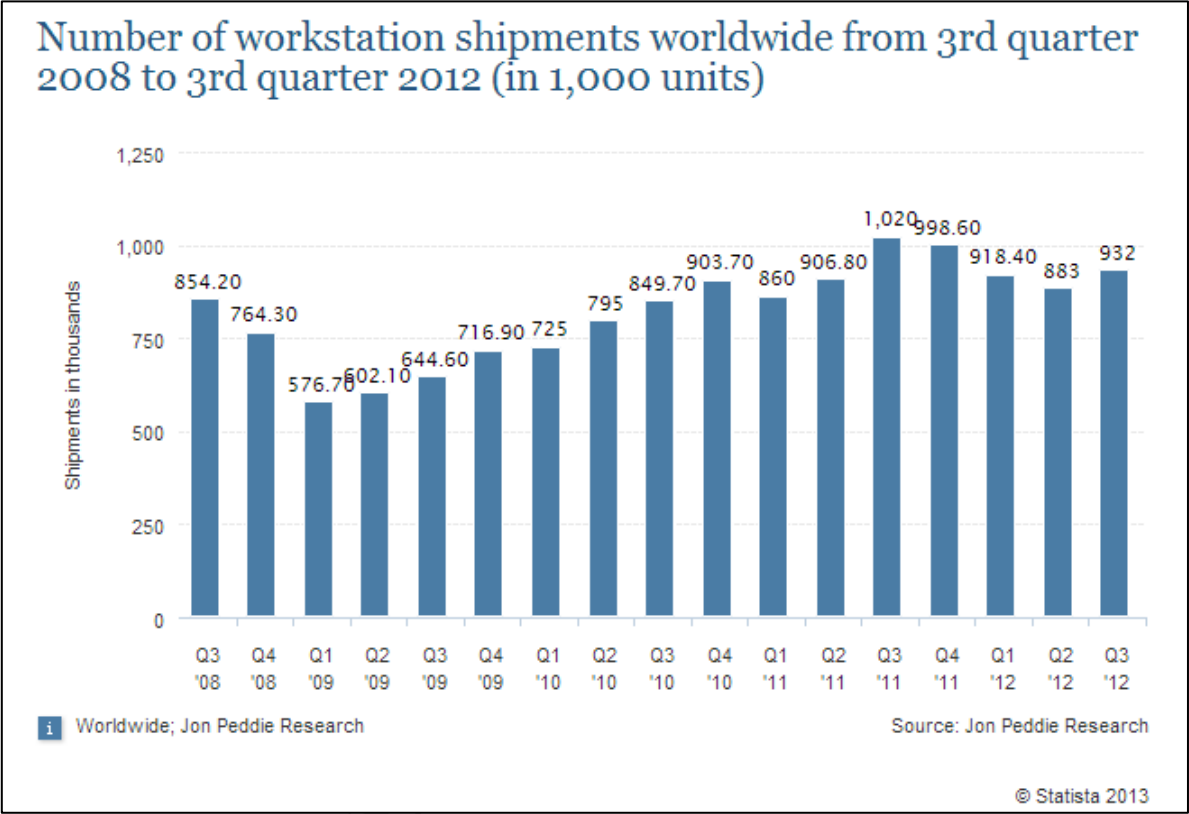
Figure 4: Number of workstation shipments worldwide from 2008 to 2012
(Source: Statista)

1.1.4   Small-scale server

The following data[15] is about the whole server market, providing a general picture for servers. Unfortunately, the desk research revealed no sources providing explicit data regarding the small-scale server market. Further input from the stakeholder group would therefore be appreciated.

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[14] Source: http://jonpeddie.com/publications/workstation_report/
[15] Source: http://www.statista.com/statistics/219596/worldwide-server-shipments-by-vendor/
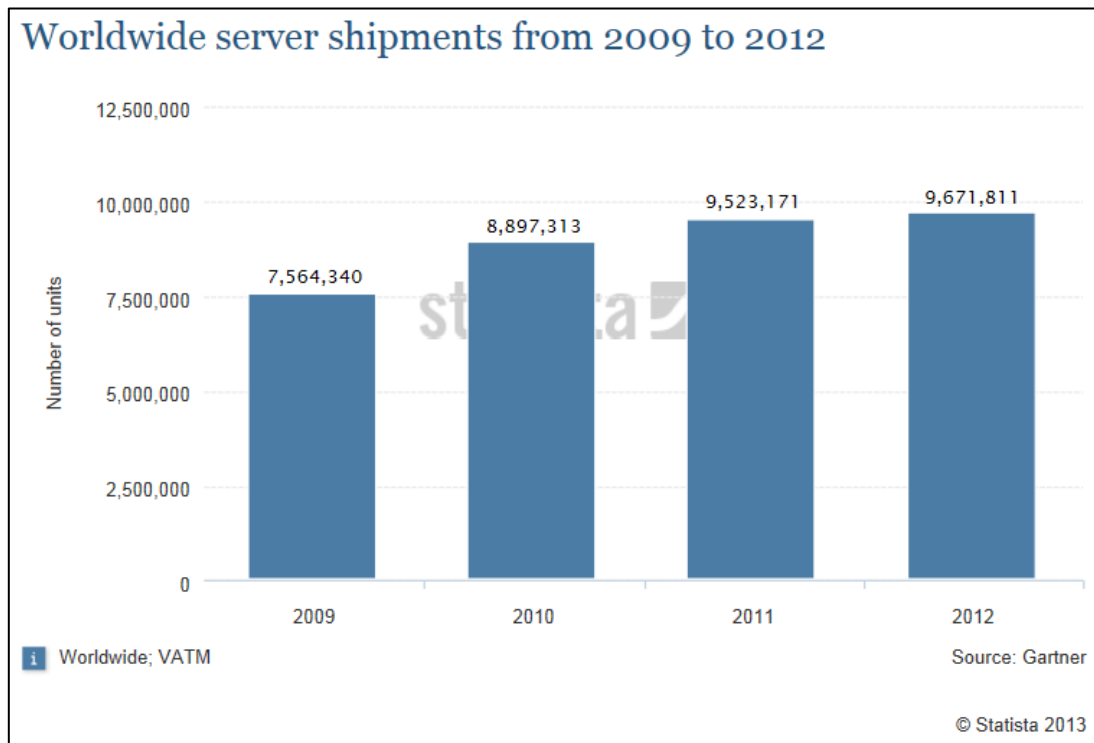
Figure 5: Worldwide server shipments from 2009 to 2012 (Source: Statista)

1.1.5 Computer displays

Figure 6 illustrates the global large-area (9"+) TFT LCD monitor shipments from 2009 to 2011[16]. It can be seen that there is a slight growth from 2009 to 2010 whereas the number of shipments has remained at a rather stable level between 2010 and 2011.

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[16] Source: http://www.statista.com/statistics/221640/global-large-area-tft-lcd-monitor-shipments-since-2009/
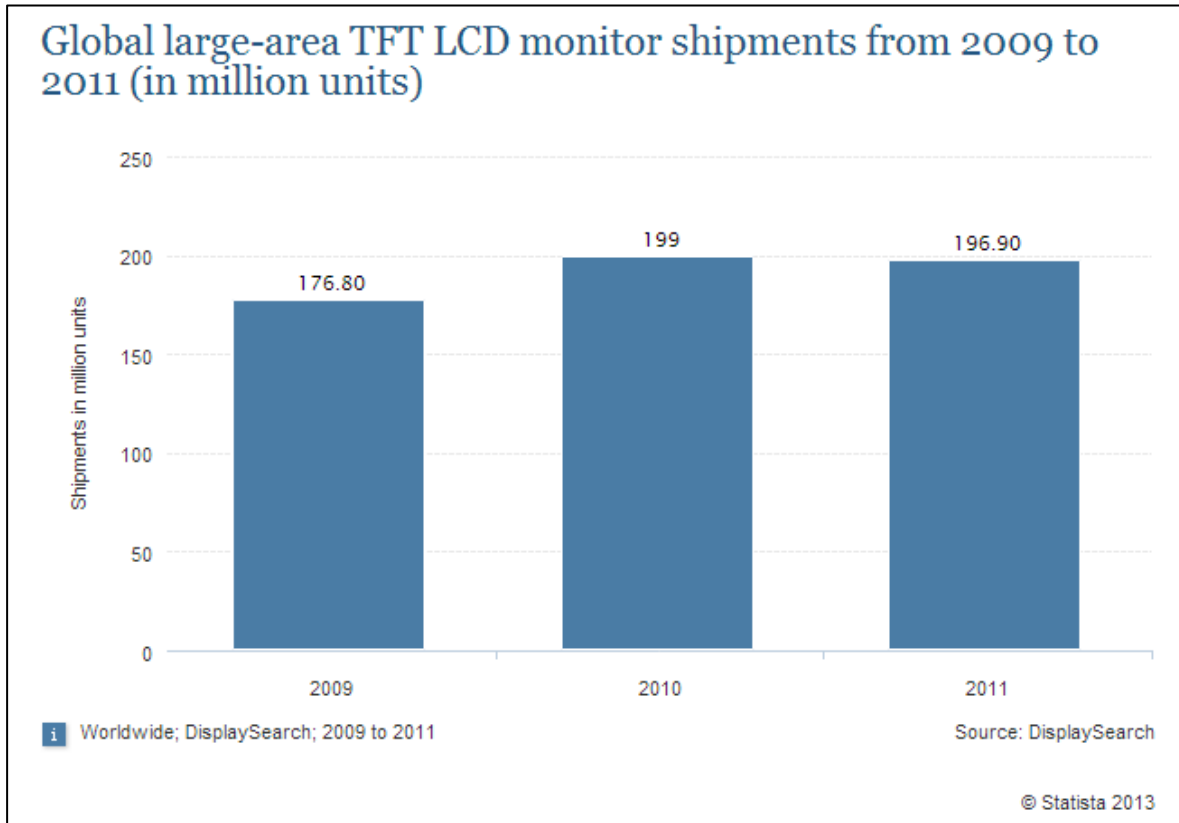
Figure 6: LCD monitors shipments from 2009 to 2011 (Source: Statista)

Screen sizes

In 2010, the average diagonal size of LCD computer displays was 17 inch, which accounted for 43% of screen sizes in the United States. The size of 19 inch had a proportion of 27%; sizes larger than 20 inch accounted for 15% (see Figure 7)[17]. According to iSuppli[18], in 2012 the average monitor sold worldwide was already 21 inches, indicating the trend towards increasing screen sizes.

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[17] Source: http://www.statista.com/statistics/216680/lcd-monitors-in-the-us-by-screen-size/
[18] Source: http://www.nytimes.com/2012/02/08/technology/for-multitaskers-multiple-monitors-improve-office-efficiency.html?pagewanted=all&_r=0
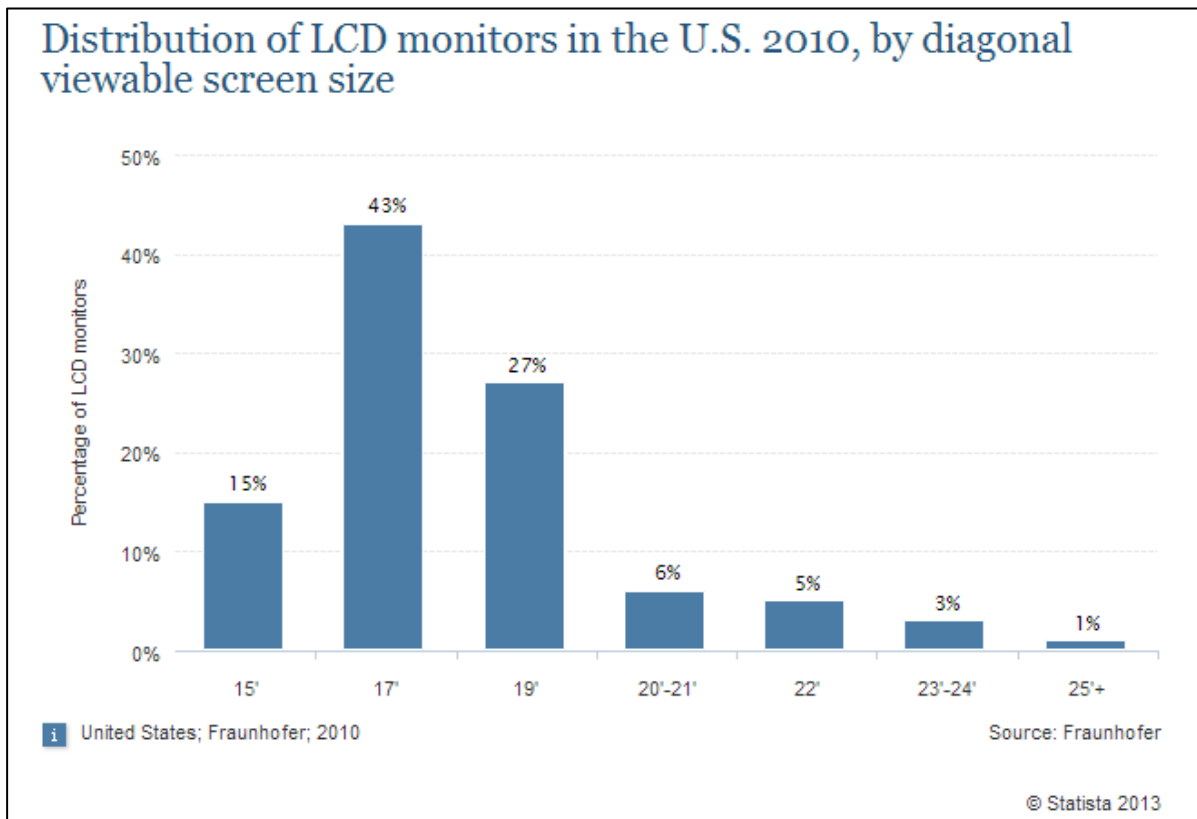
Figure 7: Distribution of LCD monitors in the U.S. 2010 by screen size (Source: Statista)

Regarding the display size of notebook PCs, a diversification is noted with larger screen sizes (18''+) sold to gamers and on the other hand, smaller and more portable devices (< 15'') for travelling.

1.2 Technological trends

1.2.1 Display technologies

1.2.1.1 LED

Within desktop displays, LCD monitors with LED backlight technology now dominate, accounting for nearly 100% of all desktop displays shipped worldwide while CRT monitors are nearly completely obsolete from the mainstream worldwide computer monitor market.

Also within notebook PCs, LED backlit technology was forecast to reach 98% of the market by the end of 2010. Notebooks with CCFL backlight were expected to almost be phased out with only 1.6% of the total market by 2011 (see Figure 8)[19].

Table 1. Notebook Backlight Penetration Percentage (on a unit basis)

Backlight Type		Q1'09	Q2'09	Q3'09	Q4'09	Q1'10	Q2'10	Q3'10	Q4'10	Q1'11
LED	Slim Type	5.0%	6.8%	7.6%	8.5%	15.9%	22.6%	26.7%	31.1%	34.9%
	Wedge Type	31.0%	49.3%	58.8%	63.7%	65.6%	67.9%	69.5%	66.7%	63.5%
CCFL		64.0%	43.9%	33.6%	27.8%	18.5%	9.5%	3.7%	2.3%	1.6%

Note: Actual results up to Q1'10; data from Q2'10 based on panel makers' shipment targets

Source: *Quarterly LED Backlight Panel Shipment & Forecast Report*

Figure 8: Notebook backlight penetration percentage (Source: NPD DisplaySearch)

In notebook applications there are two types of LED backlighting systems: slim and wedge type. Slim LED backlights for notebooks require thinner components, such as LED array and LGP (the light guide plate) compared to the wedge type. According to NPD DisplaySearch[20] the slim type will continue to grow despite higher costs and assembly issues, as a result of notebook manufacturers' priorities for slimmer form factors despite cost premiums.

1.2.1.2   Touch screen

The following figure[21] shows the touch screen penetration in different IT applications. As for netbooks / Slate PCs (tablets) and All-in-one PCs, the percentage of penetration has been continuously increasing whereas the penetration rate in regular notebooks and external computer displays is still at a very low level.

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[19] Source:
http://www.displaysearch.com/cps/rde/xchg/displaysearch/hs.xsl/100610_slim_led_backlit_notebooks_rapidly_gain_market_share.asp
[20] Source:
http://www.displaysearch.com/cps/rde/xchg/displaysearch/hs.xsl/100610_slim_led_backlit_notebooks_rapidly_gain_market_share.asp
[21] Source: http://www.displaysearch.com/cps/rde/xbcr/displaysearch/FlexTech_Sensor_Workship.pdf

Unit: Million	2009	2010	2011
Netbook / Slate PC	45	57	67
Touch Module	1.4	13	19
Penetration	3%	23%	28%
Regular Notebook	129	160	69
Touch Module	4	6	8
Penetration	3%	4%	4%

Unit: Million	2009	2010	2011
All-in-one PC	6	7	8
Touch Module	0.9	1.6	2.1
Penetration	15%	23%	25%
LCD Monitor	163	171	181
Touch Module	0.6	1.0	1.2
Penetration	0.3%	0.6%	0.7%

Figure 9: Touch screen penetration in IT application (Source: NPD DisplaySearch/2010 Touch Panel Market Analysis Report)

For market penetration within regular notebooks PCs, Figure 10 shows the global forecast of touch screen-enabled devices predicted by IHS[22]. It is forecasted that the number of touch screen-enabled regular notebooks will increase continuously from 2013. By 2016, every fourth notebook is likely to feature touchscreen.

Data from NPD DisplaySearch[23] are slightly lower; they forecast the touch screen penetration rate in notebook PCs to grow from under 3% in 2012 to more than 12% in 2013. They further expect that adoption by all-in-one PCs is one of the leading contributors to the touch screen market growth[24].

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[22] Source: http://www.elektroniknet.de/optoelektronik/displays/artikel/97785/?cid=NL

[23] Source: http://www.displaysearch.com/cps/rde/xchg/displaysearch/hs.xsl/130415_windows_8_expected_to_trigger_global_growth_in_touch_enabled_notebook_pcs.asp

[24] http://www.displaysearch.com/cps/rde/xchg/displaysearch/hs.xsl/120829_notebook_and_all_in_one_pcs_driving_touch_screen_growth.asp
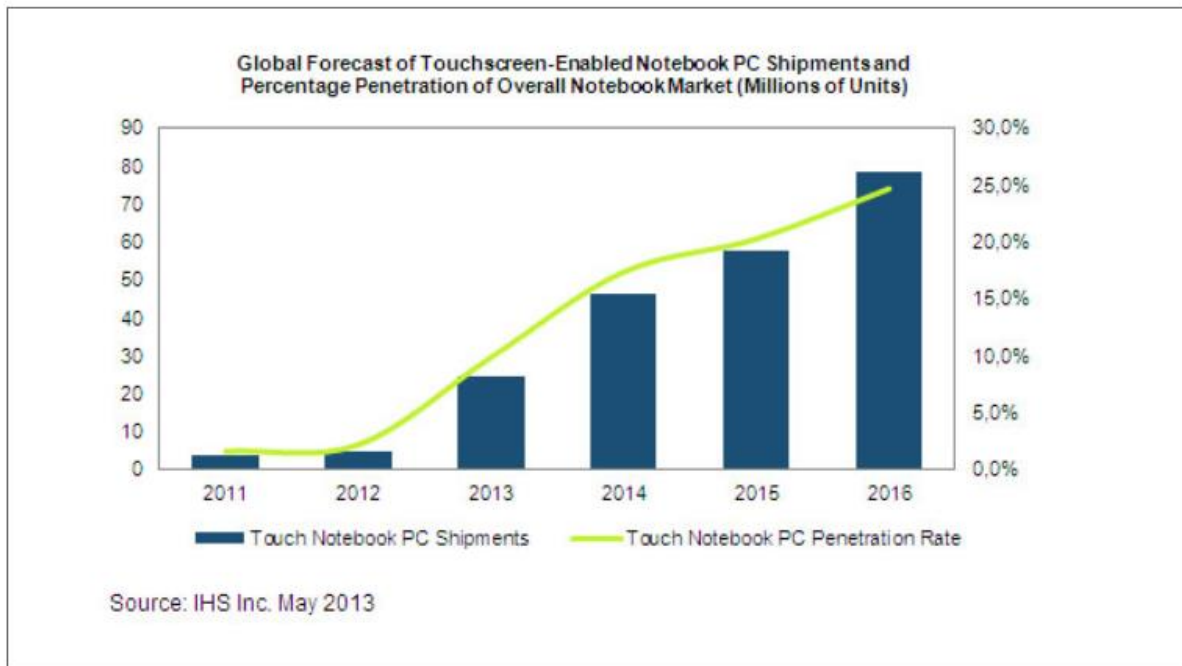
Figure 10: Global forecast of touchscreen-enabled notebook PC shipments and percentage penetration of overall notebook market (Source: IHS 2013)

According to NPD DisplaySearch[25] shipments of notebook PCs with touch capability are expected to grow 48% Y/Y in 2014.

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[25] Source:
http://www.displaysearch.com/cps/rde/xchg/displaysearch/hs.xsl/130506_tablet_pcs_and_touch_adoption_expected_to_drive_mobile_pc_shipments_through_2017.asp
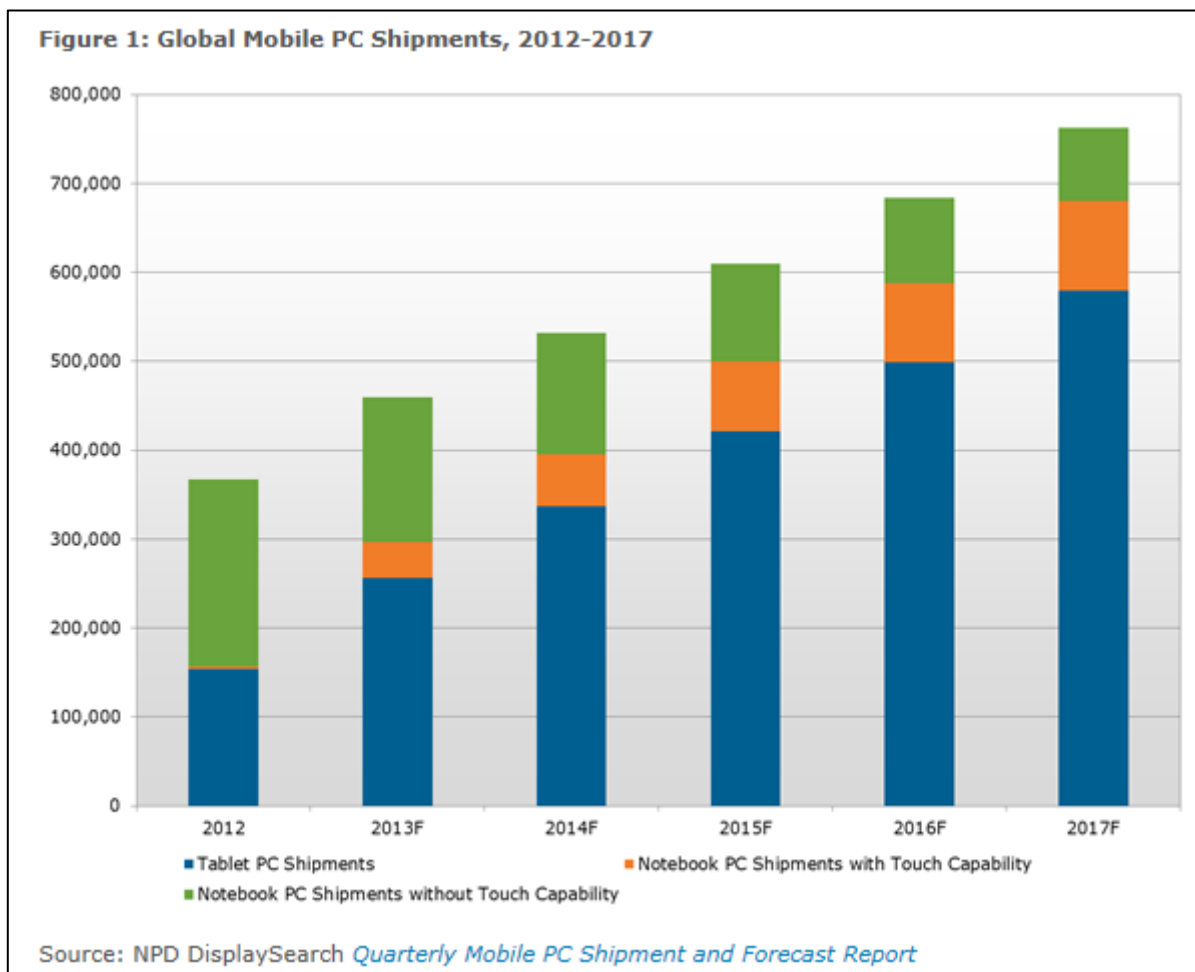
Figure 11: Global notebook PC shipments with or without touch capability
(Source: NPD DisplaySearch)

1.2.1.3   Flexible Displays

As a future technology, flexible displays based on different materials (AMOLED – active matrix O-LED, or willow glass) are expected especially for tablet PCs and notebooks.

However, according to Networkworld[26], the technology will be little more than a novelty until about 2015 although multiple manufacturers are expected to release smartphones with flexible display screens by the end of 2013.

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[26] Source: http://www.networkworld.com/news/2013/050913-flexible-smartphones-269566.html

1.2.2 Drive technology: Solid state disk (SSD) versus Hard disk drive (HDD)

SSDs are increasingly used as drive technology due to their enhanced capacity, shorter loading times of applications, silent operating mode, their slimmer form factor, better shock tolerance and lower temperature operation[27].

According to Statista[28], the number of worldwide HDD-shipments in 2012 (577 million) decreased compared to 2011 (626 million).
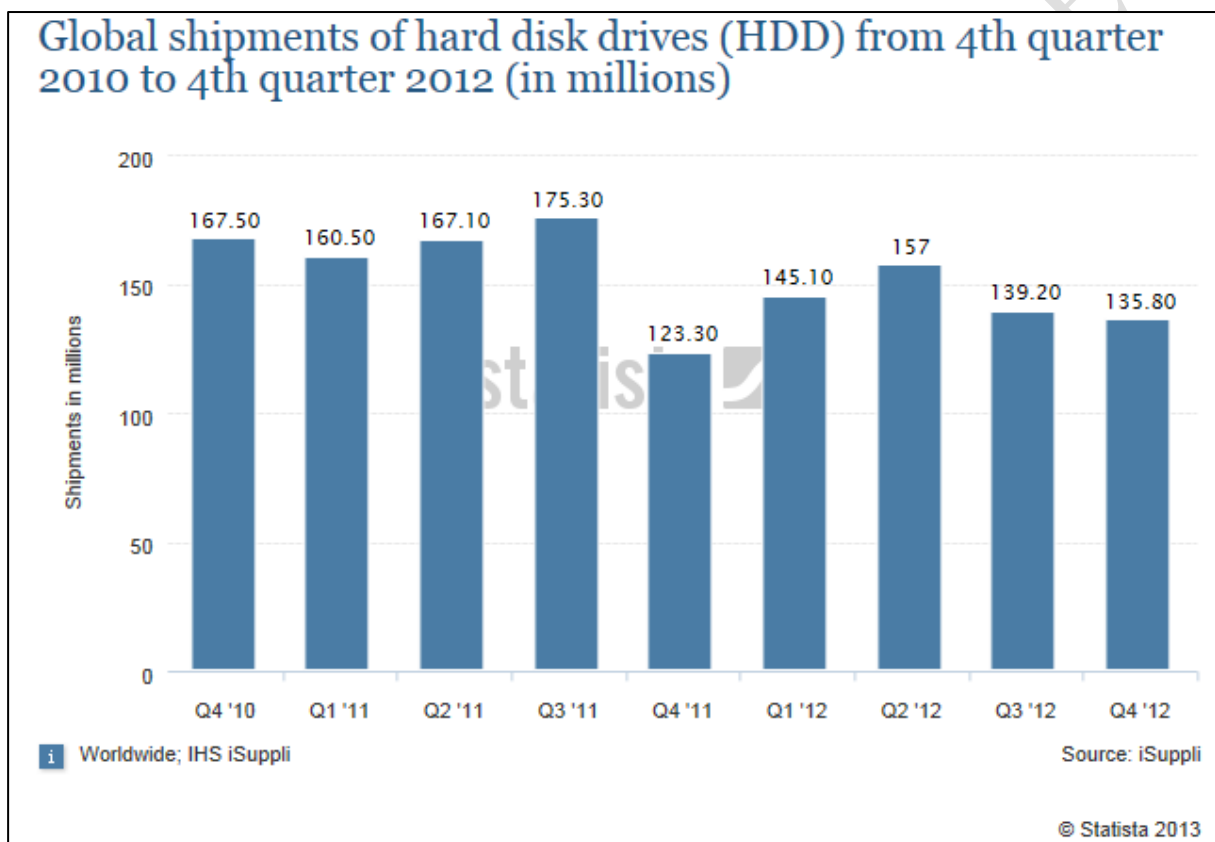
Figure 12: Global shipments of hard disk drives from 2010 to 2012 (Source: Statista)

Table 1 and Figure 13 show that the notebook and netbook HDD (hard disk drives) market is expected to decline from 2012 to 2017, whereas the market for SDD (solid-

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[27] Source: http://www.notebookcheck.com/SSD-versus -HDD-im-Vergleich.18732.0.html
[28] Source: http://www.statista.com/statistics/200551/global-sales-figures-of-hard-disk-drives-from-4th-quarter-2010/

state drives) is expected to rise in the same timeframe. The percentage of SSD of the total notebook market accounted for 6% in 2012 and is projected up to 22% in 2017.

Table 1: Storage shipments: Total notebook shipment - units by segment (Source: IHS[29])

Segment	2012	2013	2014	2015	2016	2017
HDD	249,798	223,890	209,155	209,916	194,369	193,794
SSD	16,108	22,130	30,597	37,118	44,212	54,133
Total	265,906	246,020	239,752	247,035	238,581	247,927
	2012	2013	2014	2015	2016	2017
SSD as % of Total Notebook	6%	9%	13%	15%	19%	22%
SSD as % of HDD	6%	10%	15%	18%	23%	28%
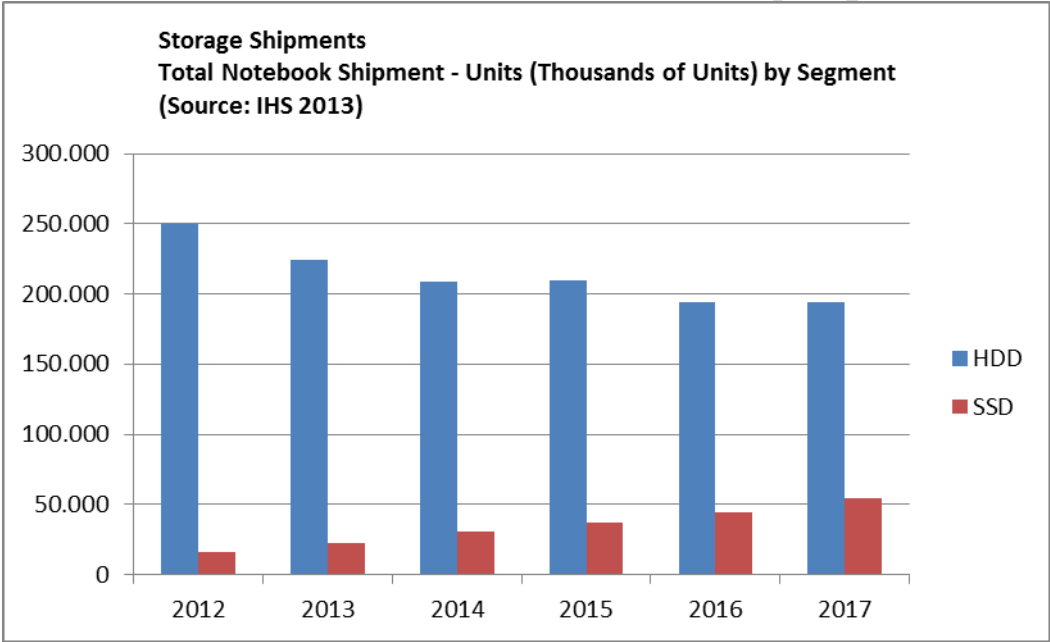
Figure 13: Storage shipments: Total notebook shipment - units by segment
(Source: own figure based on IHS 2013)

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[29] Source: e-mail-communication from 14 June 2013

1.2.3   Tablets PCs

1.2.3.1   Tablets with docking station

Docking stations for tablet PCs enable expandability (e.g. connection to televisions, external monitor, keyboard, printers, speakers), which enables tablets to be used as a conventional notebook or desktop PCs.

For example, AMD currently launched a keyboard docking station for tablet PCs with AMD processors[30]. In the peripheral device an additional battery is installed which is switched on when the tablet is locked in. The second battery automatically speeds up the processor of the tablet PC thus providing more computing power. If the tablet is removed from the docking station, the CPU gets slower thus extending the battery capacity.

In this context, tablet PCs may become increasingly attractive also for business applications where interfaces and integration into the office environment are key factors (cf. section 1.1.1).

1.2.3.2   Wireless charging

Wireless charging (also known as " inductive charging") uses a magnetic field to transfer energy between two objects[31]. The device can be charged without plugging it in (although the wireless charger itself must still be plugged into the wall). The device has to be either laid down on a charging pad, or has to be in a very short distance (about four centimetres) to the power source[32].

In the smartphone sector, wireless charging has already been launched[33]. It is based on three different technology standards. There are no examples for the computer sector so far. However, it is expected that wireless chargers will quickly be used also

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[30] Source: http://www.pcwelt.de/news/AMD_stellt_Turbo-Dock_fuer_Windows-8-Tablets_vor_-Hybrid-Loesung-7507364.html

[31] Source: http://en.wikipedia.org/wiki/Inductive_charging

[32] Source: http://www.techradar.com/news/mobile-computing/how-wireless-charging-will-change-our-devices-1146716

[33] Source: http://en.wikipedia.org/wiki/Samsung_Galaxy_S4

in tablet PCs. According to Humphries[34], Intel is developing a system that will allow their new ultra-books to wirelessly charge on a platform.

The energy consumption of wireless chargers is comparable to wired battery chargers (charging consumption plus stand-by consumption when being left plugged-in). The efficiency of a wireless power transmitter compared to wired chargers depends on the number of wired chargers that are replaced, the type of chargers and the habits of the owner[35].

1.3 Market and production structures

1.3.1 Major players, SMEs and relative market shares

1.3.1.1 Desktop PCs / Notebook PCs

Based on their worldwide market share in 2012[36], the following figure provides an overview of the major PC vendors (including desktop PCs, notebook PCs with mini-notebooks but not including tablet PCs), being HP, Lenovo, Dell, Acer Group and ASUS.

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[34] Source: http://www.geek.com/chips/intel-partners-with-idt-for-wireless-charging-ultrabooks-pcs-and-smartphones-1512285/

[35] Source: www.wirelesspowerconsortium.com/technology/total-energy-consumption.html

[36] Source: http://www.gartner.com/newsroom/id/2301715
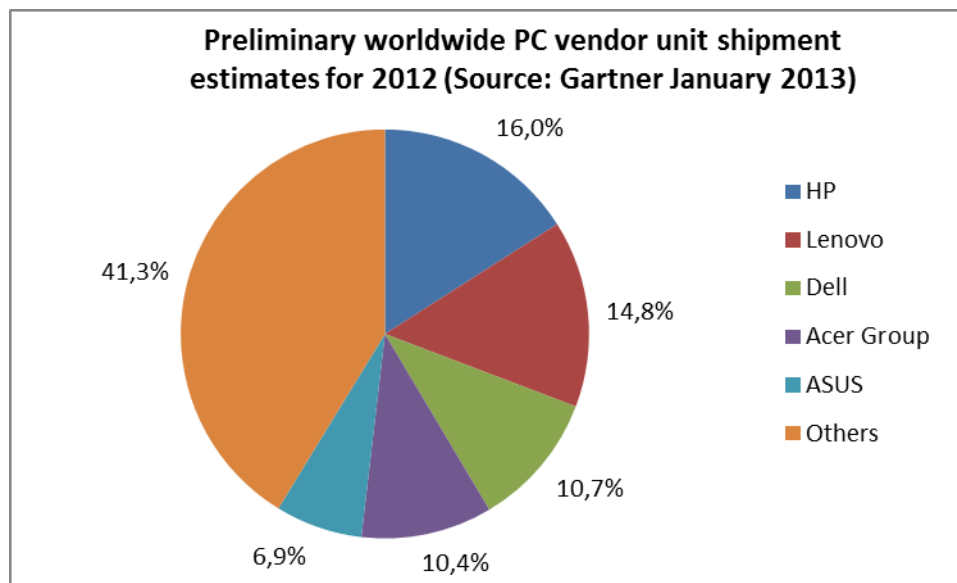
Figure 14: Worldwide market share of PC vendors 2012 (Source: Gartner 2013)[37]

Note: Data includes desk-based PCs and mobile PCs, including mini-notebooks but not media tablets such as the iPad. Data is based on the shipments selling into channels

According to Gartner[38], the EU PC market is dominated by the same five companies who together accounted for approximately 65% of the sales in the second quarter of 2012: HP (20.2%), Acer (17.3%), Asus (10.7%), Dell (8.7%), and Lenovo (7.8%).

1.3.1.2   Tablet PCs

The dominating player in the global tablet PC market is Apple, although their market share has decreased significantly from 95% in 2010 to 48% in 2013 (see Figure 15)[39,40].

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[37] Source: Gartner Press Release "Gartner Says Declining Worldwide PC Shipments in Fourth Quarter of 2012 Signal Structural Shift of PC Market" of 14 January 2013;
http://www.gartner.com/newsroom/id/2301715; last accessed 28 May 2013

[38] Source: http://www.gartner.com/newsroom/id/2112815

[39] http://www.statista.com/topics/841/tablets/

[40] Source: http://www.statista.com/statistics/159680/market-share-of-the-apple-ipad-since-2010/

Figure 15: Apple iPad's share of the global tablet market from 2nd quarter 2010 to 1st quarter 2013 (Source: Statista)

Other players in the tablet PC market are Acer, Asus, HTC, Lenovo, Motorola, Dell, HP, Samsung, HP, LG, Amazon, Sony, Sharp, Toshiba, and NEC[41].

1.3.1.3   Thin clients

Major thin client vendors are Dell/Wyse with about 31% market share in 2012, followed by Hewlett-Packard Company with 28%[42].

Further vendors are e.g. Athena Europe BV, Fujian Centerm Information Co. Ltd., Fujitsu Ltd., IGEL Technology GmbH, NComputing, Praim s.r.l., Samsung, Start SA, SUMO Technologies Ltd., and VXL Instruments Ltd.[43]

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[41] Source:
http://www.displaysearch.com/cps/rde/xchg/displaysearch/hs.xsl/tablet_pc_brand_panel_sourcing_and_odm.asp

[42] Source: http://www.pilvekontor.ee/ateafoorum/upload/pdf/DellWyse-Andreas%20Ristl.pdf

[43] http://www.idc.com/getdoc.jsp?containerId=235691

1.3.1.4 Workstations

Major vendors of desktop workstations are e.g. Hewlett-Packard Company, Dell Inc., Lenovo Group Ltd., Fujitsu Ltd., Intel Corporation, and Microsoft Corporation.

1.3.1.5 External computer displays

Important vendors of computer displays are Dell, Samsung, LG Electronics, HP, Acer,(see Figure 16).[44]
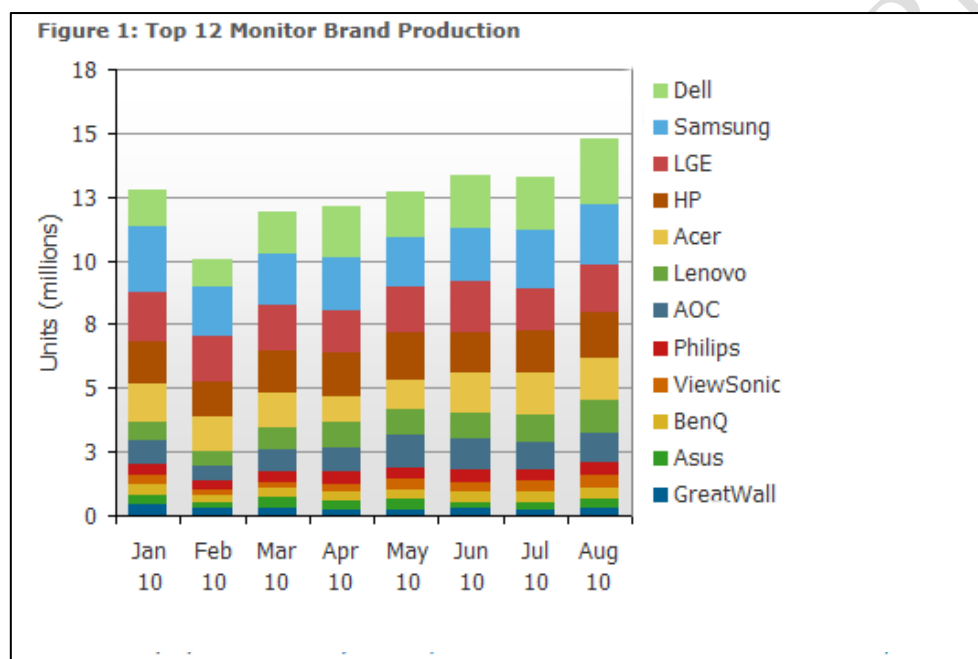
Figure 16: Top 12 monitor brand production 2010 (Source: NPD DisplaySearch/Monthly Desktop LCD Monitor Brand and OEM Production Report)

1.3.2 Front-runners and market penetration

In this section, we look to define the market for environmentally improved front-runner models. For this purpose, European and other relevant ecolabel where analysed to provide an impression on their market relevance and to identify front runner brands.

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[44] Source:
http://www.displaysearch.com/cps/rde/xchg/displaysearch/hs.xsl/100607_pc_and_peripheral_companies_remain_bullish_on_desktop_monitors.asp

1.3.2.1   EU Ecolabel

According to the European Commission[45], there are currently no EU ecolabelled computers.

1.3.2.2   Energy Star

The following analysis is based on the ENERGY STAR® Program Requirements Product Specification for Computers Eligibility Criteria Version 5.2 from August 2010. The Version 6.0 ENERGY STAR specification for computers is still in development. The list of qualified computers[46] contains 9,972 products (see Table 2) and covers 65 companies. Amongst Energy Star qualified computers, notebook PCs with 7,651 is the dominating product group. The second most awarded product group is desktop PCs with 1,368 products. Until now, 63 small scale servers have fulfilled the Energy Star criteria.

Table 2: Number of products awarded by Energy Star

Category	Number of products awarded
Notebook PCs	7,651
Desktop PCs	1,368
Integrated computers	669
Thin clients	128
Workstations	93
Small scale servers	63
Total	9,972

1.3.2.3   Nordic Ecolabelling

Regarding the current Nordic Ecolabelling criteria for Computers, valid from 2009 to 2014, **Fujitsu** is the only licence holder. Detailed information regarding the computer categories awarded is listed in Table 3.

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[45] Source: http://ec.europa.eu/environment/ecolabel/facts-and-figures.html; note: the numbers provided by the EU COM are indicative. The exact numbers are under validation and will be updated as soon as possible.
[46] Source: http://downloads.energystar.gov/bi/qplist/Computers_Product_List.xls, sighted at 6 May 2013

Table 3: Companies awarded by Nordic Swan

Category	Company awarded: Status (22.05.2013)
Desktop PCs	Fujitsu with 29 models awarded[47]
Laptops	Fujitsu with 12 models awarded[48]
Monitors	Fujitsu with 13 models awarded[49]

1.3.2.4   Blue Angel

Currently, **Fujitsu** is the only licence holder awarded by Blue Angel for the product groups desktop PCs and external computer displays. As for portable computers, thin clients, or workstations, there are no vendors awarded. Detailed information regarding the computer categories awarded is listed in Table 4.

Table 4: Companies awarded by Blue Angel

Category	Company awarded: Status (22.05.2013)
Desktop PCs	Fujitsu with 15 models awarded[50]
Portable computers	Currently there are no vendors available[51]
Monitors	Fujitsu with 1 model awarded[52]
Thin clients	Currently there are no vendors available[53]
Workstations	Currently there are no vendors available[54]

1.3.2.5   TCO

The TCO Certified criteria are applicable to desktop PCs, notebooks, tablets and all-in-one PCs. The companies awarded include **ASUS**, **Lenovo**, **Samsung**, **AOC**, and **HP Compaq**. Detailed information regarding the computer categories awarded is listed in Table 5.

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[47] Source: http://www.svanen.se/en/Buy-vanenmarkt/Ecolabelled_products/?categoryID=82&p=1

[48] Source: http://www.svanen.se/en/Buy-Svanenmarkt/Ecolabelled_products/?categoryID=79

[49] Source: http://www.svanen.se/en/Buy-Svanenmarkt/Ecolabelled_products/?categoryID=298

[50] Source: http://www.blauer-engel.de/en/products_brands/search_products/produkttyp.php?id=579

[51] Source: http://www.blauer-engel.de/en/products_brands/search_products/produkttyp.php?id=584

[52] Source: http://www.blauer-engel.de/en/products_brands/search_products/produkttyp.php?id=619

[53] Source: http://www.blauer-engel.de/en/products_brands/search_products/produkttyp.php?id=582

[54] Source: http://www.blauer-engel.de/en/products_brands/search_products/produkttyp.php?id=581

Table 5: Companies awarded by TCO

Category	Company awarded[55]: Status (23.05.2013)
TCO Certified Desktop PCs (March 2012)	Lenovo with 3 models awarded
TCO Certified Notebooks 4.0 (March 2012)	ASUS with 1 model and Samsung with 8 models awarded
TCO Certified Edge Notebooks 1.0 (February 2011)	Samsung with 1 model awarded
TCO Certified Tablets 2 (November 2012)	Samsung with 3 models awarded
TCO Certified All-in-one PCs 2.0 (March 2012)	AOC with 1 model, HP Compaq with 2 models, Lenovo with 4 models, Samsung with 6 models awarded

1.3.2.6 EPEAT

In the EPEAT database[56], in total 2,337 computer products from 29 vendors in the United States fulfilled the environmental criteria (Status: 23.05.2013). The United States has the most manufacturers or brand owners registered. The overview table shows that the most registered product group is notebooks, followed by external computer displays, and desktops PCs. As for tablet PCs, only one product fulfils the criteria.

Table 6: The manufacturers or brand owners registered by EPEAT in the United States

Company Name	Desktops	Displays	Integrated Desktop PCs	Notebooks	Tablet Notebooks	Workstation Desktops	Thin Clients	Total
Ace Computers	15	0	0	4	0	5	0	24
Acer Inc.	9	37	0	9	0	0	0	55
Apple Inc.	6	2	13	26	0	4	0	51
ASUSTeK Computer Inc.	10	22	6	13	0	0	0	51
BenQ	0	7	0	0	0	0	0	7
CTL Cor-poration	6	4	0	1	0	0	0	11
Dell Inc.	28	28	4	105	0	8	16	189
EIZO Corporation	0	28	0	0	0	0	0	28

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[55] Source: http://79.136.114.89/pls/nvp/!tco_search
[56] http://ww2.epeat.net/searchoptions.aspx

Company Name	Desktops	Displays	Integrated Desktop PCs	Notebooks	Tablet Notebooks	Workstation Desktops	Thin Clients	Total
Fujitsu Limited	3	0	0	30	0	0	0	33
Gammatech Computer Corporation	0	0	0	9	0	0	0	9
GETAC	0	0	0	7	0	0	0	7
Grace Global, Inc.	1	0	0	3	0	4	0	8
Hewlett-Packard	33	18	37	118	0	11	10	227
Howard Technology Solutions, A Division of Howard	4	0	1	3	0	1	0	9
Hyundai IT America Corp.	0	32	0	0	0	0	0	32
Lenovo	46	16	7	150	0	10	0	229
LG Electronics Inc.	0	201	0	0	0	0	0	201
MMD-Monitors & Displays Taiwan Ltd.	0	113	0	0	0	0	0	113
NCS Technologies, Inc.	55	0	0	2	0	0	1	58
NEC Display Solutions, Inc.	0	37	0	0	0	0	0	37
Oracle America Inc.	0	0	1	0	0	0	2	3
Panasonic	0	0	0	9	0	0	0	9
Samsung Electronics	0	306	7	128	0	0	1	442
Sony Elec-tronics Inc.	1	0	31	305	0	0	0	337
Toshiba	0	1	3	85	0	0	0	89
TPV Technology Limited	0	50	0	0	0	0	0	50

Company Name	Desktops	Displays	Integrated Desktop PCs	Notebooks	Tablet Notebooks	Workstation Desktops	Thin Clients	Total
Transource	6	0	0	7	0	0	0	**13**
ViewSonic Corporation	0	14	0	0	0	0	0	**14**
Xplore Tech-nologies Corporation	0	0	0	0	1	0	0	**1**
TOTAL	**223**	**916**	**110**	**1014**	**1**	**43**	**30**	**2,337**

1.4 Consumer aspects

1.4.1 Computer penetration

1.4.1.1 PCs

Statistics depict consumer PC penetration per capita in Western Europe from 2000 to 2015 (see Figure 17) [57]. In Western Europe, consumer PC penetration per capita was 36% in 2010 meaning that every third person had a computer. The PC penetration per capita is projected to reach 50% in 2015, i.e. every second person would acquire a PC. Note that there is no clear definition of PCs. We assume that PCs cover both desktop PCs and notebooks.

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[57] Source: http://www.statista.com/statistics/203667/pc-penetration-per-capita-in-western-europe-since-2000/
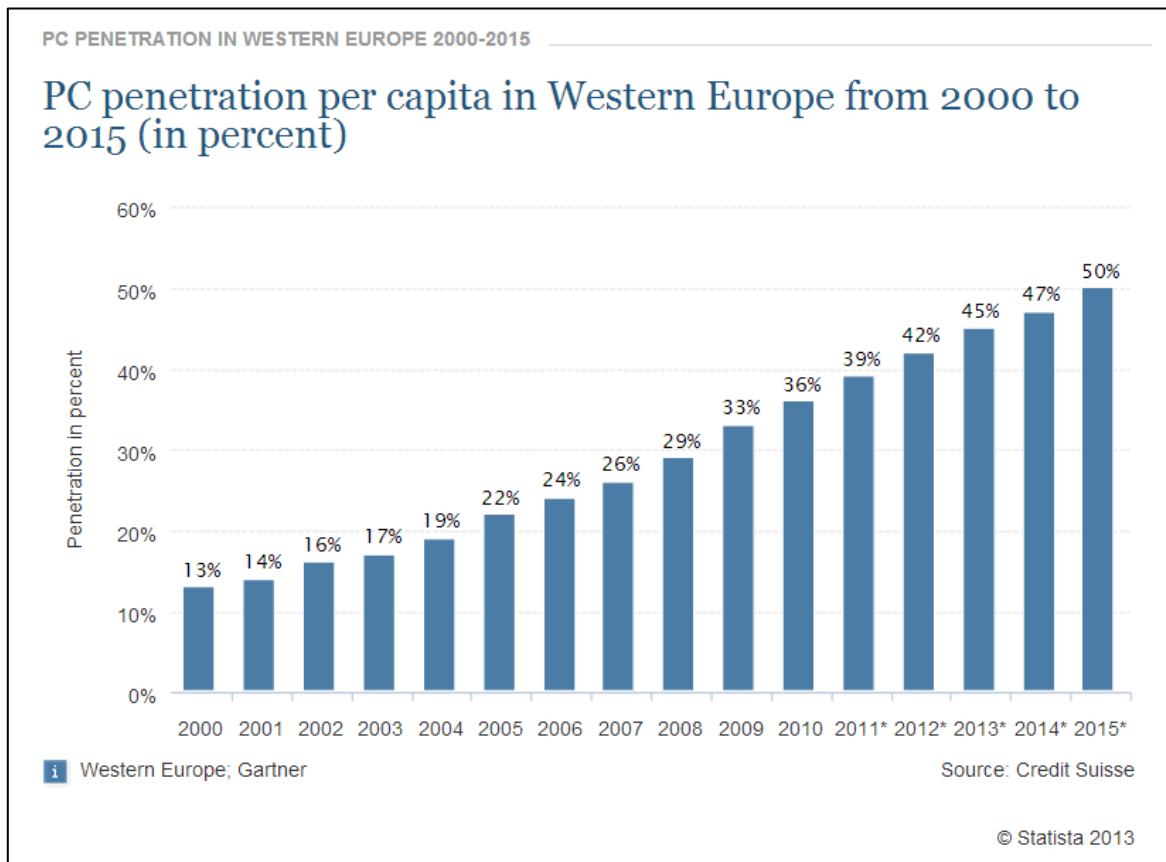
Figure 17: PC penetration per capita in Western Europe from 2000 to 2015 (Source: Statista)

According to the OECD[58], computer penetration rates are the highest in Iceland, the Netherlands, Luxembourg, Sweden, Norway and Denmark where over 90% of households had access to a home computer by 2011. Between 2000 and 2011, the share of households with access to a home computer increased by over 40 percentage points in France, Ireland, the United Kingdom, Austria and Spain.

1.4.1.2   Notebook PCs

Figure 18 shows the share of population that owned laptop and netbook computers in 2012 by country[59]. With 80%, the penetration rate is highest in Italy. Within the other

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[58] Source: http://www.oecd-ilibrary.org/sites/factbook-2011-en/08/02/04/08-02-04-g1.html?contentType=/ns/StatisticalPublication,/ns/Chapter&itemId=/content/chapter/factbook-2011-75-en&containerItemId=/content/serial/18147364&accessItemIds=&mimeType=text/html

[59] Source: http://www.statista.com/statistics/256275/ownership-and-personal-use-of-laptops-and-netbooks-by-country/

countries analysed, laptop or netbook ownership and usage was found to have a similar share with around 70%.

OWNERSHIP AND PERSONAL USE OF LAPTOP/NETBOOK COMPUTERS 2012, BY COUNTRY

Share of population that owned and used laptop/netbook computers in 2012, by country

Worldwide, selected countries

Source: Ofcom

© Statista 2013
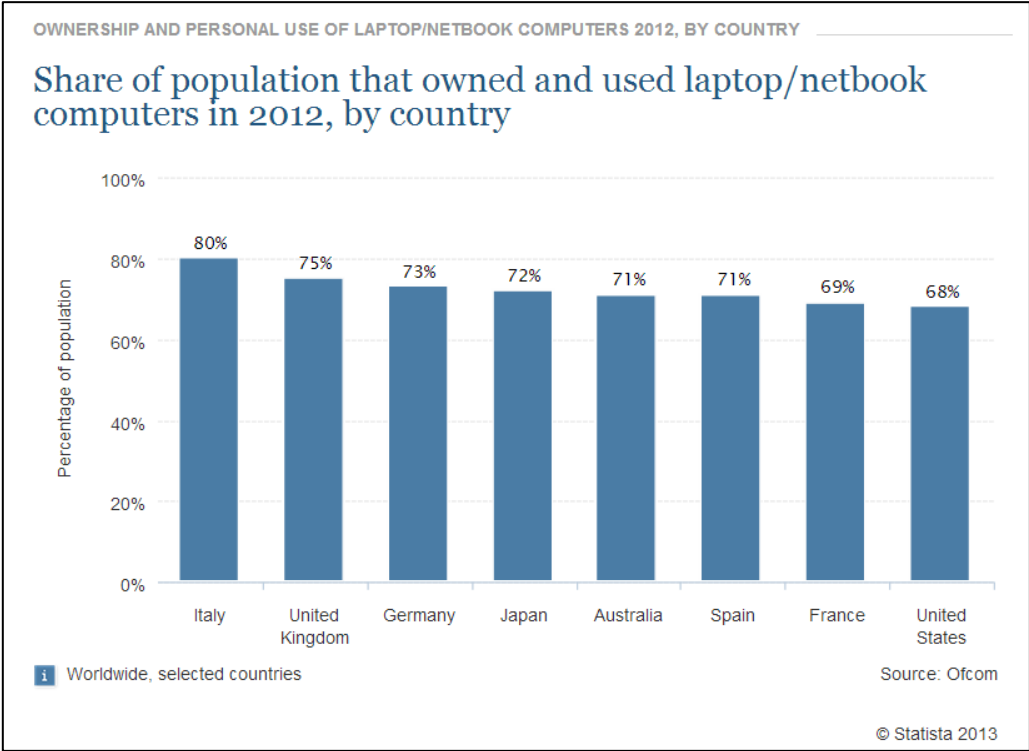
Figure 18: Share of population of use of laptop/netbook computers in 2012 (Source: Statista)

1.4.1.3   Tablet PCs

Figure 19 shows the share of population that owned a tablet PC in 2012. Within the selected European countries, Spain and Italy have the highest penetration rates with 24% and 23%, whereas the penetration rate of tablet PCs in Germany is comparably low with 10%.
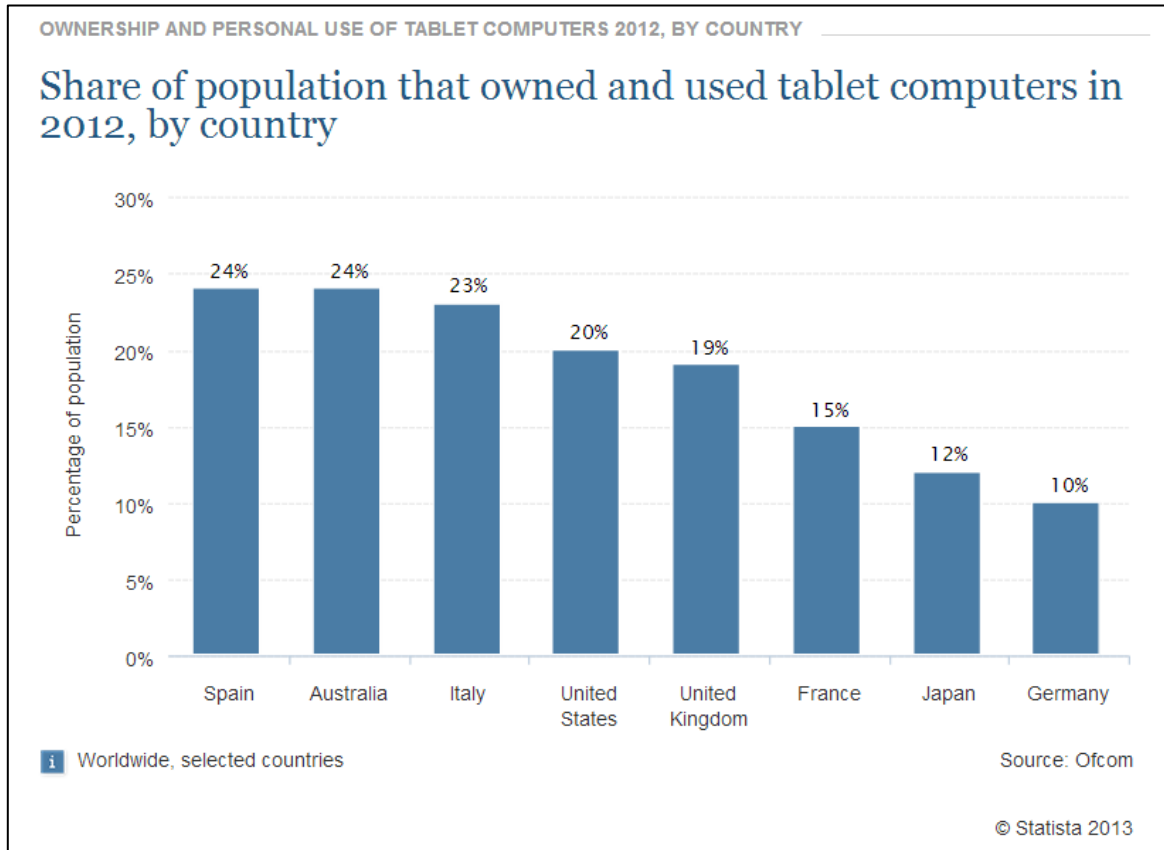
Figure 19: Share of population owing and using tablet PCs in 2012 (Source: Statista[60])

1.4.2 Computers replacement cycle and reasons

The following table provides the average economic lifetimes for desktop PCs, notebook PCs and external LCD computer displays as referred to in the EU Ecodesign preparatory study Lot 3.

Table 7: Average economic lifetimes (Source: EuP Lot 3)

Equipment	Average economic lifetime (years)
Desktop PCs	6
Notebook PCs	5
External computer displays (LCD)	6

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[60] Source: http://www.statista.com/statistics/256277/ownership-and-personal-use-of-tablet-computers-by-country/

In contrast, Table 8 shows the average replacement cycles for Desktop and Notebook computers. These figures are rather lower indicating that most computers are replaced, not because they are broken (economic lifetime), but - for example - due to the fact that the performance (operating system, application software) is no longer considered fit for purpose.

Table 8: Replacement cycle of computers in years

Category	Replacement cycle in years	Source	Note
Desktop PCs	3.58 a	http://www.itconsultingnj.com/pc-replacement-cycle-is-it-time-for-a-new-computer	Results from a study of 177 U.S. large businesses
Notebook PCs	3 a		
	2.4 a (normal notebooks) to 3.5 a (robust notebooks)	http://www.statista.com/statistics/182759/average-lifetime-of-normal-and-rugged-notebooks/	End users of U.S. companies

Gartner conducted a survey with 177 large businesses to find out the reasons for PC replacement. 36% of the respondents indicated that the main reason for the replacement of PCs was to improve user productivity, while 27% cited escalating support costs with older PCs. 23% stated that new software requirements led to the need for new PC systems. Minor reasons were the end of a lease, the devices being fully depreciated, or mobility requirements.[61]

According to Killick[62], there can be the following general reasons motivating the replacement of ICT equipment (see Table 9).

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[61] Source: http://www.informationweek.com/the-pc-replacement-decision/164900387
[62] Source: http://www.itango.infoxchange.net.au/resources-library/article/ict-equipment-replacement-strategy

Table 9: ICT equipment life spans and rationales for replacement

Item	Cycle	Rationale for replacement
PCs	3 years	• Current technologies can be out of date/ hard drives more unreliable within 3-4 years • Reduced performance with updates and software • User expectation increases • Standard warranties are 3 years
Laptops	2 years	• Laptops more susceptible to wear and tear • Expensive to repair • Lower performance per €
Servers	5 years	• Being left permanently on and heavily used, suffers more stress on core components. • Server software at end of supportable lifecycle. • Server software upgrades may well require new hardware
Monitors	5 years	• Health & safety and aesthetic reasons often drive organisations to replace.

According to EuP Lot 3, there are indications that 20% of computer equipment goes to a second use, thus adding 2 to 3 years to their lifetime.

Especially in the business sector it is a usual practice that leased devices are refurbished after first usage and are resold as second hand IT.

1.4.3   Utilisation patterns of desktop, notebook and tablet PCs

There are a lot of debates about whether tablets will replace desktop or notebook PCs. According to Reisinger (2013)[63], tablets are popular and have been under-cutting notebook sales, but it is unlikely that they will entirely replace the full range of PCs from notebooks to desktops. Ten reasons are listed by the author, for example, that the processor in tablet PCs would still be weak in comparison to the power delivered by PCs chips, virtual keyboards would not be universally accepted, windows would be the enterprise's favourite, and productivity in enterprises.

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[63] Source: http://www.eweek.com/mobile/tablets-still-cannot-replace-laptop-desktop-pcs-10-reasons-why

In contrast to this view, a survey from Nielsen[64] indicated in 2011 that the tablet PC will be the new primary computing and entertainment device. Figure 20 shows the reasons for using tablet PCs instead of desktop or notebook PCs.
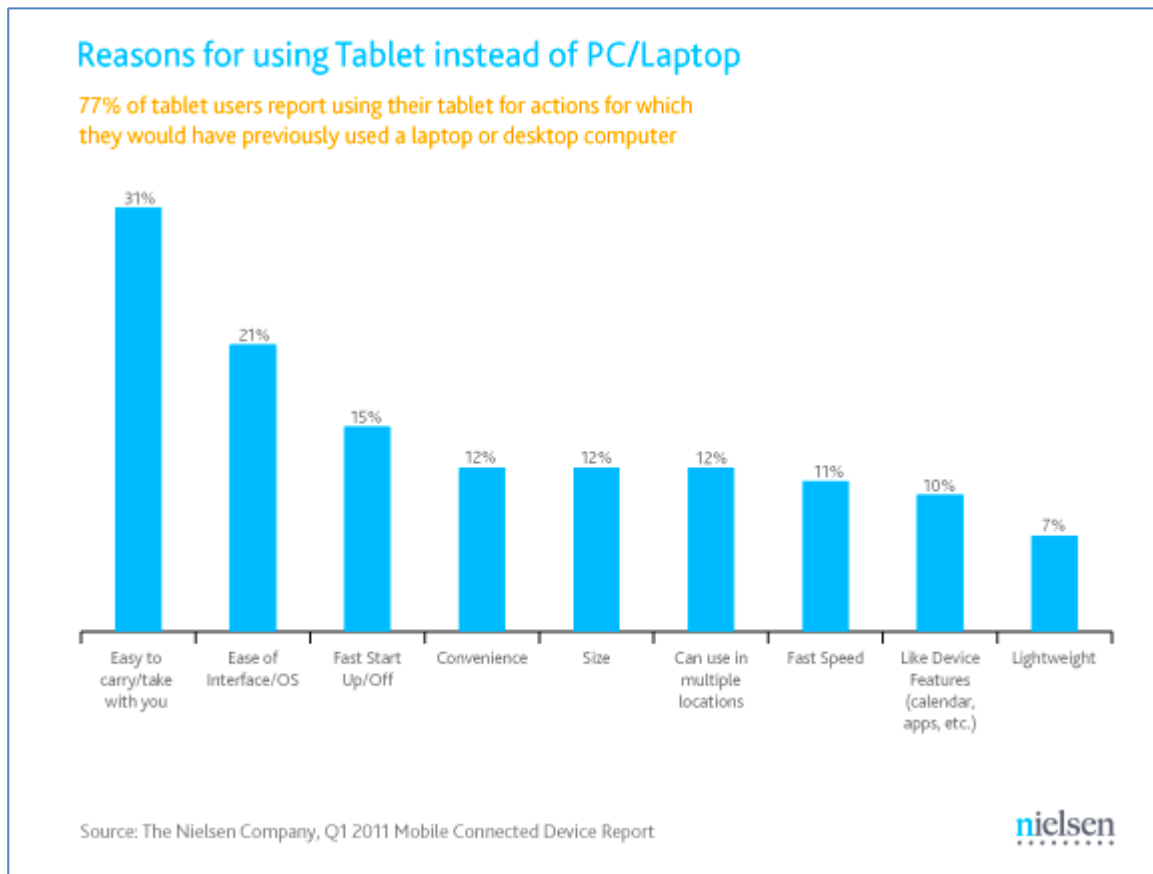
Figure 20: Reasons for using tablets instead of Desktop/Notebook PCs (Source: Nielsen)

Moreover, the following figure[65] shows a comparison of the activities that people most often undertake on their traditional PCs and tablets. More than half of the respondents said that they used their tablet PC for browsing websites, checking emails, reading e-books/news, listening to music, playing games, making social

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[64] Source:
http://www.pcworld.com/article/227415/nielsen_study_tablets_replacing_laptops_and_ereaders.html
[65] Source: http://www.statista.com/statistics/183435/comparison-of-traditional-pcs-and-tablets-by-the-type-of-usage/

networks, and watching videos. As for traditional PCs, web browsing, emails, social networking, and editing files are the major activities.

It shows that tablets PCs enable people to undertake almost the same activities compared to traditional PCs except editing files. Using solely tablets to edit files is a constraint. However, more and more tablets with docking stations are emerging which facilitate file editing via tablets (see also section 1.2.3.1). And as tablets become more powerful from a hardware perspective, a trend to replace traditional desktop and notebook PCs is likely.

Comparison of activities undertaken on traditional PCs and tablets in 2010

Web Browsing — Tablets: 68%, Traditional PCs: 81%
E-mail — Tablets: 62%, Traditional PCs: 81%
Reading eBooks, news, magazines — Tablets: 54%, Traditional PCs: 27%
Social Networking — Tablets: 54%, Traditional PCs: 55%
Listening to music — Tablets: 52%, Traditional PCs: 41%
Playing games — Tablets: 52%, Traditional PCs: 46%
Watch video — Tablets: 51%, Traditional PCs: 48%
Create / edit files — Tablets: 21%, Traditional PCs: 54%

Percentage of respondents

Traditional PCs   Tablets

Selected countries; 8.203 respondents; AlphaWise; October 2010

Source: Morgan Stanley

statista

Figure 21: Comparison of activities undertaken by traditional PCs and tablets (Source: Statista)

1.4.4 Trend to multiple devices

1.4.4.1 Computers

According to GfK[66], the trend is for a second and even a third device. Overall, increasing numbers of IT products are appearing in West European households. The digital way of life is expanding in all directions. For instance, the current trend in computers now seems to be to own a second and even a third device. Many consumers are not only using a stationary desktop PC or all-in-one computer at home, but also have a notebook, or netbook as a full-service mobile device, not to mention a media tablet for digital entertainment.

1.4.4.2 Monitors

To expand the computer's display e.g. to view large spread sheets or to open two different applications at the same time, the usage of a second, dual monitor seems to be increasing. According to NEC Display, a major supplier of monitors, 30 to 40% of the employees of its corporate customers used more than one monitor, up from 1% four years ago[67]. For professional mobile notebook users who require dual screen capabilities, portable USB displays are provided using the PC's USB port for power. Models are slim and light weight and equipped with a photo frame stand.

1.4.5 Trend to use computers as alternate means for watching TV

Many consumers are starting to use non-traditional mediums for viewing TV or video programming, mostly via the Internet. PCs, both desktops and notebooks, were the primary devices used for watching video content aside from the TV. This was the case for nearly 40% or more of the consumers in every country surveyed (see Figure 22). There were also a small but notable number of consumers using mobile devices to view content. In some emerging regions, this may be based on a better developed

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[66] Source: http://www.gfk.com/Documents/Press-Releases/2012/20120829_gfk_it_ifa_2012_efin.pdf

[67] Source: http://www.nytimes.com/2012/02/08/technology/for-multitaskers-multiple-monitors-improve-office-efficiency.html?pagewanted=all&_r=0

mobile infrastructure and a relatively high penetration of wireless networks compared to the traditional TV broadcasting system[68].
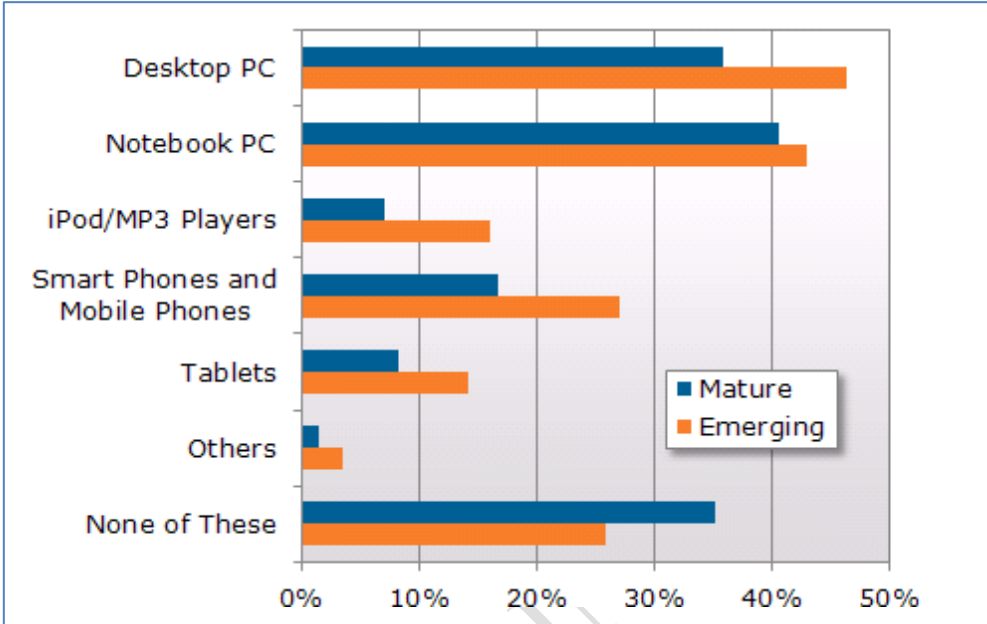

**Figure 22: Usage of additional devices for viewing TV/Video content in 2012
(Source: NPD DisplaySearch)**

NPD DisplaySearch[69] surveyed households about the additional devices used to view TV/video content, finding that more households in emerging markets use devices other than a TV, including mobile devices such as tablets, smart phones, and MP3 players. The reason is that households in emerging markets have only one TV but multiple generations living under one roof, and the mobile device penetration of these markets is high which enables consumers to access content in other ways.

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[68] Source:
http://www.displaysearch.com/cps/rde/xchg/displaysearch/hs.xsl/110524_displaysearch_tv_replacement_study_highlights_consumer_tv_usage_and_alternate_means_for_watching_tv.asp
[69] Source:
http://www.displaysearch.com/cps/rde/xchg/displaysearch/hs.xsl/120723_consumers_in_emerging_markets_such_as_china_Brazil_will_drive_tv_demand.asp

1.5 Summary of key market aspects relevant for the criteria revision

The key aspects of the market analysis being relevant for the revision of EU ecolabelling and Green Public Procurement criteria for PCs can be summarised as follows:

- The PC market (desktop, notebook and tablet PCs) is expected to further rise, mostly driven by the **increasing market share of tablet PCs**.

- The tablet PC market is projected to dominate the PC market from 2014. This trend is facilitated e.g. by docking stations for tablet PCs that enable the use of tablets like traditional PCs (e.g. file edition).

- Contrary to the market for PCs for consumer or office work, which suffered a decline in volume due to the trend to tablet PCs, **workstations** for professional computing don't seem to follow this trend. With 3.5 million units shipped worldwide, the overall percentage of desktop PCs (148 million units in 2012) is small. However, due to their **higher energy consumption** compared to other computer product categories as well as **an extensive 24/7 use phase** (24 hours a day, 7 days a week) their relevance in terms of the environmental performance is significantly higher compared to the market share.

- The **thin client market** is expected to remain on a steady growth due to **increasing interest in cloud computing**, low total cost of ownership, high security, easy manageability and easy transition from traditional PCs to a thin client network.

- For small scale servers, no explicit market data, relevance and trends could be found; thus stakeholders' feedback on this point would be welcome.

- Today's computer displays are **LCD monitors with LED backlight** technology while CRT monitors / CCFL backlight technology are almost phased out and will not play a future role.

- For external computer displays, the trend is further going towards **larger screen sizes**; the average screen size of computer displays sold in 2012 is indicated to be 21 inch. Regarding the display size of notebooks, a diversification is noted with larger screen sizes > 18'' on the one hand (for gamers or office

applications), and smaller and more portable devices for travelling purposes like netbooks etc. < 15'' on the other hand.

- The trend is towards households with **multiple computers**: not only using a stationary desktop PC or all-in-one computer at home, but also having a notebook, or netbook as a full-service mobile device, combined with a media tablet for digital entertainment.

- The trend is towards **dual or multiple monitors at the workplace**. One major supplier of displays states that 30 to 40% of the employees of its corporate customers used more than one monitor. For professional mobile **notebook users, portable UBS displays** are provided using the PC's USB port for power.

- The **touch screen functionality of displays** is expected to increase. Especially for netbooks, tablet PCs and All-in-one PCs, the touch screen penetration rate already has been continuously increasing. For traditional notebooks, forecasts differ, with an expected penetration rate of between 8% in 2013 and 25-50% in 2016.

- **Flexible displays** based on special glass or active-matrix O-LED are expected to be first introduced for smartphones by the end of 2013 and will not play a major role for the notebook or tablet PCs market within the next few years.

- **PCs**, both desktops and notebooks, become the primary devices used for **watching video content** aside from the television.

- Concerning the **drive technology** of computers, hard disk drives (HDD) will still dominate the storage market compared to solid state disks (SSD) in the coming few years. However, it is predicted that the HDD market will shrink due to the usage of ultra-books and tablets that use SSDs.

- For **tablet PCs, docking stations** will expand their usability as conventional notebook or desktop PCs which might make them increasingly attractive also for business applications where interfaces and integration into the office environment are key factors influencing product choice.

- For tablet PCs and ultra-books, **wireless charging** might become a trend especially in public usage environments and W-LAN hotspots like restaurants, train stations, airports etc. The overall energy consumption, however, depends on the number of wired chargers that are replaced, the type of chargers and the charging habits of the owner.

- Most computers are replaced not because they are broken (**economic lifetime**), but due to the fact that the performance (operating system, application software) is no longer valid or limits users' productivity, support costs with older PCs escalate, or new mobility requirements lead to an **earlier replacement**. Especially in the business sector, a significant share of computer equipment goes to a second use, thus adding 2 to 3 years to their useful lifetime. For example, leased devices are refurbished by specialised companies after the first usage and are **resold as second hand IT**.

- Regarding Energy and Ecolabels, **Energy Star** is the most relevant label (nearly 10,000 products awarded), followed by the US Ecolabel **EPEAT** (around 2,300 products awarded). Fujitsu is the only PC vendor awarded with the German Blue Angel and the Nordic Swan; moreover, a number of products by Lenovo, ASUS, Samsung, AOC and HP are awarded with the TCO label for computers.

- Personal communication by one PC vendor indicates that in the computer market, **Green Public Procurement criteria play a rather significant role**, as manufacturers orientate their product developments according to the GPP criteria. Moreover, these criteria seem to be **applied rather to business products** whereas for products sold to private consumers, environmental criteria seem to play only a minor role from the supply perspective.