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Green ICT

Pink elephants or real returns?

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'Green ICT' – Pink elephants or real returns?

The current debate over 'Green ICT' was triggered by media hype around climate change in 2007. The industry had built up a clean, non-polluting image that appeared, on the face of it, to be free of environmental hazard. Now, though, it is becoming clear that its carbon footprint is significant. The ICT sector is causing round about 2% of global CO_2 emissions, as much as air transport – a situation we consider to be unsustainable.

'It's not just the carbon, stupid'

Notwithstanding the positive overall environmental value of ICT, this issue needs to be put at the top of the sector's management agenda (on both the buy and sell sides). However, to look at the direct carbon footprint of the sector alone would be to take too narrow a view of what 'Green ICT' actually means. The questions 'How green is the ICT industry today?' and 'What needs to be done to become green?' need to be addressed based on a full life-cycle assessment of ICT products. Our analysis has identified four main areas of environmental impact, which differ in terms of their materiality during the different stages of the life cycle: resource use (ex energy), hazardous substances, carbon footprint, and 'environmental justice'.

Obstacles – why the industry is not yet 'green' enough

The obstacles on the road to a more environmentally sustainable ICT sector are fairly obvious, and they are also material. First of all, the industry is highly competitive, and this has led to strategies on cost leadership, resulting in complex global production networks and supply chains with high shares of outsourced contract manufacture. It is obvious, not only that it is difficult to monitor and verify environmental compliance within such a system, but also that the system's intrinsic cost pressures are themselves in conflict with environmental goals. In a recent survey, ICT professionals (buy side) cited time pressure, cost and a lack of corporate commitment as the biggest obstacles to implementing new 'Green ICT' technologies. Other significant barriers are the scarcity of information and a lack of knowledge within the organisation.

ICT – paving the way to a 'low(er)-carbon economy'

The direct environmental footprint of the ICT sector is only one side of the coin. The sector's positive role in making economic activity more efficient (i.e. less energy intensive) also needs to be recognised, and the opportunities for this need to be fully exploited. These opportunities include e-commerce and telecommuting, for example, which can both reduce energy use for freight and passenger transport. However, it is hard to say at present whether these indirect gains will exceed the incremental energy consumption caused by the sales growth and market penetration of ICT equipment and infrastructure.

Catalysts for change

It is fair to say that being 'green' has not been a priority in the ICT sector so far. Companies that are both aware and concerned about the issue still represent a small minority. Obviously, this is in sharp contrast with predictions with regard to the future of 'Green ICT'. The question that arises is: what are the factors that will make the industry change course? In general terms three major structural drivers can be named:

(1) Increasing energy and carbon costs; (2) the impact of climate change and other environmental issues on brand values and customer behaviour; (3) government and regulatory measures.

Will environmental aspects soon count among the top buying criteria for IT-related goods and services?

The issue of climate change, and the increasing pressure being exerted on companies to tackle it, have come to the fore and are acting as a kind of catalyst for overall change. Gartner, for example, believes that, with increasing industry maturity and sophistication over how to tackle energy efficiency, a paradigm shift will occur in the majority of companies by 2010. This is now close to being realised, and if it is, it will put a lot of pressure on vendors of ICT equipment and infrastructure to prove their 'green' credentials.

Regulatory pressure, voluntary initiatives

EU is leading the way

No doubt, regulation and legislation will constitute a strong driver of change. The EU is leading the way in this respect and is setting the benchmark for other countries and regions worldwide. China, for example, has started to copy regulatory schemes like the EU Directive on Reduction of Hazardous Substances (RoHS), and in some respects proposes actually to go beyond the EU blueprint. Other benchmark-setting regulatory initiatives for the ICT sector include the EU Directive on Waste Electrical and Electronic Equipment (WEEE); EU legislation on registration, evaluation and authorisation of chemicals (REACH); and the EU Directive on Energy-using Products (EuP).

Important role of 'eco-labelling' initiatives

The EU way of tackling 'green' issues relating to ICT products is in sharp contrast to the US approach. In preference to regulation, it is focusing on voluntary initiatives that are either driven by the ICT industry alone or in partnership with governmental organisations acting as independent, standard-setting bodies. These include so-called 'eco-labelling' initiatives such as the Electronic Product Environmental Assessment Tool (EPEAT) and the US government's Energy Star programme.

'Green ICT' – Disclosure of relevant information by companies

Carbon Disclosure Project

Closing the circle: the carbon footprint of the ICT industry and the Carbon Disclosure Project

One prominent initiative that is neither driven by the ICT industry itself nor is particularly dedicated to it is the Carbon Disclosure Project (CDP). In looking at the CDP we somehow close the circle by getting back to our starting point – the climate change debate. The initiative seeks information on the business risks and opportunities presented by climate change and greenhouse gas emissions from the world's largest companies. And although it only covers direct emissions by companies and not the entire life-cycle impact of ICT products, it is a significant step towards transparency and manageability. The CDP classifies all ICT-related industry groups as 'low-carbon sector'. For 'Semiconductor Equipment & Products' the disclosure rate is just above 40%, whereas for 'Computers & Peripherals' it is much higher at around 70%.

'Green ICT' – a look at companies' ESG reports

59.6% of ICT companies within our sample have provided ESG reports over the past two years

An important source of information to investors is reports provided by companies themselves. Following on from our note 'GRI reporting – Aiming to uncover true performance' (September 2007), we have analysed the ESG reports of the ICT companies we look at in this note. We have found that out of the 57 companies in our sample, 34 have reported on ESG issues over the past two years (a 59.6% report rate, which ranges

from 38.9% for Semiconductors to 83.3% for Office Electronics). In doing so, 13 adhere to one of the various GRI reporting standards, nine of them to most recent, the G3 standard.

Benchmarking ICT companies based on self-reported performance indicators …

For the nine G3 reports in our sample we have looked at the question of the usability and comparability of the self-reported performance indicators. G3 requires companies to report 30 environmental indicators, of which 17 are considered 'core' and 13 'additional'. Looking at the 'Content Indices' (a feature required by G3) of the nine reports, we find that the average reporting rate for the core indicators is 64.7%; this compares with 46.7% for the overall 'all sectors' sample that we used in our 'GRI reporting' note (for the additional indicators: 38.5% vs 24.3%). Our final step was to try to benchmark companies based on some of the performance indicators that we consider to be material within the 'Green ICT' debate. These include 'Materials used', 'Energy consumption', 'Water usage', 'GHG emissions', 'Waste generated' and 'Products recycled'.

… is a 'Mission Impossible'

The conclusions we have drawn from what we found resemble those of our general note on 'GRI reporting'. The overall picture on the scope and the quality of performance indicators reported is disenchanting. In particular, direct comparisons of companies are still very difficult (indeed, almost impossible). This explains to some degree why we see the need for a more complex rating process, which takes into account not just the qualitative and quantitative information provided by companies themselves but also information from external sources.

Ratings – Introducing the WestLB 'Green ICT' indicator

'Green ICT' ratings for 57 companies from all over the world

To assess the 'green' credentials of ICT companies we have developed a 'Green ICT' indicator and additional sub-indicators, all based on our extra-financial rating system. We have rated 57 ICT companies from around the world. We have covered six industry groups: 'Communications Equipment', 'Computer Hardware', 'Computer Storage & Peripherals', 'Office Electronics', 'Semiconductor Equipment' and 'Semiconductors'. Among the top 10 ranked companies across all groups are NEC, Toshiba, Seiko Epson, ASML, Fujitsu, Dell, Canon, Ricoh, Ericsson and Sun Microsystems.

Integrating 'Green ICT' information with traditional financial information

Investment ideas from the perspectives of three different styles

In this note we integrate the 'Green ICT' ratings of companies with traditional financial selection criteria based on growth and value measures. The aim is to provide investment ideas from the perspective of three types of investor (investment styles): 'Growth', 'Value' and 'G.A.R.P.' (Growth At a Reasonable Price).

Significant correlation between financial characteristics and 'Green ICT' scores

Looking at the findings of our analysis, we can say that they basically appear to be the mirror image of each other. In both cases we have found a clear and statistically significant association between the financial scores based on 'Growth' and 'Value' measures respectively. These associations are positive for 'Value' (i.e. higher 'Value' scores imply higher 'Green ICT' scores) and negative for 'Growth' (i.e. higher 'Growth' scores imply lower 'Green ICT' scores). This result is not produced by any 'technical', artificially induced correlation between our 'Value' and 'Growth' measures; all 'Growth' measures we use are independent of stock prices. The table below summarises our investment ideas (long and short) for the three different investment styles under consideration.

'Green ICT' investment ideas from three different style perspectives

Company	Growth score	Value score	Green ICT z score	Market Cap in US$*	Price 15/05/08
Long ideas - Growth					
ASML Holding	4.00	3.54	1.47	13,304.8	29.93
Tokyo Electron	3.88	2.31	0.88	10,742.9	65.08
Short ideas - Growth					
Micron Technology Inc	4.15	4.30	-1.01	6,668.7	8.84
ARM Holdings	3.44	2.15	-1.13	2,795.8	2.08
Nvidia Corporation	3.43	3.50	-1.23	13,211.5	23.78
Broadcom	3.50	1.92	-1.36	12,910.2	27.58
Research in Motion Ltd.	4.71	1.75	-1.43	67,244.0	140.88
Juniper Networks	4.07	2.50	-1.43	14,693.5	28.17
Marvell Technology Group	3.69	2.58	-1.68	6,902.0	14.83
Long ideas - Value					
ASML Holding	4.00	3.54	1.47	13,304.8	29.93
Dell Inc	2.69	4.25	1.34	40,644.8	20.63
Ericsson	1.87	4.54	1.29	40,042.7	2.70
Sun Microsystems Inc	2.91	4.08	1.19	10,694.4	13.49
STMicroelectronics	2.44	4.46	1.05	8,519.4	12.92
Hewlett Packard Co	2.41	4.08	1.00	120,472.6	46.73
Short ideas - Value					
Micron Technology Inc	4.15	4.30	-1.01	6,668.7	8.84
Nvidia Corporation	3.43	3.50	-1.23	13,211.5	23.78
Long ideas - G.A.R.P.					
ASML Holding	4.00	3.54	1.47	13,304.8	29.93
Short ideas - G.A.R.P.					
KLA Tencor Corp	2.41	2.85	-1.45	8,330.9	46.27

* as of 15/05/08

Source WestLB Research, JCF, SiRi

Conclusions

No low-hanging fruit to be harvested

Is 'Green ICT' just a pink elephant, an illusion that will vanish as quickly as it appeared on the industry's radar screen, or is it indeed about tapping new profit potential and reducing financial risks? We believe that the latter is true, but we also feel that quick wins are not in sight – nor are there any low-hanging fruit.

For industry leaders it will not suffice just to have a 'green' marketing message in place

Most ICT organisations are still at the very early stages of 'going green'. There is a big gap between media coverage of 'Green ICT' and what companies are actually able to show in terms of programmes and performance. We believe that 2007 marked an important milestone in a long-term process of change that will take many years to be completed. 'Green procurement' and changes in the regulatory environment will certainly put a lot of pressure on vendors of ICT equipment and infrastructure to prove their 'green' credentials. For industry leaders it will not suffice just to have a 'green' marketing message in place; companies who still believe this will lose competitiveness and market share.

'Green ICT' and 'Sustainable ICT'

Environmental and social dimensions are closely intertwined because they have the same causes as human rights abuses and/or labour issues. At the end of the day, 'Green ICT' needs to be addressed within the broader context of 'Sustainable ICT'.

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‘Green ICT’ – Pink elephants or real returns?

The ICT sector causes around 2% of global CO_2 emissions, as much as air transport – a situation we consider to be unsustainable. The pressure on vendors of ICT equipment to reduce the carbon footprint of their products will significantly increase going forward. Public attention is focusing on improvements in the energy efficiency of ICT products. However, what vendors tend to conceal is that the life-cycle carbon footprint of ICT equipment is dominated by production rather than operation. This example shows that answers to the questions ‘How green is the ICT industry today?’ and ‘What needs to be done to make it green?’ need to be based on a full life-cycle assessment (‘from the cradle to the grave’) of ICT products – from the extraction of raw materials for production, to the disposal or recycling of obsolete equipment.

Coming under fire

CO_2 footprint in the spotlight

Media hype around climate change has triggered the current debate about ‘Green ICT’

Is ‘Green ICT’ just a pink elephant, an illusion that will vanish as quickly as it appeared on the industry’s radar screen, or is it indeed about tapping new profit potential and reducing financial risk? The current debate over ‘Green ICT’ was triggered by media hype around climate change in 2007. Barely a day went by last year without a headline about the impact of greenhouse gases on the environment. And as public opinion moved from scepticism to acceptance, fingers began to be pointed at the industries assumed to have the most significant carbon footprints. Utilities and automotive producers came under attack, as did the airline industry. Less attention, however, has been paid to the information and communications technology (ICT) sector, which is traditionally considered to be a ‘clean’ industry. The industry has built up a clean, non-polluting image that appears on the surface to be free of environmental hazard. Now, though, it is becoming clear that its carbon footprint is significant. According to data provided by Ericsson, for example, all ICT sectors combined account for 1.9% of all CO_2 emissions.

CO_2 emissions by the ICT industry

Segment	Main units (2006)	Primary energy	CO_2 emissions
Mobile Telecom	2.6 bn subs	0.12%	0.14%
Fixed Telecom	1.3 bn fixed lines, 200m broadband lines	0.26%	0.30%
ICT, commercial use	34m servers, 400m PCs	0.75%	0.80%
ICT, household use	600m PCs	0.55%	0.60%
Total		**1.70%**	**1.90%**

Source Ericsson

Industry accounts for approximately 2% of global CO_2 emissions, as much as aviation

Gartner Inc., the benchmark industry consulting firm, recently put ‘Green ICT’ at the top of its agenda for 2008, also saying that the industry accounts for approximately 2% of global carbon dioxide (CO_2) emissions, the same amount as the aviation industry. And there is no doubt its impact will increase further. We live in an era of unprecedented information growth. In 2006, 161 exabytes (161,000,000,000,000,000,000 bytes) of digital information was created and copied (source: Global Action Plan). That is equivalent to 3m times the information in all the books ever written, or 12 stacks of books, each extending

more than 93m miles from the Earth to the Sun. In 2007, the total volume of digital information created and replicated globally reached 281 exabytes (source: IDC). Global Action Plan estimates that the amount of information created and copied in 2010 will increase six-fold from the 2006 level.

Scope of 'Green ICT' is broader

Gartner's estimate of the ICT industry's CO_2 footprint includes the in-use phase of PCs, servers, cooling, fixed and mobile telephony, local area networks (LANs), office telecommunications and printers. Gartner concludes that this is unsustainable, notwithstanding the positive overall environmental value of ICT, and that the topic needs to be put at the top of the sector's management agenda (on both the buy and sell sides). We fully agree with this, but we would also say that to look at the carbon footprint of the sector alone would be to take too narrow a view of what 'Green ICT' should actually mean to them. Its scope is much broader (see 'It's not just the carbon, stupid', p. 8).

Has 2007 marked the tipping point?

Another point we would stress is that most ICT organisations are still at the very early stages of 'going green'. There is a big gap between media coverage of 'Green ICT' and what companies are actually able to show in terms of programmes and performance. Whether 2007 indeed marked the tipping point in this respect, as Gartner believes, remains an open question. We differ from this typical consultant's statement in arguing that 2007 marked an important milestone in a long-term process of change that had begun much earlier and will take many years to be completed. Quick wins are not in sight, and there are certainly no low-hanging fruit to be harvested.

Complex global production chains make the 'greening' of ICT a difficult undertaking

The obstacles on the road to a more environmentally sustainable ICT sector are fairly obvious, and they are also material. First of all, the industry is highly competitive, and this has led to strategies on cost leadership, resulting in complex global production networks and supply chains with high shares of outsourced contract manufacturing. It is obvious that, within such a system, not only is it difficult to monitor and verify environmental compliance, but the system's intrinsic cost pressures are themselves in conflict with environmental goals.

Equipment vendors prefer to focus on energy efficiency during the period of use, but this is not the whole story

So it should come as no surprise that many companies try to direct and focus public attention towards improvements in the energy efficiency of their products. This is certainly a material issue, as the explosive growth of energy use in data centres shows, and it is certainly necessary to see progress in this space. However, what producers tend to conceal is that the life-cycle carbon footprint of ICT equipment is dominated by production rather than operation. For example, it is estimated that the production process alone accounts for 81% of a PC's life-cycle energy use. This example shows that answers to the questions 'How green is the ICT industry today?' and 'What needs to be done to become green?' need to be based on a full life-cycle assessment of ICT products. We are aware that this is an ambitious call, but also an unavoidable one.

We see two major drivers that will shift 'Green ICT' from being a mere corporate communication tool, as it has been in the past, to a cold-hearted business matter in the future:

- Mounting regulatory pressure, leading to significantly rising compliance costs.
- Demand-side pressures exerted by 'green' procurement policies and a shift in consumer preferences, both triggered by the climate change debate in the first instance. Gartner, for example, expects that by 2009, more than one-third of ICT organisations will have one or more environmental criterion in their top six buying criteria for ICT-related goods and services, and that by 2010, 75% of organisations will have adopted full life-cycle energy and CO_2 footprints as mandatory criteria in buying PC hardware.

'It's not just the carbon, stupid'

Need to address the full life-cycle impact

From the extraction of raw materials for production, to the disposal or recycling of obsolete equipment

'Green ICT' is not just about the CO_2 footprint of ICT equipment during the period of operation/use. The energy efficiency of products is certainly a material issue within the 'Green ICT' debate, but it is only one among several matters. As we have already noted, what is needed is a full life-cycle assessment (LCA) of ICT products, from the extraction of raw materials for production to the disposal or recycling of obsolete equipment.

Case study: Seiko Epson

Seiko Epson uses LCA to reduce the ecological impact of its use of resources. Epson reports that after analysing at the design stage the potential environmental impact of the eco-friendly PX-5800 printer across its life cycle, its design engineers began zeroing in on materials that have a serious affect on global warming. Ordinary steel was singled out for the high CO_2 emissions associated with steel production. As parts made from steel began to fall by the wayside in favour of more eco-friendly alternatives, the printer underwent a structural overhaul that made it far smaller and lighter than any of its predecessors.

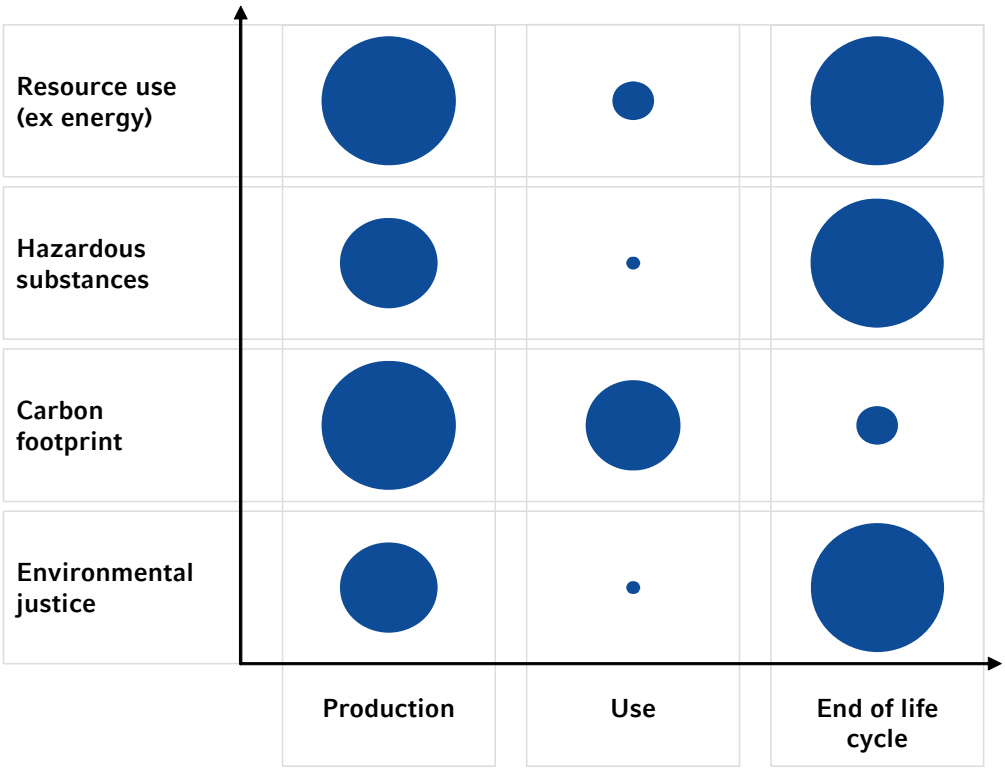
Four main areas of environmental impact

Our analysis has identified four main areas of environmental impact, which differ in terms of their materiality during the different stages of the life cycle:

- Resource use (ex energy)
- Carbon footprint
- Hazardous substances
- 'Environmental justice

The following chart gives an overview, with the size of the bubbles indicating the degree of materiality. Materiality, by the way, is defined here with respect to the environmental footprint, i.e. the external environmental costs of ICT products.

Life-cycle assessment of ICT equipment, and the materiality of the four main areas of impact



Source WestLB Research

Environmental and social dimensions are intertwined

At this point, just a few words on the subject of 'environmental justice', which seems to be out of line to some extent within the 'Green ICT' context. Environmental justice – a concept defined by the UN – describes the uneven regional distribution of the adverse environmental impacts caused by the ICT sector. It is a concept that links the environmental dimension of issues with their social dimension. The bulk of the external costs that are produced as a result of raw material extraction, manufacturing, and recycling and disposal of e-waste are currently incurred by the developing rather than the developed world.

'Green ICT' and 'Sustainable ICT'

Environmental and social dimensions are closely intertwined because they have the same causes as human rights abuses and/or labour issues. At the end of the day, 'Green ICT' needs to be addressed within the broader context of 'Sustainable ICT'. Issues that are material from a 'Sustainable ICT' perspective but are not part of the 'Green ICT' issue, and hence are not discussed in detail in this note, include mobile telephony/ electromagnetic fields and the 'digital divide', for example.

Electromagnetic fields

Material sustainability issues not covered by 'Green ICT'

Electromagnetic fields (EMFs) of all frequencies represent one of the most common and fastest-growing influences on the environment, according to the World Health Organisation (WHO). The world's entire population is now exposed to varying degrees of EMF, and those levels will continue to increase as technology advances. Some stakeholders fear that extended exposure may lead to increased levels of cancer or other illnesses. Scientific opinion regarding the health risk of EMF radiation from mobile

phones and network base stations remains divided. The WHO finds that 'to date there is no evidence to conclude that exposure to low level electromagnetic fields is harmful to human health.' However, to better assess the risk to health the WHO is promoting the 'Interphone Study', a series of multinational case-control studies to assess the cancer risk of exposure to radiofrequency, coordinated by the International Agency for Cancer Research (IARC). Its initial findings send mixed signals.

Reputational and litigation risks may increase significantly

Health concerns among consumers and communities where antennae are located already pose some risk to vendors of telecommunication and communication equipment, with class-action lawsuits the most significant threats. Reputational and litigation risk would greatly increase if future research reveals a definite link between health issues and mobile phone handsets. Companies that contribute to research in this field and that provide information to the public will probably face less significant impairment to the values of their brands than their competitors.

The digital divide

Widespread access to modern ICT (internet, TV, telephone) is considered to be a driving factor of economic development. However, a growing digital divide, defined as a gap (whether in socio-economic, racial, generational or geographical terms) between those people with effective access to digital and information technology and those without it, is being observed. Approximately two in every three people in the USS have direct access to a computer. In sub-Saharan Africa, fewer than two in every 100 do.

Within the EU, the digital divide is primarily a matter of age and education

In today's society, jobs and education are increasingly directly related to the internet. Thus the digital divide widens the gap between the 'winners' and 'losers' from economic development. In a global context, the digital divide means that in countries where the internet and other technologies are not accessible, education is suffering, and uneducated people cannot compete in the global economy. As ICT affects innovation, productivity and growth, it is expected to widen the income gap between countries (UNCTAD report). An EU study conducted in 14 European countries in 2005 found that within the EU the digital divide is primarily a matter of age and education, with the young and better educated using internet more than the elderly and less well educated. There is also a marked digital divide in rural areas.

A great challenge not only to governments but also to the private sector

Narrowing the digital divide, by giving more people access to IT, is one of the great challenges facing both governments and the private sector. Broadband is especially instrumental in attracting foreign investment in technology, and will ultimately be a key driver of growth. International cooperation between governments aimed at dealing with the global digital divide has now begun. One example of this is the Global Alliance for Information and Communication Technologies and Development (GAID), an initiative approved by the UN Secretary-General in 2006. Another project, supported by the UN and a number of technology companies, is the One Laptop Per Child (OLPC) project, which aims to distribute – free of charge – millions of Linux-based laptop computers.

Corporate engagement should pay off in future

Corporates joining these initiatives can reap the benefits of being part of such networks; in many cases they can get governmental support and easier access to new markets. They should be able to create front-runner profits and gain helpful experience. Expanding digital access is thus a vehicle for expanding sales and profitability. Besides, engagement in developing countries has also positive reputational effects.

Microsoft has joined the OLPC initiative of late

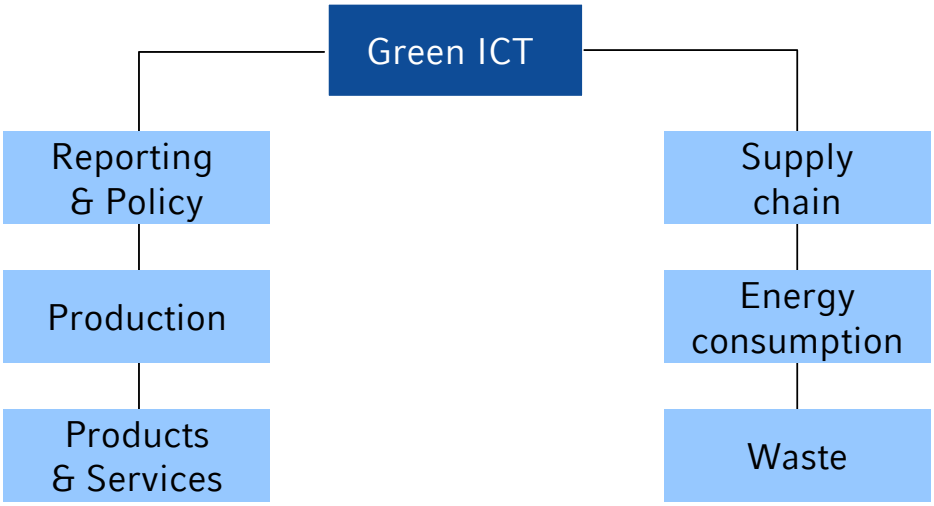
This has been recognised by Microsoft of late; the company has decided to support the OLPC initiative recently. It will make the Microsoft Windows operating system available on OLPC's low-cost XO laptops. Trials of the XO running Windows are planned to begin in June in key emerging markets. The availability of Windows, in addition to Linux, on the XO laptop will allow customers to have an expanded choice of operating environments that best fit their requirements.

WestLB 'Green ICT' indicators

Rating of companies based on our 'Extra-Financial Risk Navigator'

In order to bring the issue of 'Green ICT' down to company level, we have looked at suitable sub-components (or items) of our extra-financial rating system (see 'Extra-Financial Risk Navigator – focusing on sector-specific factors', March 2006). We have aggregated these items to form an overall 'Green ICT' indicator and several sub-indicators that focus either on the different dimensions of performance (e.g. reporting, products) or on particular episodes of ICT product life cycles (e.g. supply chain, waste).

WestLB 'Green ICT' indicators



Source WestLB Research, SiRi

Sub-component weights and normalisation

The methodology is the same as for our overall extra-financial risk rating. Sub-components, however, are equally weighted here (for our overall rating we work with a weight matrix) and raw scores obtained are transformed into comparable, normalised scores (z-scores). A more detailed description of our approach can be found in the chapter 'Green ICT – Rating companies on a global basis' (see p. 98 ff).

Global company universe

With respect to the companies covered we started with our benchmark universe, the DJ STOXX Global 1800 as of January 2008. We then selected six sectors (based on the GICS level 4 classification) to define the ICT super-sector. These include Communications Equipment, Computer Hardware, Computer Storage & Peripherals, Office Electronics, Semiconductor Equipment, and Semiconductors. We have been able to rate 57 ICT companies within these sectors based on the information available in our database. The table below gives on overview of our findings (for a detailed discussion, see p. 103 ff again).

'Green ICT' ratings (total) – best and worst in class

GICS sector level 4	Company	Rank sector	Rank overall	Market Cap USD m*	Country
Communications Equipment	Ericsson	1	9	40,042.7	Sweden
	Juniper Networks	10	54	14,693.5	USA
	Research in Motion Ltd.	10	54	67,244.0	Canada
Computer Hardware	NEC Corporation	1	1	10,655.1	Japan
	Wincor Nixdorf AG	9	34	2,516.3	Germany
Computer Storage & Peripherals	Seiko Epson Corp.	1	3	3,995.9	Japan
	SanDisk Corp.	6	43	7,423.0	USA
Office Electronics	Canon	1	7	63,925.5	Japan
	Neopost SA	6	38	3,631.8	France
Semiconductor Equipment	ASML Holding	1	4	13,304.8	Netherlands
	KLA Tencor Corp	7	56	8,330.9	USA
Semiconductors	STMicroelectronics	1	12	8,519.4	Switzerland
	Marvell Technology Group	18	57	6,902.0	USA

* as of 15/05/08

Source WestLB Research, SiRi

Taking a look at the 'Products & Services' sub-indicator findings

The findings above are based on total 'Green ICT' scores, balancing all the different areas of relevance against each other. As an example, we take a brief look at the findings for one of the sub-indicator rankings below. We have selected the 'Products & Services' sub-indicator here, because it is the one that is linked most closely to the core of what is currently being debated under the heading 'Green ICT'. From the life-cycle perspective it intersects with the 'use' and 'end of life cycle' periods. Hence, it has a kind of cross-sectional function.

Three items for the six sectors

For our 'Products & Services' sub-indicator there are three items that applies to all six sectors we have looked at. These are:

- Targets and programmes to reduce the energy consumption of products
- Targets and programmes to reduce the environmental impact of a product at the end of its useful life
- Controversies over products or services

The three items are equally weighted (i.e. each contributes 1/3 to the final score). The following table summarises the findings (for more detail, refer to p. 98 ff again).

'Green ICT' sub-indicator 'Products & Services' – best and worst in class

GICS sector level 4	number of companies	products score median	products score max	products score min	company with … highest scores	lowest scores
Communications Equipment	11	-0.52	0.77	-1.17	Alcatel-Lucent, Ericsson	Juniper Networks, Nortel, Qualcomm, Research in Motion
Computer Hardware	9	0.12	2.06	-0.28	NEC Corporation	IBM
Computer Storage & Peripherals	6	-0.52	1.74	-1.17	Seiko Epson Corp.	SanDisk
Office Electronics	6	0.45	1.42	0.12	Canon, Ricoh	Brother Industries, Neopost, Xerox
Semiconductor Equipment	7	0.12	1.74	-1.17	ASML Holding	KLA Tencor Corp, Lam Research
Semiconductors	18	-0.52	0.12	-1.17	Advanced Micro Devices, a.o.	ARM Holdings and others
all	**57**	**0.12**	**2.06**	**-1.17**	**NEC Corporation**	**many**

* Ranking is based on one item only here ('controversies over products and services'). None of the four companies has raised any concerns with respect to environmental issues; hence all have the same high score.

Source WestLB Research, SiRi

Integrating 'Green ICT' information with traditional financial information

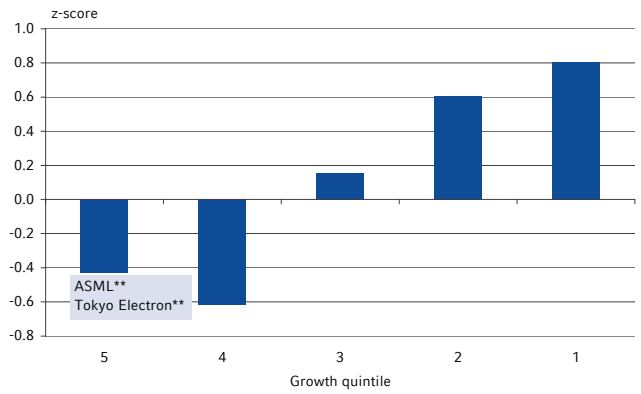
Investment ideas from three different style perspectives

In this note we integrate 'Green ICT' ratings of companies with traditional financial selection criteria based on growth and value measures (for details, see p. 113 ff). The aim is to provide investment ideas from the perspectives of three types of investor (investment styles): 'Growth', 'Value' and 'G.A.R.P.' (Growth At a Reasonable Price). We do not claim to deliver a recommended portfolio here yet, because the number of stocks in our ICT universe (57) is simply too small to arrive at a reasonable degree of diversification. At this point, however, we would point out that we will apply the G.A.R.P. stock selection process described below to our ESG stock universe to generate a portfolio that will be measured against a generally accepted benchmark (DJ STOXX Global 1800).

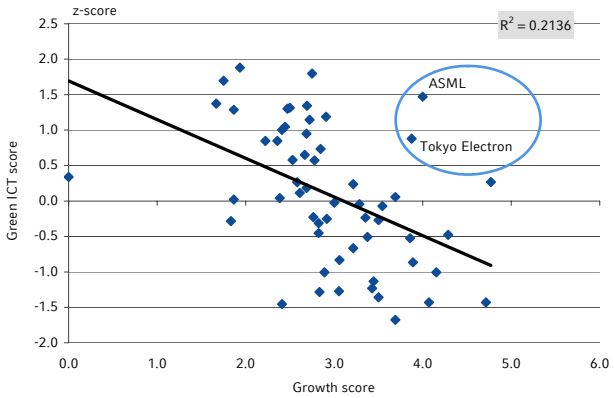
Significant correlation between financial characteristics and 'Green ICT' scores

Looking at the findings of our analysis, we can say that they basically appear to be the mirror image of each other. In both cases we have found a clear and statistically significant association between the financial scores based on 'Growth' and 'Value' measures respectively.

'Growth' style: Quintile analysis – average 'Green ICT' scores*



'Value' style: Significant positive association between 'Value' and 'Green ICT' scores



* For this analysis we used a secondary quintile ranking to assure that quintiles are equally populated. Secondary ranking in this case means that we've set up a ranking list based on the aggregated value scores and then divided this list into five equally sized groups again. It is for these five groups we show the average 'Green ICT' scores. ** Long ideas: companies with significantly above-average 'Green ICT' scores. **Source** WestLB Research, JCF, SiRi

As the chart above shows, these associations are positive for 'Value' (i.e. higher 'Value' scores imply higher 'Green ICT' scores) and negative for 'Growth' (i.e. higher 'Growth' scores imply lower 'Green ICT' scores). To be clear about this here: this result is not produced by any 'technical', artificially induced correlation between our 'Value' and 'Growth' measures; we do not use valuation ratios such as B/M, for example, to classify stocks with respect to their growth potential. All 'Growth' measures we use are independent of stock prices. The table below summarises our investment ideas (long and short) for the three different investment styles under consideration.

'Green ICT' investment ideas from three different style perspectives

Company	Growth score	Value score	Green ICT z score	Market Cap in US$*	Price 15/05/08
Long ideas - Growth					
ASML Holding	4.00	3.54	1.47	13,304.8	29.93
Tokyo Electron	3.88	2.31	0.88	10,742.9	65.08
Short ideas - Growth					
Micron Technology Inc	4.15	4.30	-1.01	6,668.7	8.84
ARM Holdings	3.44	2.15	-1.13	2,795.8	2.08
Nvidia Corporation	3.43	3.50	-1.23	13,211.5	23.78
Broadcom	3.50	1.92	-1.36	12,910.2	27.58
Research in Motion Ltd.	4.71	1.75	-1.43	67,244.0	140.88
Juniper Networks	4.07	2.50	-1.43	14,693.5	28.17
Marvell Technology Group	3.69	2.58	-1.68	6,902.0	14.83
Long ideas - Value					
ASML Holding	4.00	3.54	1.47	13,304.8	29.93
Dell Inc	2.69	4.25	1.34	40,644.8	20.63
Ericsson	1.87	4.54	1.29	40,042.7	2.70
Sun Microsystems Inc	2.91	4.08	1.19	10,694.4	13.49
STMicroelectronics	2.44	4.46	1.05	8,519.4	12.92
Hewlett Packard Co	2.41	4.08	1.00	120,472.6	46.73
Short ideas - Value					
Micron Technology Inc	4.15	4.30	-1.01	6,668.7	8.84
Nvidia Corporation	3.43	3.50	-1.23	13,211.5	23.78
Long ideas - G.A.R.P.					
ASML Holding	4.00	3.54	1.47	13,304.8	29.93
Short ideas - G.A.R.P.					
KLA Tencor Corp	2.41	2.85	-1.45	8,330.9	46.27

* as of 15/05/08

Source WestLB Research, JCF, SiRi

Outline of our research note

The three parts of our research note: the issues; rankings; reporting

In part 1, we firstly take a brief look at the general set-up of the sector and at the most important industry trends for the future. Secondly, we give an overview of the most material 'green' challenges facing the sector. Thirdly, we discuss the role of ICT in making the overall economy less energy-intensive, and the trade-off against the industry's direct environmental footprint. Fourthly, we describe the obstacles to making the ICT sector greener. Finally, we explain why we think that a process of change has now started, and why companies that want to be industry leaders need to embrace the issue of 'Green ICT'. In part 2 we focus on the quality of environmental reporting by ICT companies. In part 3 we benchmark companies within the global ICT sector with respect to their 'green' credentials and integrate these ratings with traditional financial selection criteria based on growth and value measures.

The anatomy of the sector, and current trends

One of the world's largest and fastest-growing industries

The ICT sector has become one of the largest industries worldwide, and even among those it is one of the industries with the highest growth potential going forward. It is characterised by a complex value chain with substantial – and still increasing – participation by emerging and developing countries in international production networks. The boundaries of the sector are fuzzy. The definition we use is that provided by the European Information Technology Observatory (EITO) in co-operation with the ICT services and consulting firm International Data Corporation (IDC). It identifies four market segments: 'ICT equipment', 'software', 'IT services' and 'carrier services'. The ICT equipment market segment is of outstanding importance to us where the issue of 'Green ICT' is concerned. It in turn is divided into four sub-segments:

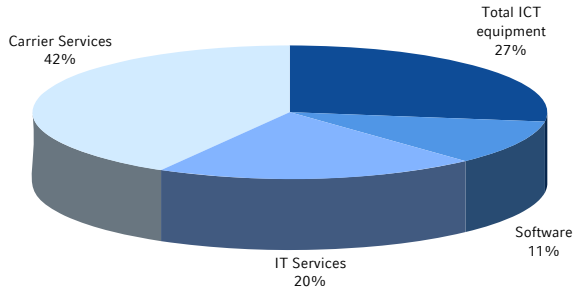
- 'Computer hardware'
- 'End-user communication equipment'
- 'Office equipment'
- 'Datacom and network equipment'

The overall market, and its segments

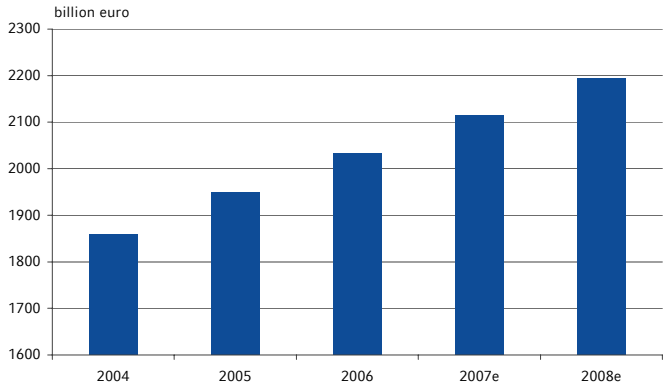
Overall market size amounts to more than €2 trillion

The total ICT market size is estimated at €2.2 trillion in 2008 (EITO, 2007) at constant 2005 exchange rates. ICT equipment's share of this market is approximately 27%, which implies a value of €600bn.

Global market segments – % shares (2008E)*



Total market development 2004-08E (global)



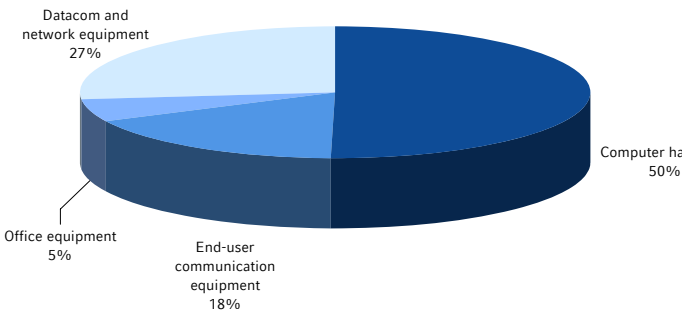
* World total ICT market: total value 2008E: €2,195bn at constant 2005 exchange rates

Source EITO, 2007

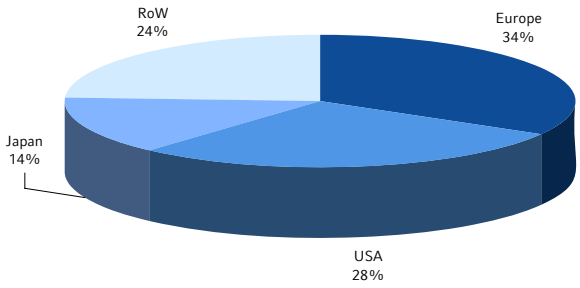
Europe held a 33.4% share of the global ICT market in 2006 (see chart below at right). The 'computer hardware' segment accounted for roughly half of the European ICT equipment market in the same year (see chart below at left).

The ICT market in Europe (total value in 2006: €680bn)*

Europe: Total ICT equipment (2006: €164bn) – % market shares by segment



Europe and the world – shares of the total ICT market 2006 (total market value: €2,033bn)



* at constant 2005 exchange rates; RoW: Rest of World

Source EITO, 2007

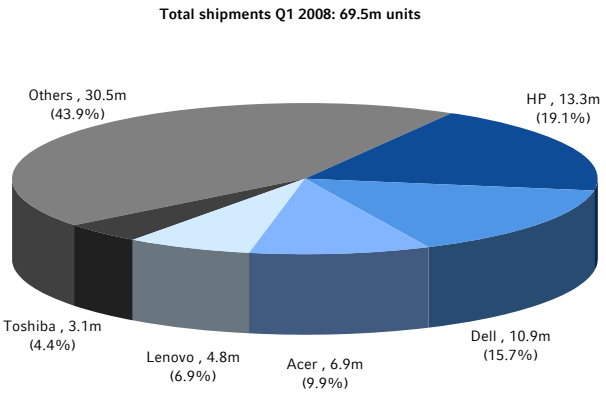
Current trends in the PC and mobile phone markets

Market shares by vendors

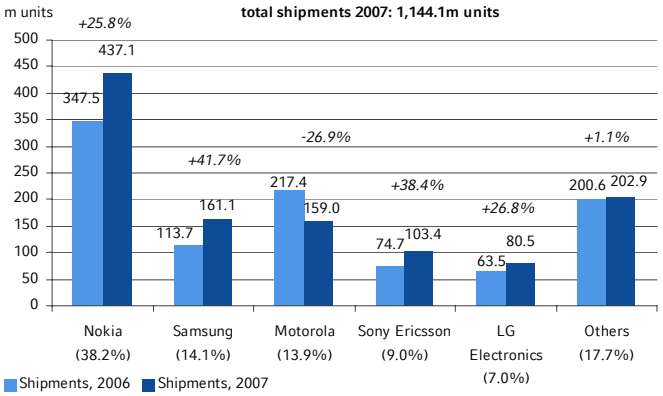
Worldwide PC shipments grew by 14.6% to 69.5m units in Q1 2008, which was above previous estimates of 13.2%, according to IDC. The US market's y-o-y growth rate slipped to a meagre 3.5% as the general economic malaise currently affecting the US economy began to impact on the domestic PC market.

The worldwide mobile phone market grew to 300m devices in Q4 2007. According to IDC, the 334m handsets shipped during the Christmas holiday quarter was a new record for the industry, and was up 15.3% over Q4 2007. Total shipments in FY 2007 reached 1,144.1m units, up 12.4%.

Global PC market in Q1 2008 by vendor*



Global mobile phone market by vendor**



* m units shipped, market share in %, each as of 31 March 2008;
** m units shipped, % y-o-y growth in (in italics); % market share as of end 2007 (in brackets)

Source IDC, 2008

Global production/supply chains

Contract manufacturing

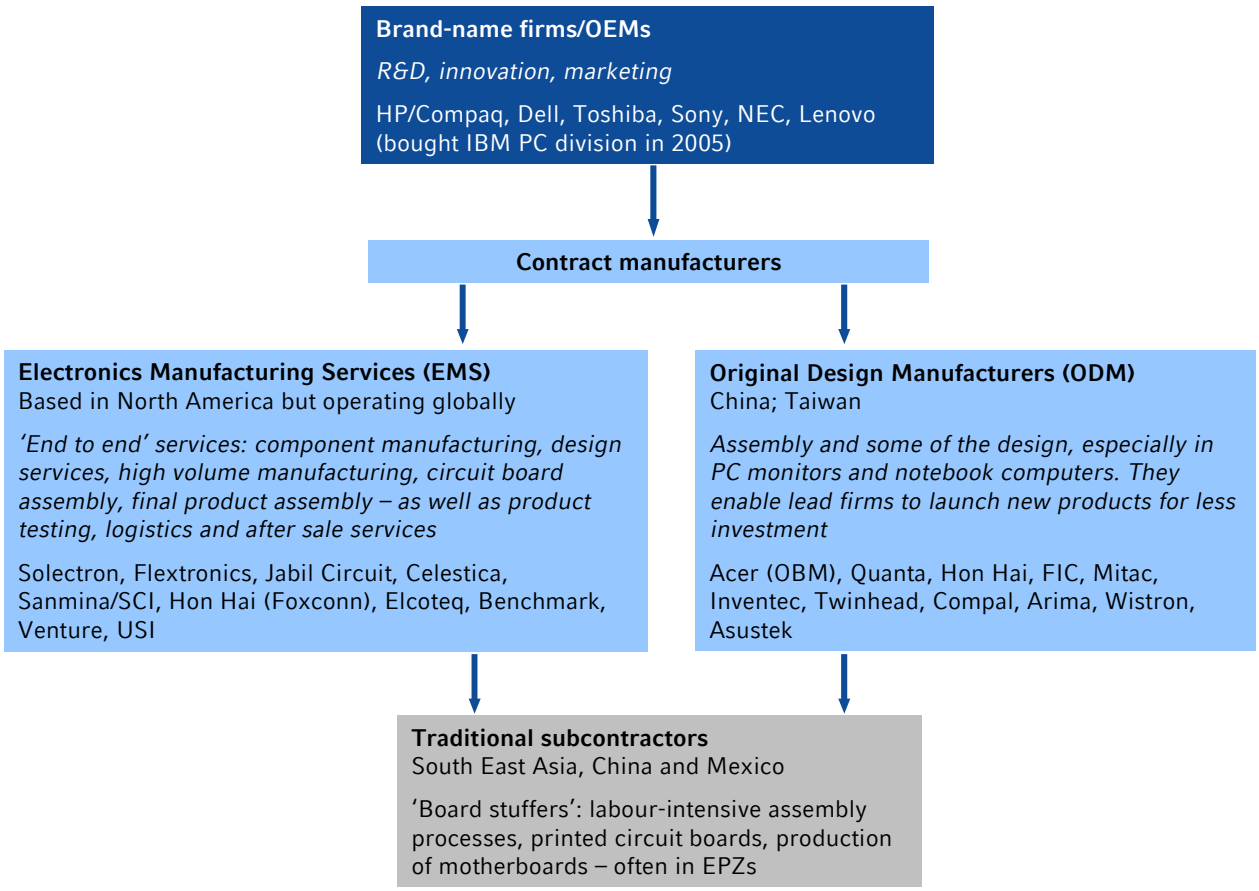
Outsourcing process started in the mid-1980s

One of the core characteristics of the ICT sector is its extraordinarily high level of outsourcing. The first original equipment manufacturers (OEMs) – the brand-name firms – outsourced their low-margin operations to contract manufacturers in the mid-1980s. For companies such as IBM, Cisco and Sun Microsystems, manufacturing was no longer where they added value. They got paid instead for understanding customer needs, and for design and distribution. This increased pressure to get their less-profitable manufacturing assets off their balance sheets. Some companies have ended up with minimal or no manufacturing capacity of their own.

Two major types of contract manufacturer

There are two major types of contract manufacturer in the electronics sector: electronics manufacturing services (EMS) companies, and original design manufacturers (ODMs). Contract manufacturers grew rapidly during the 1990s, and have become important players in the ICT production chain, some with revenues higher than those of OEMs. The lines between EMS and ODM companies are blurring.

PC global production system (modular production structure)



Source ILO, 2007

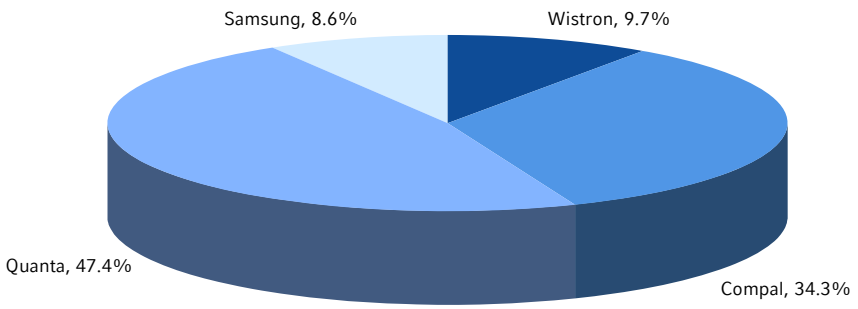
75% of the manufacture of ICT products is now outsourced

We estimate that around 80% of the manufacture of all ICT products is now outsourced to contract manufacturers, and that this share is still increasing. One example is mobile PCs (notebooks, laptops). In 2001 OEMs merely outsourced around 50% of their manufacture according to iSupply. This figure increased to over 80% by 2004, and to an estimated 90%-plus in 2007. iSupply expects it to stabilise around this level in future. The globalisation of production has thus reached a state of maturity. The share of outsourced production varies across product groups. For motherboards of desktop PCs it is virtually 100%, but for their final assembly it is 'only' around 70%.

Some final assembly is still done by OEMs themselves

Some OEMs, such as Fujitsu Siemens Computers, still consider final assembly to be an important interface with the customer, so these branded OEMs carry it out themselves. They use contract manufacturers for large-scale manufacture of printed circuit boards or pre-assembled product kits (also called the 'bare bones').

Dell's ODMs and their shares of business



Source iSupply, 2006

A state of maturity has been reached

The globalisation of production and supply chains has more or less reached maturity. Efficiency potentials are almost fully exploited, and only marginal improvements appear possible. So, globalisation of production is no longer in itself a trend for the future. However, it is clear that mobility of companies will remain high, i.e. the state of globalisation that has been achieved is not static, but dynamic. Relocation decisions by companies (e.g. Nokia's decision to go to Romania) are only temporary in nature, i.e. they will be reviewed continuously. Many of today's winners are likely to be tomorrow's losers.

Sector structure and its adverse effects on ESG issues

Single-driver focus on reducing costs

As described above, the global production network of ICT hardware vendors has been optimised strongly over the past two decades, resulting in a highly concentrated, clustered structure of contract manufacturers. OEMs more or less all work together with the same small set of suppliers, located in just a few attractive regions (e.g. China). The catalyst for the optimisation of supply chains was cost pressure in a highly competitive market. This single-driver focus in itself explains why ESG standards tended to be neglected in the past, and continue to do so to some extent. A factor that has supported this neglect is the international mobility of capital that gives bargaining power to the industry in negotiations with governments, which compete hard to attract ICT investment. The whole structure makes it hard for local and international organisations to address this issue and to trace responsibilities.

Moral hazard

Thus the slow progress in terms of ESG performance has a clear cause – and there is another aspect that should not be overlooked: The products of OEMs (e.g. notebooks) do not differ from each other in practical terms with regard to their ecological and social balance – and this is a stable equilibrium. No OEM has the incentive to move away from this, since all of their costly efforts would benefit all other OEMs as well (the free rider problem).

Increased operational risks of optimised supply chains

The price of (cost) efficiencies

As noted above, the (cost) efficiency of supply chains has increased over the past decade or so to a degree that is close to optimal. Incumbents were forced to move in this direction as a necessary condition of remaining competitive. Efficiency gains, however, have come at a price. On the one hand, reputational risk has increased due to a lack of control over working conditions and environmental impact.

Increase in non-diversifiable risk

On the other hand, operational risk too has increased due to concentration on just a few contract and component manufacturers. An example of this emerged at the beginning of March, in which the entire machinery of notebook production was disrupted by a fire at an LG Chem production site, the fourth-largest producer of power supply units for portable computers. This example shows that focusing on just a handful of key suppliers has increased systematic, non-diversifiable risk for the industry. This is also relevant to the issue of product quality/product recalls, for example.

Company rankings: WestLB 'Green ICT' sub-indicator 'Supply chain'

Our 'supply chain' sub-indicator rests on three items:

- Targets and programmes for environmental improvement of suppliers
- Percentage of ISO 14001 certified suppliers
- Controversies over supply chain issues

Sun Microsystems and Altera reach highest scores

These three items are available for all the six sectors we have looked at. Hence, each one receives a weighting of 1/3 for all companies in our sample. The findings are summarised in the table below (for more details, see p. 101 ff). The two companies with the highest scores across all sectors are Sun Microsystems and Altera.

'Green ICT' sub-indicator 'Supply chain' – best and worst in class

GICS sector level 4	number of companies	suppliers score avg	suppliers score max	suppliers score min	company with … highest scores	lowest scores
Communications Equipment	11	-0.28	1.35	-1.30	Nokia, Tom Tom	Corning Inc, Juniper, Qualcomm, Research in Motion
Computer Hardware	9	0.86	2.82	-0.12	Sun Microsystems Inc	Apple Inc., IBM, Wincor Nixdorf
Computer Storage & Peripherals	6	0.07	1.05	-0.12	SanDisk Corp.	EMC Corp.
Office Electronics	6	0.56	1.35	-0.12	Brother Industries, Konica Minolta	Canon, Neopost, Ricoh
Semiconductor Equipment	7	-0.38	1.64	-1.30	Tokyo Electron	KLA Tencor Corp, Lam Research, OC Oerlikon Corp.
Semiconductors	18	-0.03	2.82	-1.30	Altera Corp.	Linear Technology, LSI Corp., Micron Technology

Source WestLB Research, SiRi

Globalisation: focus shifts from supply chains to sales markets

Enormous market growth potential down the road

As noted above, the globalisation of supply chains is a process that is now more or less complete. In future, we expect a shift in focus towards another dimension of globalisation – that of sales. Increasing levels of wealth and personal income in emerging markets opens enormous growth potential for the industry. The first wave is now over, and market shares have been allocated surprisingly close to the guidance given by the saturated markets of the developed world. The second wave will be more complex in nature, since it will target not only new groups of first-time buyers but also the so-called upgrade market, i.e. more knowledgeable consumers with higher expectations regarding the functionalities and performance of products.

And the process of tapping new markets will not stop at Brazil, Russia, India and China (the BRIC countries). Long-term growth prospects are intact for Africa and other developing regions as well, given their still low penetration rates.

Boundaries becoming blurred

Universal presence of ICT capabilities

ICT capabilities are an embedded feature of numerous devices

ICT capabilities are an embedded feature in numerous devices and networked systems. A typical household in the EU may have 25 or more microcontrollers (computer chips) in various appliances within the home. Those devices manage a dynamic array of widely divergent but reliable technologies such as lighting, telephones, DVD players, and even washing machines, refrigerators, and microwave ovens. A typical car has as many as 50 or more microcontrollers embedded within its many different components. Digital control devices and sensors have been rapidly replacing analogue electronic devices and numeric controls in numerous industrial processes wherever economically and technologically feasible. Microprocessors, using application-specific integrated circuits (ASICs) and other solid-state components, can guide the actions or movements of ubiquitous mechanical systems such as motors, pumps, fans, compressed air systems, and even more sophisticated industrial equipment such as machine tools, mixers, conveyors, and robots. Thus sensors, automatic controls and smart software programmes all now have widespread use in every sector of the economy, including buildings, transportation, electric power generation, consumer appliances, and entertainment.

Integration of hardware, software and services

Tight integration of hardware, software and services

One of the main trends of the industry is the tight integration of hardware, software and services (e.g. music downloads, navigation) in order to increase the user-friendliness of products. Providing innovative products in this area will be the key to sector leadership in the future. Companies like Apple and Nokia have paved the way towards integrated strategies. As a part of this process, the boundaries between ICT and consumer electronics will become more blurred in the future.

Convergence

Convergence is not a new issue for the ICT industry. However, it is only now that companies' strategies towards convergence are becoming mainstream. Many of today's ICT trends can be read in the framework of convergent ICT. This convergence process is increasingly broad, and is now taking place at several levels (see EITO, 2007):

- Voice and data and media content
- Fixed and mobile
- Networks and IT
- User and devices

A classic example of convergence is voice over internet protocol (VoIP). The core concept of VoIP is the process of utilising broadband connections not only to handle all data transfer needs, but also voice. Voice and data have always run on separate lines, with data lines mostly underutilised. By converting analogue voice signals into packetised data, voice can be merged onto the same existing data line, allowing companies to save on both energy (see p. 58) and infrastructure costs. Enterprises have been putting voice and data on the same backbone wide-area networks (WANs) for years by partitioning the bandwidth. Now that it is all IP, they do not need to split the bandwidth but they do need

to classify the traffic based on its nature, in order to ensure appropriate network latency and quality.

New catalysts for innovation

Commercialisation and obsolescence cycle is extremely short

Companies will remain under constant pressure to develop innovative new products. The commercialisation and obsolescence cycle is extremely short, and this continually challenges companies' ability to anticipate, to respond to and/or to proactively set new trends in consumer demand. Hardware in itself will be little more than a commodity in the future. Differentiation will no longer be based on performance criteria. Instead, it will operate firstly on the basis of design and other 'intangible differentiators' like marketing capability (incl. the setting of life-style trends), service and support, corporate reputation, and environmental and social performance (i.e. 'Green IT'). The new innovation cycle will focus on the user interface. The key to a product's success will lie in its ability to provide more user-friendliness and maximum network functionalities. And this can only be achieved by optimisation of the interplay between hardware and software components. An example of the success of this approach is Apple's iPhone. The vendors that prevail will be those that can offer products that are tailor-made to the needs of different consumer groups, while at the same time offering a high degree of connectivity and network functionality.

'Next-generation broadband'

A catalyst for a new wave of innovations will be 'next-generation broadband' – and this is true of both fixed-line and mobile networks. We expect an increase in data transfer rates by a factor of 100, opening up a wide range of new opportunities (e.g. mobile internet applications).

Optimisation of data centre design

With respect to servers and data centres, the issue of energy efficiency (see p. 28) will move to the top of the priority lists of buying organisations due to potential cost savings and concerns about supply-side security. Server virtualisation and optimised data center design will come to the fore. Vendors cannot avoid responding to this trend if they are to remain competitive.

Tightening of the regulatory environment, and the increasing costs of compliance

Ongoing source of litigation and reputation risks

In addition to increased challenges posed by the shortening of innovation cycles and complex supply chains, a much stricter regulatory environment (targeting the use of hazardous substances, the disposal and recycling of products, and the energy efficiency of products) has begun to take hold in Europe and Japan, and is expected to spread to other jurisdictions. Gartner, for example, expects that suppliers to large global enterprises will need to prove their 'green' credentials via an audited process to retain preferred supplier status by 2011. Compliance costs will increase across the entire supply chain, potentially exerting pressure on profit margins. The complexity of supply chains will make compliance checks and controls a challenging task for OEMs, and will constitute an ongoing source of litigation and reputational risk (see chapter 'Catalysts for change', p. 65).

Life cycle assessment – Material 'green' challenges for the ICT sector

As explained above, 'Green ICT' is not just about the CO_2 footprint of ICT equipment during the period of operation/use. The issue is connected to the entire life cycle of ICT products, from the extraction of raw materials for their production, to the disposal or recycling of obsolete equipment. In our life cycle assessment we will go through individual material issues below, referring back the matrix shown on p. 9. We start at the top with the subject of resource use.

Resource extraction and use

Production of ICT equipment is a highly resource-intensive activity

The production of ICT equipment is a highly resource-intensive activity. A UN study has found, for example, that the manufacture of a computer and its screen requires at least 240 kg (530 pounds) of fossil fuels, 22 kg (48 pounds) of chemicals and 1.5 tons of water. The ratio of fossil fuel use to product weight is 11, much higher than for many other manufactured goods. Another, even more extreme example is a core component of ICT products: semiconductors. The 'environmental weight' of semiconductors far exceeds their small size: 1,672 grams of fossil fuel and chemicals is needed to produce a D-RAM chip weighing just 2 grams.

As the following table shows, it is still difficult to benchmark ICT companies against each other with respect to their specific resource intensity based on reported information. Disclosure practices in this area are definitely unhelpful, and need much improvement (for more information on reported numbers, see p. 84 ff).

'Materials used by weight or volume' as reported by companies*

Company	Definition in respective company report	2007	2006	2005	2004	2003	2002
Ericsson	Products (t)		106,000.0	85,500.0	80,000.0	75,000.0	77,500.0
	Packaging (t)		22,000.0	25,500.0	NA	NA	NA
Nokia	*NA*						
Cisco	*NA*						
IBM	*'Specific measures of weights are not universally available or part of our acquisition measurements.'*						
Dell	*NA*						
HP	**Total packaging weight used (t)**	**224,000.0**	**223,000.0**	**162,000.0**			
	- paper (t)	184,000.0	187,000.0	139,000.0			
	- plastic (t)	40,000.0	36,000.0	23,000.0			
	Total packaging per products sold globally (average grams)						
	- paper (g/unit)	255.0	273.0	290.0			
	- plastic (g/unit)	55.0	53.0	48.0			
Toshiba	**Materials total (t)**		**2,696,741.0**				
	- Iron (t)		1,271,737.0				
	- Plastics (t)		270,296.0				
	- Others (t)		1,144,062.0				
	Chemical substances, amount handled (t)		40,276.0				
STM	Chemicals consumption (t)		21,378.0	18,669.0	16,938.0		
	Chemicals consumption - normalised values (kg/production unit; 2000 = 100)		60.5%	60.2%	61.1%	65.5%	71.1%
ASML	*NA*						

* Based on all available GRI (G3 only) company reports (G3 performance indicator: EN1)

Source WestLB Research, company reports

One possible response to the challenge of resource intensity is the substitution of non-renewable resources by renewable ones, as the following example shows.

Increasing the 'plant ratio' from 50% to 90%

Case study: NEC

NEC has developed a plant-derived plastic for electronic devices, to reduce the environmental footprint of its products by using renewable resources while at the same time reducing the use of hazardous substances, and it has created the first mobile phone in the world to be made from this kind of plastic. Kenaf is a quick-growing species of hibiscus that has a long history of cultivation for its fibre in India, Bangladesh, Thailand, parts of Africa and, to a small extent, south-eastern Europe. Today, its principal farming areas lie throughout China and India. Emerging uses of its fibre and oil include engineered woods, insulation (e.g. for the automotive industry and technical applications), and clothing-grade cloth. NEC claims that it has improved the heat resistance of polylactic acid by adding Kenaf fibre, while being satisfied with other practical characteristics such as durability; thus it uses Kenaf fibre-reinforced bioplastic in PC parts and in a prototype mobile phone. According to NEC, this phone has a 'plant ratio' as high as approximately 90%, while that of ordinary bioplastics used for electronic devices is approximately 50%.

The problem of short obsolescence cycles

Although industry or individual company initiatives like this certainly need to be acknowledged, we doubt that they will suffice to cope with the challenge of a growing market, driven by strong and increasing demand in emerging markets and by high replacement demand in the saturated markets of the developed world. As described above (see 'New catalysts for innovation', p. 21), replacement cycles are already extremely short and are tending to be reduced even further. This is not just a source of strong competitive pressure, but is also in the commercial interests of the ICT industry as a whole. One driver of the shortening of obsolescence cycles is new software, e.g. new versions of Microsoft Windows in the PC segment. Increased hardware requirements for new software functionalities are regarded as a trigger for replacement purchases, although this factor has failed to some degree for the first time with the introduction of Vista. Frequency of replacement nevertheless remains high, driven by better integration of hardware and software functionalities, among other things. From an environmental point of view the result is alarming: we estimate that 400m PCs will be discarded worldwide in 2008 alone, most of which will end up as hazardous e-waste in developing countries (see p. 48).

Extending the lifespan of ICT equipment would be a viable strategy

The added utility for the consumer of replacing seemingly obsolete equipment is sometimes rather questionable, as the example of Microsoft Vista has shown. Microsoft is finding it difficult to persuade institutional clients to switch from Windows NT to Vista. So the market is obviously working to some degree. The problem, however, is that the price of a PC does not by any means reflect the environmental cost of its manufacture. So a viable strategy to reduce the environmental footprint would be to increase the lifespan of ICT products – a strategy that will only work if equipment users get the right price signals.

Life-cycle energy use is dominated by the production and not by the use of a computer

An extension of product lifespans would significantly contribute to a reduction of the carbon footprint of ICT products (see p. 27 for a comprehensive discussion of the topic). In contrast with many home appliances (e.g. refrigerators), the life-cycle energy use of a computer is dominated by production (81%) rather than operation (19%). The production of one PC consumes 535 KWh on average. This shows that the current debate about the sector's carbon footprint, which is dominated by the energy consumption of ICT equipment during use, is heavily biased: it is energy consumption during the

manufacturing phase, and the unjustifiable shortness of replacement cycles, that need to receive more attention in this debate. It is clear to us, though, that this call will certainly not be supported by the industry.

Use of water in production

Serious conflicts of interest at production locations

As noted above, water is an important resource used in computer and semiconductor manufacture. So access to water is an important parameter to equipment producers in deciding where to locate. At the same time, water is an increasingly scarce resource in many parts of the world, and this gives rise to serious conflicts of interest. For example, the shortage of water is a big issue in Taiwan, and the seemingly unlimited expansion of ICT factories there has caused conflict between different types of water use. Water consumption for a factory producing 30,000 eight-inch wafers per month requires 2,000-2,500 tons of water a day. In 2002 the Taiwan government decided to reallocate agricultural water for use by the ICT industry, and to build a dam and a desalination plant, among other things, to supply the high-tech sector. Farmers and residents are protesting against the environmental impact of what they regard as the inequitable distribution of water, but the government has favoured the high-tech industry.

'Total water withdrawal by source' as reported by companies*

Company	Definition in respective company report	2007	2006	2005	2004	2003	2002
Ericsson	Water consumption/discharge (Mton)		1.1	NA	1.0	NA	2.5
Nokia	**Water consumption (m^3)**		**1,357,385.0**	**1,196,508.0**	**1,281,500.0**	**1,050,449.0**	**1,163,000.0**
	Municipal water supply (m^3)		1,292,136.0	1,122,706.0	1,097,251.0		
	Ground water (m^3)		65,249.0	73,802.0	184,249.0		
Cisco	*Website with text, but no clear figures*						
IBM	*'The vast majority of IBM's water use is municipal water. IBM has therefore not established a metric for water withdrawal by source.'*						
Dell	Water usage at US facilities (US gallons, millions)	~ 240	~ 210				
HP	Water consumption (m liters)	7,359.0	8,358.0	8,136.0			
Toshiba	**Water ('000s m^3)**		**56,730.0**				
	- Industrial water ('000s m^3)		38,317.0				
	- City water ('000s m^3)		5,951.0				
	- Groundwater ('000s m^3)		12,427.0				
	- Other water ('000s m^3)		354.0				
	Amount of water intake ('000s m^3)		60,870.0	54,099.0			
	Ration to production output (compared to 2000)		89%	87%			
STM	**Water consumption ('000s m^3)**		**22,215.0**	**21,834.0**	**20,550.0**		
	Water consumption - normalised value (m3/production unit; 1994=100)		31.3	34.0	36.1	40.9	47.0
ASML	Total tap water consumption ('000s m^3)	451.0	379.0	339.0			
	Water use / net sales (liters/Euro)	0.12	0.11	0.13			

* Based on all available GRI (G3 only) company reports (G3 performance indicator: EN8)

Source WestLB Research, company reports

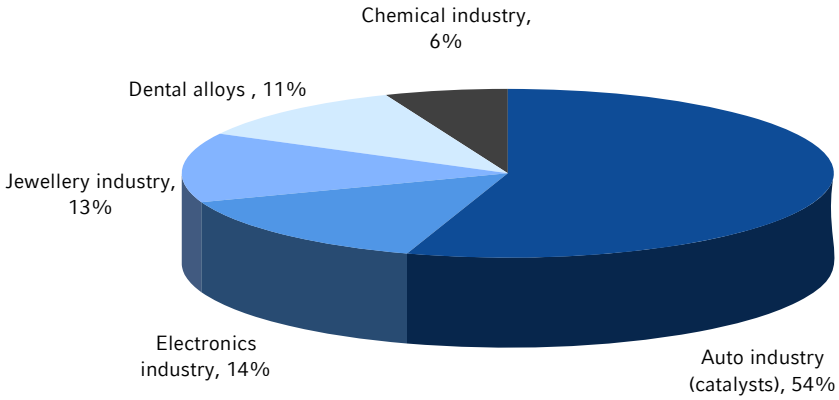
Extraction of raw materials

ICT products contain substantial amounts of minerals and metals

The ICT life cycle starts with the extraction and processing of raw materials, often obtained through mining. Mobile phones, laptop computers etc. contain substantial amounts of minerals and metals, including beryllium, gold, cobalt, tantalum, tin and platinum-group metals (PGMs). One much-used PGM is palladium. In electronic products, palladium is mostly used in multilayer ceramic capacitors (MLCCs), components that are used in almost all types of electronic product. The industry

consumed 33,000 kg of palladium in 2006, accounting for 14% of total global demand and an increase of 10% from the year before.

Palladium consumption in 2006



Source Centre for Research on Multinational Corporations (SOMO)

Extraction of metals and minerals to make ICT products can have a devastating effect on the environment

The extraction of non-renewable resources (minerals and metals) for the manufacture of ICT products can have a devastating impact on the environment. Mining of metals produces an enormous amount of waste, as the intended metal accounts for only a very small percentage of the total extracted mass. For example, 1 ton of copper can produce about 110 tons of waste and 200 tons of overburden – created by blasting away the soil and rock. The huge amounts of waste generated by these mining processes can contain toxic substances such as arsenic and lead, leading to contamination of the environment with a huge impact on the surrounding communities.

OEMs face demands to assume responsibility for their entire supply chain

When companies close down their mining operations, they often do so without cleaning up the land, and governments in many developing countries have not required 'cleaning up guarantees' from mining companies. Even in the cases where such guarantees exist, problems such as failure to honour such guarantees or the bankruptcy of a mining company can leave a government with a pile of toxic waste and huge costs. One of the major problems involves the accountability of individual mining companies for the industry's collective impact on air, surface and underground water resources. Less directly, mining activities can cause social disturbances, such as prompting significant inflows of migrant workers. It is no surprise, hence, that one demand faced by ICT OEMs is to assume responsibility for their entire supply chain, including the extraction of raw materials (for a discussion of the supply chain issue in general, see p. 16 ff).

Brand companies have not done enough to integrate the mining of metals into their supply chain management

The ICT industry itself feels that there is inadequate traceability, or sphere of influence, for a full supply chain approach extending as far back as the extractive phase. The guidelines and codes of conduct of most brand companies claim responsibility for the whole chain of production, but in practice companies tend only to address issues that occur towards the end of the supply chain. It seems to us fair to say that the industry has not done enough so far to integrate the mining of metals into their efforts at corporate responsibility. This view is supported by a recent survey conducted by SwedWatch, FinnWatch and the Centre for Research on Multinational Corporations (SOMO).

Twelve out of 22 companies responded

In 2007 they sent out a questionnaire to the world's largest brand companies producing PCs, mobile phones, MP3 players, webcams and game consoles. The questions aimed to find out whether companies knew where the metals included in their products came from (traceability), whether they or their suppliers attached social and environmental criteria to their procurement of metals, and whether they thought that they, as market-leading brands, could contribute to the enhancement of labour and environmental standards within the extractive sector (sphere of influence). Twelve out of 22 companies responded to the survey. The organisations also received a joint industry response from the Electronic Industry Code of Conduct (EICC, see p. 76) and the Global E-Sustainability Initiative (GeSI, see p. 77).

Findings of a survey conducted by SwedWatch, FinnWatch and SOMO about the responsibility assumed by brand companies for the extraction of raw materials used in the manufacture of their products

Company	Did the company answer the questionnaire?	Does the company know where the metals included in its products have been extracted?	Does the company think that the extraction of metals lies within its sphere of influence?	Did the company give out names of their component suppliers?
Nokia	No*		Limited influence*	No
Samsung	No			No
Motorola	Yes*	No	Extremely limited	No
Sony Ericsson	Yes*	Only tantalum	Some influence	No
Philips	Yes*	No	No	No
Dell	Yes*	No	Not directly	No
Acer	Yes	No	Very little	No
Apple	No*		Limited influence*	No
LG Electronics	No			No
Toshiba	No			No
IBM	No*		Limited influence*	No
Lenovo	Yes*	No	No	No
Packard Bell	Yes	No	No	No
Hewlett- Packard	Yes*	No	To some extent	Only battery suppliers
Fujitsu Siemens	No			No
Creative	Yes	Unclear	Yes, by using recycled materials	No
Sandisk	Not reachable	-	-	-
RIM	No			No
Logitech	No			No
Microsoft	To some questions*	Unclear	Unclear	No
Nintendo	Yes	No	Indirectly	Yes
Sony	Yes*	Unclear	Little or none	No
Palm Europe	No			No

* These companies are members of the EICC and/or the GeSI, which submitted common replies on behalf of their members. This letter answered some of the questions in the questionnaire.

Source SOMO, 2007

Lack of traceability

The companies that responded to the survey state that they do not purchase metals by themselves, and often do not know from which countries the metals included in their products originate. However, the Taiwan computer company Acer says that it is aiming for more traceability in the company's CSR work. A few years ago, Sony Ericsson investigated where the tantalum used in its mobile phones originated from.

Companies view their ability to influence metal producers as small or non-existent

In its joint response the industry expressed concern about social and environmental conditions associated with the mining industry. It stressed that brand companies are often small consumers of metals and that they are many steps removed from the extraction, refining and trading of minerals and metals. The responses from individual companies express a variety of views. In general, companies consider their responsibility to be no more than indirect, and they view their ability to influence as small or non-existent. However, the following examples suggest that the companies in question acknowledge some sort of responsibility in relation to the extractive stage. The MP3 brand company Creative states that the extraction of metals is within the company's sphere of influence, since the use of metals can be reduced and recycling can be encouraged. Hewlett-Packard states that it does not use tantalum in its products. Motorola requires all suppliers to verify in writing that materials they sell to Motorola do not contain tantalum derived from illegally mined Congolese ore. Dell is trying to avoid including tantalum that has been extracted illegally, or in regions where either the environment or wildlife is threatened.

Responsibility only for first- and second-tier suppliers

In most cases OEMs shift the responsibility for the procurement of metals used in consumer electronics to their direct suppliers, and they tend not to know whether their demands for compliance with social and environmental criteria ever reach the extractive industry. Microsoft writes that it expects its suppliers to share the same values as the company itself, e.g. that working conditions should be fair and safe and the environment protected. However, it directly monitors only first-tier and certain critical second-tier suppliers. Hewlett Packard states that metals are procured on tiers 3 to 6 of its supply chain, a position broadly confirmed by Dell (tiers 3 to 4).

Transparency

Very few companies targeted by the questionnaire submitted information about their suppliers of components. Nintendo was the main exception, though Hewlett Packard publishes the names of its battery suppliers.

Conclusion

Not much is known yet about the raw material extraction stage of the ICT industry's production chain. Brand companies are not transparent with regard to this issue, and claim that they have insufficient influence over the mining industry. Some producers claim that they do not procure sufficient amounts of raw materials to be able to press mining companies to adopt a more sustainable approach to mining. This argument is not valid in our view, since the industry as a whole can indeed be regarded as a significant consumer of metals, as we have shown by the example of palladium above. And we believe that brand companies and their large first tier suppliers could take a sector-wide approach in putting mining companies and other companies in the supply chain under significant pressure to ensure that their products are extracted in a more sustainable manner.

Carbon footprint

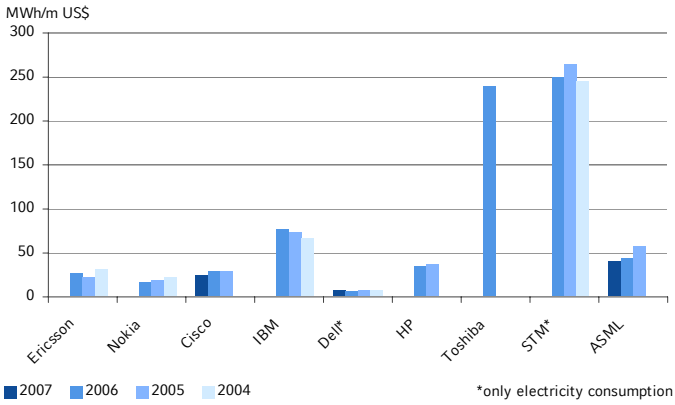
Energy consumption of ICT equipment is the most material concern

In the chart on p. 9 the resource intensity of ICT products shows up twice: first under 'Resource use (ex energy)', and second under 'Carbon footprint'. We have made this distinction in order to stress the utmost importance of the topic of climate change, while at the same time not neglecting other material issues within the debate about resource intensity, e.g. the high need for water resources (see p. 22). During the period of use it is definitely the energy consumption of ICT equipment that is the most material 'green' concern. We must not forget, however, that the life-cycle energy use of a computer is

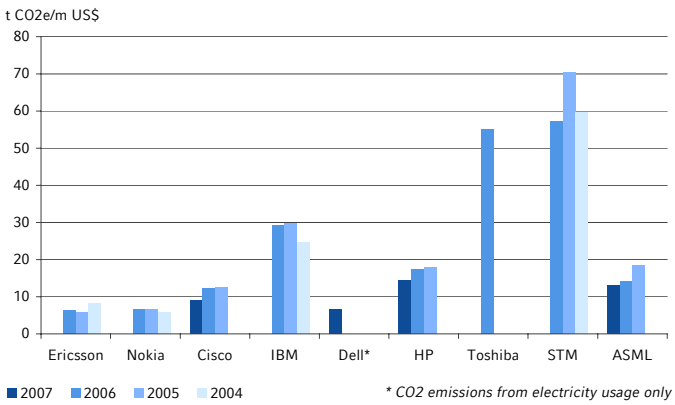
dominated by production (81%) rather than operation (19%). In order to benchmark companies with respect to their energy and carbon footprints, we have looked at the information disclosed by companies themselves. Here again we have found the data to be of limited or poor comparability (for more information on reported numbers, see p. 84 ff).

Carbon footprint of ICT companies (as reported)*

Specific energy consumption per unit of sales**



Specific GHG emissions per unit of sales***



* Based on all available GRI (G3 only) company reports
** G3 performance indicators: EN3 ('Direct energy consumption') and EN4 ('Indirect energy consumption')
*** G3 performance indicator: EN16 ('Total direct and indirect greenhouse gas emissions by weight')

Source WestLB Research, company reports

Energy use by data centres

Consumption is expected to double by 2011

A hotly discussed issue within the debate about carbon footprint is the enormous increase in energy use by data centres, i.e. facilities that primarily contain electronic equipment used for data processing, data storage, and communications networking. A recent study by the US Environmental Protection Agency (EPA) showed that this sector consumed about 61bn kilowatt-hours (KWh) in 2006 (1.5% of total US electricity consumption) for a total electricity cost of about US$4.5bn (at 2005 price levels). This is double the level in 2000, and the EPA expects consumption to double again by 2011 to more than 100bn KWh. Gartner estimates that the intensive power requirements needed to run and cool data centres account for around 25% of the ICT sector's CO_2 emissions (in-use phase of equipment only).

Projections based on the 'current efficiency trends' scenario

The EPA estimates the current peak load on the power grid from data centres at about 7 gigawatts (GW), which is equivalent to the output of about 15 baseload power plants. If current trends continue, this demand would rise to 12 GW by 2011, which would require an additional 10 power plants. These projections refer to EPA's core scenario, i.e. the so-called 'current efficiency trends' scenario. It basically extrapolates the trajectory of the current energy usage of US servers and data centres based on recently observed efficiency trends for IT equipment and site infrastructure systems.

Two main drivers of growth in energy usage

There are two main drivers of this tremendous growth rate. First, the increasing demand for data processing and storage needs to be mentioned. Data centres have become commonplace, and essential to the functioning of our socio-economic system. They can be found in nearly every sector of the economy: financial services, media, high-tech, universities, government institutions, and many others use and operate data centres to aid business processes, information management and communications functions. A

number of regulations have been introduced in recent years relating to privacy and data security, which significantly increase storage requirements. A 2006 EU directive on data retention requires member states to ensure that communications providers retain data for between six months and two years. The EU's Markets in Financial Instruments Directive (MiFID), together with proposed government-led projects surrounding identity cards, national health services and road pricing, will also have an enormous impact on data storage.

Threat of power cuts

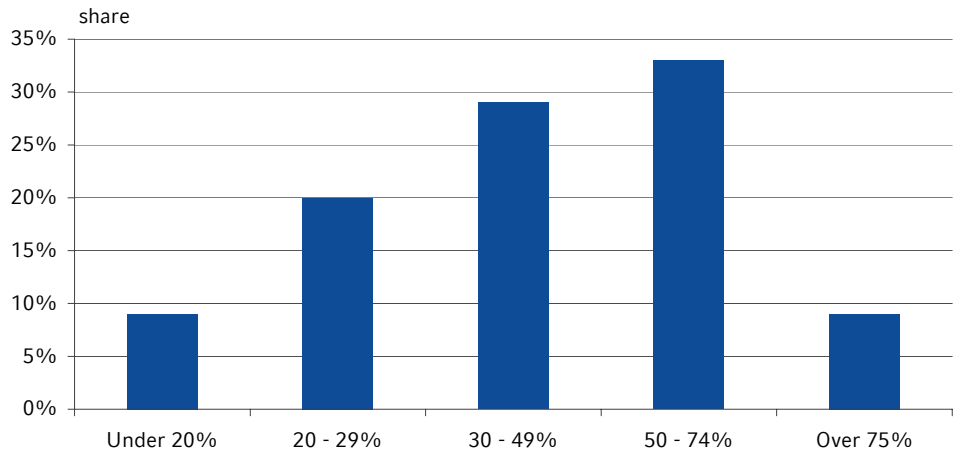
The second main driver has been the threat of power cuts, particularly in the USA. Power cuts have serious ramifications for ICT in terms of potential loss of service. The common way of safeguarding against this risk is to increase storage capacity, operate stand-alone generators and utilise an uninterrupted power supply. Some organisations also maintain duplicate ICT systems in back-up offices to use in the event of power failure at the primary office site. All of these solutions have the potential to increase demand for energy and increase CO_2 emissions, so that we find ourselves in a spiralling cycle of energy consumption.

Data storage and capacity trends

Significant inefficiencies

A survey conducted by Global Action Plan in September-October 2007 indicates that data storage strategies are confused and that organisations are struggling to cope with the scale of growth of data centres. There are significant inefficiencies demonstrated by the low utilisation levels of existing data storage facilities occurring; at the same time, organisations are concerned that storage capacity is running out. Some 60% of ICT departments expect to run out of physical space for data storage within two years, and one-third estimate that they will run out within 12 months. Two-thirds of ICT departments have already utilised 75% of their data centre floor space.

Average utilisation rates of server capacity



Source Global Action Plan, October 2007

Only 42% of ICT departments are using more than half of the available server storage space

At the same time, only 42% of ICT departments are using more than half of the available server storage space; 36% of responding ICT professionals do not know or cannot measure how much of their server estate is being used; and 80% of respondents do not have a power budget for their data centre. And of those that do have a power budget, over 70% are utilising more than 75% of that budget. The majority of ICT professionals believe that their company's policies on data retention and storage are not

environmentally sensitive. Nearly 37% store all data indefinitely, and only 20% feel their organisation has data storage policies that adequately allow for efficient control of information.

Direct and indirect electricity consumption

Power and cooling infrastructure accounts for 50% of total energy consumption

The power and cooling infrastructure that supports IT equipment in data centres accounts for 50% of their total energy consumption. The requirement for air conditioning has risen continuously in recent years, as servers in the rack are stacked closer and closer together, thereby leading to constant growth in the amount of heat per square metre that has to be cooled. The maximum permissible ambient temperature for a server suite is 26 degrees Celsius; damage can occur within a very short time if this temperature is exceeded. The ratio of indirect cooling electricity consumption to direct electricity used by servers is known as the power usage effectiveness (PUE).

Energy-efficiency opportunities in data centres

Data centre energy usage could be reduced by around 20%, even with existing IT equipment

There is significant potential for energy efficiency gains in data centres. Improvements can be expected on an extrapolation of current trends, if nothing else. However, many technologies are commercially available, or soon will be, that could improve even further the energy efficiency of microprocessors, servers, storage devices, network equipment and infrastructure systems. For instance, existing technologies and design strategies have been shown to reduce the energy use of a typical server by 25% or more. Even with existing IT equipment, implementing best energy management practices in existing data centres and consolidating applications from many servers to one server could reduce current data centre energy usage by around 20%.

'State of the art' scenario: reductions of up to 55% by 2011

The EPA's 'state of the art' scenario, for example, identifies the maximum energy efficiency savings that could be achieved using available technologies. It assumes that US servers and data centres will be operated at maximum possible energy efficiency using only the most efficient technologies and best management practices available today. This could reduce electricity usage by up to 55% from the 'current efficiency trends' scenario by 2011.

Annual savings in 2011 by scenario (vs 'current efficiency trends')

Scenario	Electricity consumption savings (bn KWh)	Electricity cost savings (US$bn, 2005)	CO_2 emissions avoided (m tons CO_2)
Improved operation	23	1.6	15
Best practice	60	4.1	38
State of the art	74	5.1	47

Source EPA, 2007

Gains appear achievable without compromising availability, performance or network security

These energy-efficiency gains appear to be achievable without compromising data centre availability, performance or network security, which are essential for these strategies to be accepted by the market. Since energy efficiency is a secondary attribute of the equipment used in data centres (see p. 63), changes that would compromise performance will generally not be implemented. In other words, data centre designers and managers will first ensure that primary needs – performance and availability – are satisfied, and will only then choose from among products and practices based on energy efficiency. In some situations, improved energy efficiency increases performance and availability. For instance, better-distributed cooling in data centres can eliminate hotspots and thereby

prevent equipment faults. Finally, it is important to note that the energy efficiency measures addressed here reduce the costs of excessive energy use and excessive power and cooling infrastructure. These include:

- Consolidation of resources (such as storage, networks, databases) so that they all sit on a single server
- Replacing old resources with smaller, faster, more efficient technology; including distributed generation technologies (see below)
- Identifying and retiring any unused or unnecessary storage capacity
- Intelligent design of the data room, including 'dynamic cooling', which targets hot spots within the room
- Introducing server virtualisation technologies (see below)

Distributed generation technologies

Multiple advantages of the fuel cell technology

The use of fuel cells and other distributed generation (DG) technologies in data centres is taken into consideration in the 'state of the art' scenario that we discussed above. DG resources can reduce data centre energy costs, particularly when used in combined heat and power (CHP) systems, which use waste heat to provide cooling. CHP systems can produce attractive paybacks and are well suited to the steady power and cooling loads of data centres. DG also has the environmental benefit of reduced criteria pollutants. Fuel cell DG systems offer many attractive qualities, such as DC power output. But fuel cells, as a new market entrant, are priced at premiums to traditional DG systems. So while DG systems based on traditional gas turbine or engine technologies can be considered cost effective without incentives, fuel cells in many cases will need financial incentives to be cost effective. Finally, DG systems, particularly fuel cells, do not have a long record of high-power-quality, high-availability applications such as data centres. Given the high cost of outages for these types of facility, more demonstrations and conclusive information about system availability are needed before most facility designers and operators would likely be willing to adopt DG and CHP technologies. First steps in this direction have been undertaken recently, as the example of T-Systems, which is a business unit of Deutsche Telekom, demonstrates.

'Self-sufficient' data centre pilot project started in 2007

Case study: T-Systems

T-Systems is one of the main partners in a pilot project started in 2007 that runs a sealed-off section of the data centre at the Euro Industrial Park (EIP) in Munich with the help of electrical power generated exclusively from a fuel cell driven by locally generated biogas. The project makes use of a fuel cell newly developed by CFC Solutions, the so-called 'hot module', consisting of a gas conditioning unit, a carbonate fuel cell and a control cabinet with a power inverter. The hot module is subjected to an endurance test in the T-Systems data centre suite: the fuel cell is designed for use in continuous operation – around the clock, seven days a week. The aim of the project is to develop a model for a doubly secured data centre that is independent of the public power supply, while providing the highest possible levels of availability and reliability.

Overall efficiency of 90%

Locating fuel cell technology on a consumer's premises offers a whole range of benefits. With its overall efficiency of 90%, it reduces the line and transmission losses that are typical of conventional power supply systems. And the distribution of the fuel cell's energy output could hardly be better suited for use in the data centre, where half of the energy needed is for air conditioning. As no combustion takes place in the fuel cell when converting biogas into electrical current, there are no exhaust fumes that would harm the environment. Thus the use of biomass produces the desired ecological effects: climate conservation through the use of renewable resources, and the avoidance of unnecessary energy transportation through the cultivation of crops in the immediate vicinity. In addition, the residues from the biogas plant can be used as valuable fertiliser.

From this pilot project with a fuel cell driven with biogas, it is only a small step to a 'green data centre' that not only produces its own power, but also supplies power and heat for other consumers. For instance, the fuel cell's surplus heat not needed for the air conditioning could be transmitted to neighbouring apartments during winter months.

Server virtualisation

Data centre optimisation technologies

Recent developments in virtualisation technology allow fewer servers to store the same amount of data. Server virtualisation involves a software application dividing one physical server into multiple isolated virtual environments. There are three different approaches to server virtualisation: hardware virtualisation, operating system virtualisation, and para-virtualisation (a special virtualisation technique presenting a software interface to virtual machines that are similar but not identical to that of the underlying hardware).

Data centre optimisation – potential energy savings

Category (size of data centre)	Small (air cooling)	Medium (air and chilled water cooling)	Large (air and chilled water cooling)
Typical size	10,000 sq ft (930 sq m)	30,000 sq ft (2,800 sq m)	>35,000 sq ft (>3,300 sq m)
Energy savings by using DSC (% of cooling costs)	40%	30%	15%
Annual cost savings (based on local energy costs)			
USA ($0.08/KWh)	$430,000	$750,000	$860,000
Europe, Middle East and Africa ($0.15/kWh)	$790,000	$1,400,000	$1,600,000
Asia-Pacific and Japan ($0.24/KWh)	$1,300,000	$2,200,000	$2,500,000
MWh saved	5.300	9.100	10.500
CO_2 emissions for electricity generation avoided (tonnes/year)	2.600	4.600	5.300
Equivalent to:	560 cars off the road for a year, or 300,000 gallons of gas	1,000 cars off the road for a year, or 520,000 gallons of gas	1,100 cars off the road for a year, or 600,000 gallons of gas

Source HP

Beyond virtualisation

Besides virtualisation, all big vendors offer a more or less complete set of data centre optimisation technologies. HP, for example, addresses the issue on several fronts. Besides virtualisation, 'green' innovations offered by the company include new chipset design, energy-efficient server blades and new techniques such as dynamic smart cooling. HP estimates that the latter alone can reduce energy consumption by 15-40%.

Reducing energy costs by 50%

A case study published by expertON Group has quantified the potential savings and payback period of a 'green' approach to data centre technology. The case study comprises a medium-sized enterprise with 900 employees. The company runs its own data centre with 25 servers, 120 blades and 10,000 GB of storage volume. The consultancy estimates its annual energy costs at €165k, which it believes it can reduce by €47k through virtualisation, and by an additional €35k using 'Green ICT' components. The payback period is 32 months assuming stable energy prices, but shrinks significantly to 18 months should energy prices rise by 20%.

Addressing barriers to the improvement of energy efficiency

Barriers are typically not technological, but organisational in nature

To realise the potential benefits of greater energy efficiency in data centres, a number of market barriers need to be addressed (for a more comprehensive look at the obstacles on the road to 'Greener ICT', see p. 59 ff). The barriers that prevent data centres from adopting changes offering very reasonable paybacks are typically not technological, but organisational. They include:

- **Lack of efficiency definitions:** Data centre operators need standard definitions of productivity in order to purchase energy-efficient equipment, operate it in an optimal way, and design and operate buildings to house it.
- **Lack of incentives:** In many data centres, those responsible for purchasing and operating the IT equipment are not the same people that are responsible for the power and cooling infrastructure, who are typically those who pay the utility bills. This leads to a split incentive, in which those who are most able to control the energy use of the IT equipment have little incentive to do so.
- **Risk aversion:** With the increasing importance of digital information, data centres are critical to businesses and government operations. Thus, data centre operators are particularly averse to making changes that might increase the risk of downtime. Energy efficiency, while attractive in principle, is perceived as a change that is of uncertain value, and therefore may not be worth the risk.

Data centre optimisation is the easy part of the challenge

Of course, data centres represent only one part of the challenge – and typically the easier part. The distributed computing infrastructure beyond the data centre – encompassing PCs, laptops, printers, mobile phones, hand-held computers, networking equipment and so on – is where it is even more of a challenge to achieve breakthroughs in energy savings.

PCs and other office equipment

In-use carbon footprint is mainly a function of two factors

The in-use carbon footprint of PCs and other office equipment is mainly a function of two factors: technology, and user behaviour. The significance of the behavioural aspect makes the difference compared to the debate around data centres. Looking at the technology aspect first, one basic problem of PCs, for example, is that the simplest function is run with the same amount of energy as the most complex function, which results in surplus consumption of energy to no benefit. Hence, the variability of energy performance depends on the screen (the energy efficiency of a flat screen is two to three times that of an ordinary cathodic screen, depending on its size and its features); the microprocessor; and the plug and electrical cord. The latter are often neglected; on average, 40% of energy consumption comes from unnecessary heating.

Desktop virtualisation and 'thin clients'

One important way of increasing energy efficiency at corporate level is 'desktop virtualisation'. This allows a workstation to be equipped with low-energy 'thin clients' instead of traditional desktop PCs. The 'thin clients' are linked to their own virtual desktops sitting on servers. 'Desktop virtualisation' provides users with the same interface, applications and performance as a desktop-based computer. A 'thin client' (also known as a 'lean client') depends primarily on the central server for processing activities, in contrast to a 'thick (or fat) client', which does as much processing as possible, and passes only communications and storage data to the server. Because it is driven by a server instead of local processor, significant power savings can be achieved in a large environment. According to Global Action Plan, replacing 100 PCs with 'thin clients' can achieve annual power savings of between 22,000 and 53,000 KWh, depending on the efficiency of the PCs. This equates to 11.5 to 28.0 tons of CO_2. In addition to reducing energy consumption at the desktop, 'thin clients' have other benefits:

- Improved data security
- Reduced maintenance costs
- Less environmentally damaging manufacture due to not requiring a hard drive and having limited microprocessor and memory requirements
- Potential cost savings as thin clients are less expensive than PCs, although a more powerful server is required

'Power over Ethernet' (PoE)

Another technology option to reduce the energy consumption of ICT equipment is 'Power over Ethernet' (PoE). It combines data and operating power into a single Ethernet cable. PoE can deliver power to IP telephones, wireless routers, security devices, and various other types of low-power equipment, using standard cabling, without any modification to existing infrastructure. This reduces the need for AC cabling and provides power to remote Ethernet devices. And, in connection with behavioural aspects (see below), power supply to lights, computers and peripherals can all be controlled through PoE, allowing them to be turned on or off centrally. Using a swipe card system, control can be exercised at individual level, turning on equipment and lights in specific parts of an office when individual employees swipe in at the start of the working day.

Opportunities offered by nanotechnology

Nanotechnology – potential to reduce power consumption

In the ESG space, nanotechnology is usually considered only as a health and safety risk factor (see p. 41 ff). But looking at the ICT hardware sector it offers opportunities too, since it has the potential to reduce the power consumption of ICT equipment (e.g. via non-volatile memories with no power consumption when sitting idle). And there are also indirect, behavioural aspects of ICT equipment use (see section below) that could be positively influenced by this: the switching off of PCs, for example, would be encouraged due to extremely fast power-up of the computer.

Behavioural aspects of ICT equipment use

'Switch them off'

As noted above, the energy consumption of ICT equipment is not an issue that needs to be addressed by ICT equipment vendors alone. It also relates significantly to behavioural aspects of equipment use. An estimated 30% of the overall energy consumed by PCs, for example, is wasted because they are left on when they are not in use. Hence, one of the

simplest ways to improve the energy efficiency of ICT equipment is to encourage employees to switch off their computers whenever it is convenient to do so (e.g. at night and at weekends). Leaving computers on standby does not solve the problem, because even on standby they can use as much as 70% of maximum power. Monitors generally do not need a big energy surge to power up, so if the user is going to be away from a workstation for more than a few minutes, it is worth switching it off.

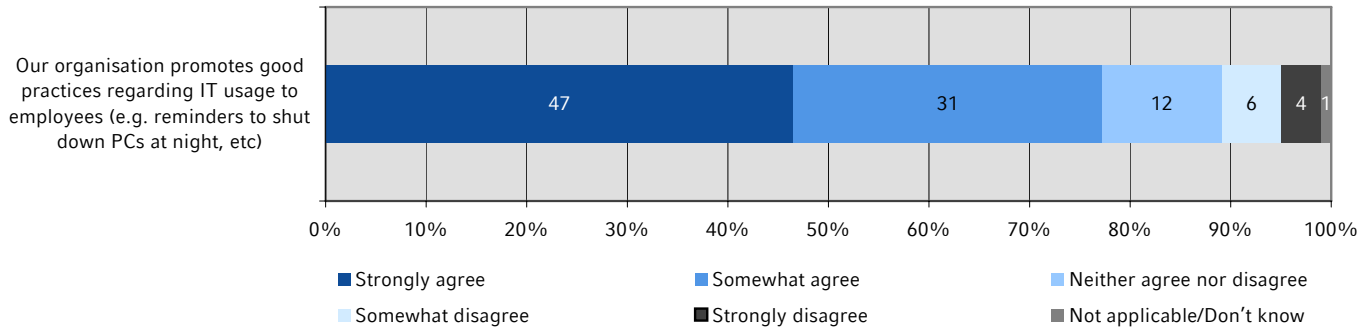
Using power-saving capabilities

Also, today's computers, such as desktops and notebooks, have many power-saving capabilities built into them. Examples are the 'sleep' and 'hibernate' modes, which can significantly reduce the amount of energy consumed during inactivity. When these capabilities are utilised during periods of inactivity, it can reduce the overall amount of energy consumed by computers by up to 60%.

Survey among ICT executives

A survey by the Economist Intelligence Unit (EIU) of 213 ICT executives from 17 different sectors during June and July 2007 showed that only about half of all respondents strongly agreed that their organisations promoted good practice to their employees regarding energy-efficient ICT usage. While this number is certainly not shockingly low, it implies that much remains to be done by companies to change the behaviour of their employees.

To what extent do you agree or disagree with the following statements, in terms of how they apply within your organisation?
% of respondents



Source Economist Intelligence Unit (EIU) survey, July 2007

ICT has failed to reduce consumption of paper

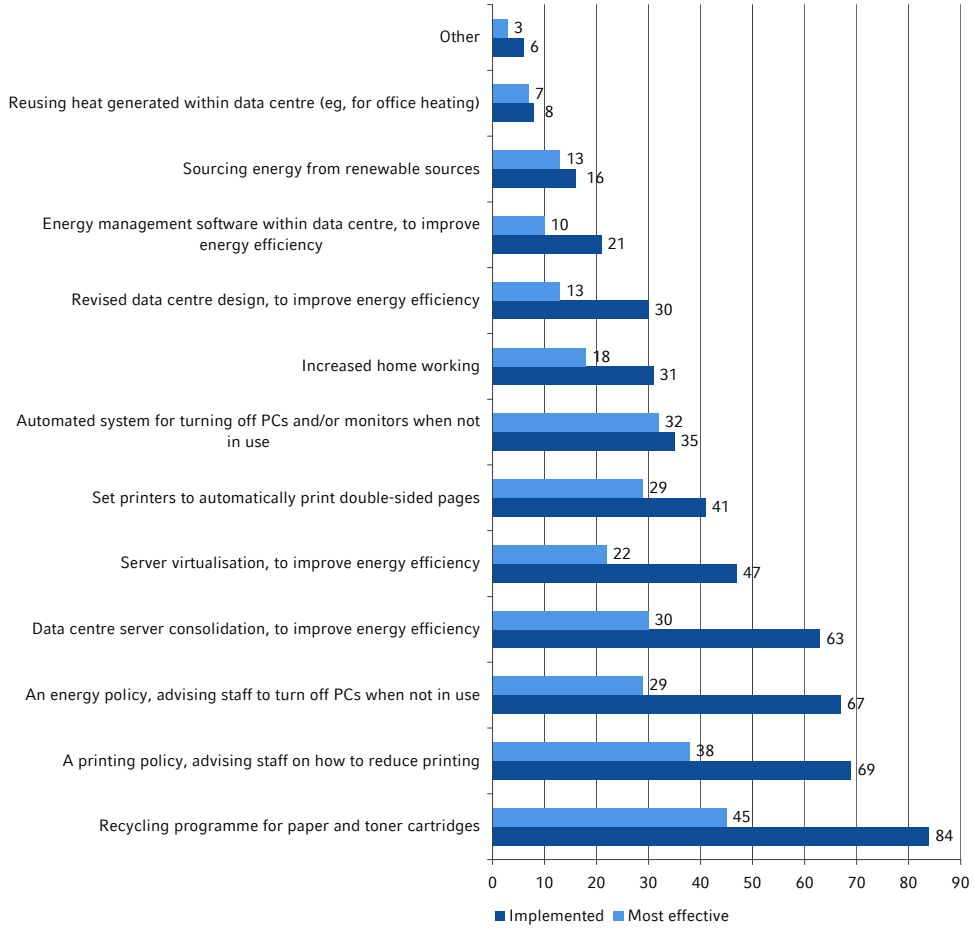
The same applies to another related topic: the use of paper and toner. Paper usage is soaring, in defiance of the notion that the digital age would bring about the paperless office. In the UK, for example, 120bn pieces of paper are printed every year (according to Global Action Plan), the equivalent of a paper mountain more than 8,000 miles high. The manufacture of this paper emits 1.5m tons of CO_2, without taking into account the impact of the manufacture of printing equipment and ink, and of the energy consumed by printers.

ICT has failed to reduce consumption of paper

The average UK office worker prints 22 pages every working day, and behavioural research suggests that 44% of this, including e.g. the printing of drafts or e-mails, or transmitting physical documents that could have been transmitted electronically, is easily avoidable. Over 21% of prints are disposed of before the end of the day. The environmental footprint of paper production is immense: 10 litres of water is required to produce one sheet of A4 paper. The paper manufacturing industry is the world's third-largest consumer of fossil fuels, and the paper manufacturing process generates large amounts of solid waste that must be disposed of. If it is not recycled, waste paper will release carbon emissions, either through being burned in an incinerator or through being

buried in a landfill site. The materiality of the issue of waste paper is well reflected in company initiatives, but ICT executives on average have big doubts about the effectiveness of recycling programmes that have been initiated.

Which of the following IT-related initiatives has your company implemented in order to reduce its overall environmental impact? Select all that apply.
% of respondents



Source EIU survey, July 2007

Mobile communications networks

Ericsson estimates that in extreme cases energy can represent up to 50% of an operator's total operating expenses. Other estimates rank energy costs third, behind labour and rentals.

NSN: 70% savings in energy consumption

In November 2007 Nokia Siemens Network (NSN) launched its 'Energy efficiency solution' to optimise energy use in mobile networks. According to NSN, the new generation of products combined with special software solutions enable up to 70% savings in the energy consumption of a base station site. In a network with approximately 5,000 base stations, serving a large metropolitan area, annual energy savings would thus be the equivalent of 73,000 tons of CO_2 emissions, equivalent to the annual emissions of 21,000 cars.

The four main elements of the solution

The four main elements of the solution are: minimising the number of base station sites by building up networks; minimising the need for air conditioning to cool the sites by increasing the ambient temperature to up to 40°C; using the latest base station

technology, for example to balance the consumption according to load; and deploying software features that optimise the use of radio access for wireless communications. NSN claims to have made remarkable achievements in reducing energy consumption throughout its base station portfolio, achieving energy consumption levels of 800W and 500W respectively for typical GSM and WCDMA base stations.

Remote areas

In remote areas, where advanced infrastructure such as power grids is not readily available, NSN is increasingly installing sites that are run by renewable energy such as solar panels, rather than use diesel generators as power source for equipment.

Ericsson focuses on its power-saving software features

NSN's direct competitor Ericsson focuses on its power-saving software features to reduce energy use by its networks; hence it arrives at less spectacular energy savings estimates. These software features put those parts of the network that are not being used in standby mode. According to Ericsson, depending on the pattern of network traffic, this innovation can save between 10% and 20% of energy per base transceiver station (BTS) when a base station is in use, while still providing the same level and quality of services to end-users. If deployed across the 1m GSM Ericsson base stations globally, this power-saving feature could mean a collective energy saving of 10-20% in radio access networks, which could result in reducing annual CO_2 emissions by 1m tons. Vodafone was the first to launch this feature in its base stations in December 2007.

With regard to emerging markets where new network sites are being built, it is essential for an operator to optimise the number of cell sites, i.e. to maximise network coverage by utilising superior network planning tools. Ericsson has introduced the so-called Expander solution to cater for exactly those needs. Ericsson also offers a number of alternative energy solutions (renewables, biodiesel) for base stations in remote areas.

Replacement of wired with wireless networks

Considerable less energy consumed by wireless networks

Commercial and residential buildings are today equipped with wired telecommunications networks by default. An emerging trend is to replace wired with wireless networks, which generally have lower bandwidth but are easier to set up and manage. In order to compare the relative impacts of these two types of network, a case study of Carnegie Mellon University's campus network, which includes ubiquitous wired and wireless networks, found that the network infrastructure alone consumed 6% of the campus electricity load. Furthermore, while there is some difference in network performance between the two types of network (thus they are not completely equivalent), the wireless network consumes considerably less energy. These findings cannot be considered representative, since a college campus (especially a highly computer-intensive one such as the one studied here) differs in many respects from other commercial, industrial or residential buildings. However, they are still useful to understanding the components of the ICT sector's carbon footprint.

Mobile phones

Contribution to CO_2 emissions on a per user basis appear to be rather low

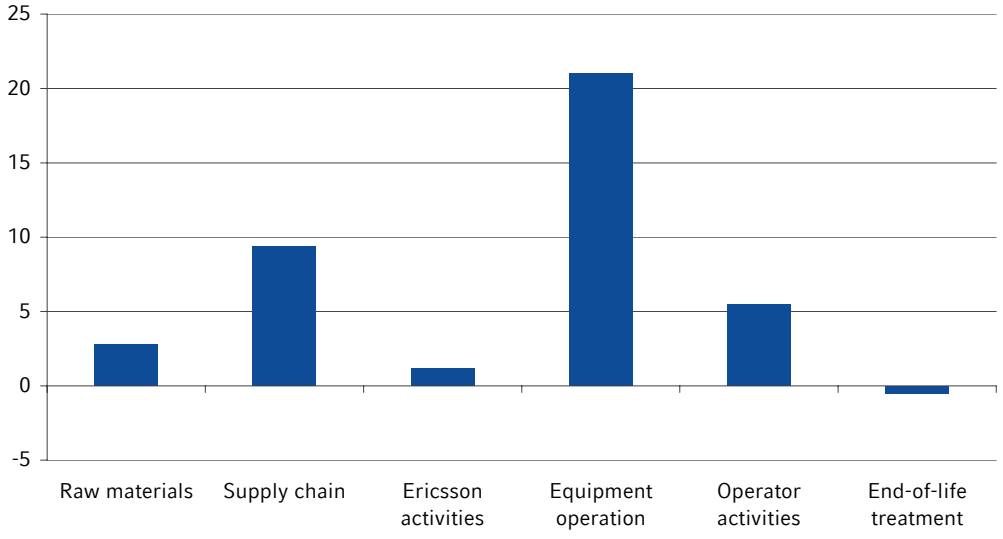
The contribution of mobile communications to CO_2 emissions on a per user basis appears to be rather low. Ericsson has calculated the CO_2 per mobile subscriber and the trends. In 1985 it saw that the average mobile subscriber caused about 185 kg of CO_2 emissions per year. Today, the company estimates that the average GSM subscriber creates emissions of around 25 kg p.a. of CO_2, about the same as a single 5W lightbulb powered continuously. What appears to be a success story still constitutes a tremendous problem

due to exponential subscriber growth (small numbers can add up to billions). But not all technology is contributing to a reduction of the CO_2 footprint.

Use of advanced radio technology

We note, for example, that the use of advanced radio technology (i.e. UMTS in preference to GSM) is leading to higher power consumption. In the light of the strong growth of multimedia computers supporting more than one radio technology (GSM, UMTS, WiFi, Bluetooth), we think that actual energy consumption is up to 50% higher. On the positive side, it must be said that CO_2 emissions generally trend downwards once a new radio technology reaches maturity.

CO_2 footprint of mobile communications
kg CO_2 equivalent per GSM subscriber per year



Source Ericsson

LCA by companies, carbon product labelling and market implications

Strong momentum in carbon accounting and product labelling expected

Most technology providers have little or no visibility of the full life-cycle energy and CO_2 footprints of their products. However, some have started the process of life-cycle assessments (LCAs) in the recent past, and others will follow in the near future. According to Gartner's current industry outlook, the area of carbon accounting, tracking and carbon product labelling (beyond just IT) will explode during the next two years (on the subject of carbon accounting, see also 'Toward a product level standard' and 'A commentary on the product level standard' on www.london-accord.co.uk). Gartner expects that leading technology providers will start to seek differentiation of their products on full life-cycle energy and CO_2 requirements in 2009, and that enterprises will have the desire and information available (even if limited) on the procurement side to start making product and service choices based on full life-cycle energy and CO_2 footprints by 2010. To us, this sounds a bit overoptimistic, given today's realities.

Company rankings: WestLB 'Green ICT' sub-indicator 'Energy consumption'

'Best of all': Toshiba

For our 'Energy consumption' sub-indicator there are five items that are relevant and available for all the six sectors we have looked at. These are:

- Targets and programmes for reducing CO_2 equivalent emissions and/or energy consumption

- Targets and programmes to increase the use of renewable energy
- Data on CO_2 equivalent emissions
- Data on renewable energy consumption
- Targets and programmes to reduce the energy consumption of products

The component weightings are allocated accordingly. The company with the highest score across all sectors is Toshiba.

'Green ICT' sub-indicator 'Energy consumption' – best and worst scores in class

	number of	energy score			company with ...	
GICS sector level 4	companies	avg	max	min	highest scores	lowest scores
Communications Equipment	11	-0.10	1.56	-1.13	Ericsson	Research in Motion Ltd.
Computer Hardware	9	1.01	2.77	-0.42	TOSHIBA CORP	Wincor Nixdorf AG
Computer Storage & Peripherals	6	-0.21	1.74	-1.13	Seiko Epson Corp.	SanDisk
Office Electronics	6	0.33	1.20	-0.78	Ricoh Co Ltd	Neopost SA
Semiconductor Equipment	7	0.17	1.92	-1.13	Tokyo Electron	KLA Tencor Corp, Lam Research
Semiconductors	18	-0.35	1.47	-1.13	STMicroelectronics	Broadcom and others

Source WestLB Research, SiRi

Hazardous substances

Manufacturing

Serious local pollution and health problems

ICT devices form a complex mixture of materials and components, often containing several hundreds of different substances, many of which are toxic and create serious local pollution and health problems during both, the production and the disposal/recycling phases of the life cycle. They include flame retardants and heavy metals such as mercury, lead, cadmium and chromium. The manufacture of a circuit board weighing 4 pounds, for example, produces 46 pounds of waste, of which 40 pounds (87%) is classified as hazardous. Due to a lack of controls in countries like China, where most ICT equipment is manufactured today, waste water is sometimes discharged illegally into local irrigation ditches and creeks. Waste water typically contains heavy metals, various organic solvents and/or acid/alkaline waste liquid. Waste water treatment facilities often fail to reduce volatile organic compounds (VOCs), which are an important by-product of ICT production. Air pollution can include waste gases containing acids, alkalines, organic solvents, toxic compounds and inflammable gases.

Contamination of production sites

Huge quantities of toxic solvents are used to clean microscopic dirt and dust off chips. Studies indicate that workers' exposure to chemicals during the manufacture of semiconductors and other electronics products is tied to increased rates of cancer, reproductive problems and illness. Another issue is the contamination of production sites with toxic substances. Studies show that 1,500-2,000 sites in the USA are identified as seriously contaminated. Silicon Valley alone is home to 29 toxic EPA Superfund sites ('an uncontrolled or abandoned place where hazardous waste is located, possibly affecting local ecosystems or people' – see www.epa.gov/superfund/sites), the highest concentration in the country. Again, company reports do not really help to quantify the efforts being made in this field.

'Total water discharge by quality and destination' as reported by companies*

Company	Definition in respective company report	2007	2006	2005	2004	2003	2002
Ericsson	*'Ericsson currently has no water discharge other than domestic sewage and rainwater collection. …'*						
Nokia	Total Water discharge						
	- Municipal treatment facility (m^3)		1,292,136.0	1,122,706.0	1,097,251.0		
	- Nokia treatment facility (m^3)		65,249.0	73,802.0	184,249.0		
	Discharges to water, total (t)		1,035.0	890.0	839.0	771.0	798.0
	- BOD5 (5 day biological oxygen demand)		411.0	353.0	333.0	306.0	316.0
	- TSS (total suspended solids)		542.0	466.0	440.0	404.0	418.0
	- N (nitrogen)		66.0	57.0	53.0	49.0	51.0
	- P (phosphate)		16.0	14.0	13.0	12.0	13.0
Cisco	*Website with text only*						
IBM	*'IBM does not report water discharges by location in its consolidated, corporate-wide reporting. …'*						
Dell	*NA*						
HP	*'Wastewater is not a material environmental issue for HP operations. …'*						
Toshiba	Total amount of water discharged ('000s m^3)		54,325.0				
	- BOD (Biochemical oxygen demand) (t)		389.0				
	- COD (Chemical oxygen demand) (t)		407.0				
STM	Emissions to water (kg)						
	Eutrophication (kg [P + N])		385,031.0	387,051.0	252,119.0		
	Aquatic oxygen demand (kg COD)		354,965.0	443,870.0	518,935.0		
	Heavy metals to water (kg heavy metals)		13,279.0	17,522.0	19,520.0		
	Aquatic ecotoxity (kg Cu Eq)		13,964.0	11,490.0	10,772.0		
ASML	*Only rough information about one site*						

* Based on all available GRI (G3 only) company reports (G3 performance indicator: EN21)

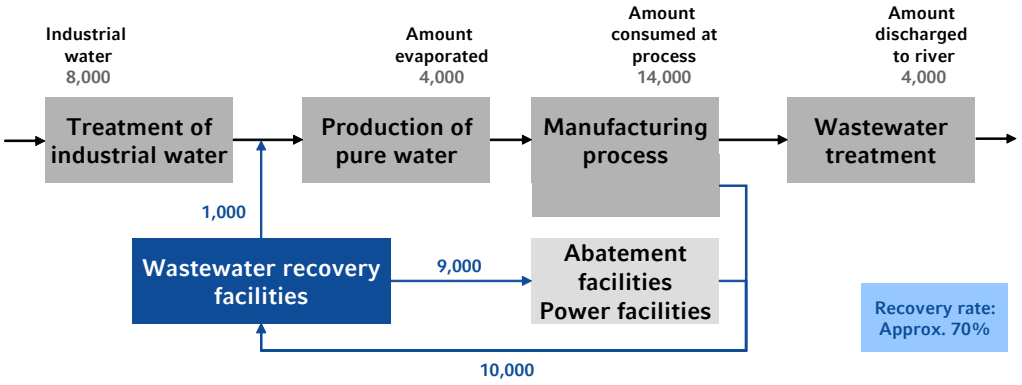
Source WestLB Research, company reports

Wastewater recycling at a semiconductor plant

Case study: Toshiba

Measures to reduce the amount of wastewater at Toshiba's new 300mm-diameter wafer-ready clean room facility at Yokkaichi Operations were included from the early stages of the design of the manufacturing process. Certain chemical substances are recovered by dedicated systems immediately after their use, in order to reduce the wastewater treatment load and enable recycling of chemical substances. As a result, the amount of wastewater discharged from the clean room has been reduced from the initially anticipated 18,000m^3 per day to 14,000m^3 per day. Moreover, by recovering 70% of the wastewater through reverse osmosis (RO) membrane filtration, 10,000m^3 of recovered water per day is reused as raw water for producing pure water or as water for the waste gas cleaning/cooling tower. As a result, the amount of intake of industrial water has been reduced from the initially anticipated 18,000m^3 per day to 8,000m^3 per day.

Toshiba case study: Overview of water supply and discharge



Source Toshiba

Minimising landfill disposal

Case study: Konica Minolta

Konica Minolta has implemented zero-waste measures that aim to accomplish both economic and risk management goals. Its zero-waste activities reflect its intention to minimise waste destined for disposal as landfill, by promoting recycling of waste. Activities are based on two levels of criteria. Level 1 criteria include target rates for recycling (over 90%) and for final disposal (landfill) (less than 5%, including secondary residue). To reach Level 2, Konica is targeting a 30% rate of reduction in externally discarded waste volumes per sales unit from its fiscal 2001 level; thus it is striving to reduce both costs and risk.

Konica has implemented risk management to ensure that discarded waste is reliably and properly handled. For group companies in Japan the company has established criteria for selecting waste disposal contractors. The database includes a wide range of related information, such as illegal waste disposal, laws and regulations, environmental technologies, and other knowledge accumulated within the group.

In pursuing resource recovery, top priority is given to the in-house recycling of leftover materials produced in the manufacturing process. Konica researches and develops new recycling and production technologies to facilitate this. It reports that, as a result, the total volume of waste from group manufacturing sites worldwide in fiscal 2006 was 35,681 tons, the volume of recovered resources (the volume recycled both in house and externally) was 34,500 tons, and the volume of landfill was just 662 tons. Thus, the resource recovery rate was 96.7% and the final disposal rate (the landfill rate) was 1.9%. All these activities resulted in approximately ¥2bn in annual savings.

Nanotechnology

Creating new and better products with the help of nanomaterials

Nanotechnology is the ability to measure, see, manipulate and manufacture things of a size between 1 and 100 nanometres, i.e. at the scale of single atoms and molecules. One nanometre is one billionth of 1 metre; a euro banknote is roughly 100,000 nanometres thick. Nanomaterials are designed to exhibit novel or enhanced properties that affect their physical and chemical behaviour, in effect presenting opportunities to create new and better products. Consequently, nanotechnology has the potential to make significant contributions to many fields, such as biotechnology, energy, transportation, agriculture, consumer products (incl. consumer electronics) and semiconductors.

Increasing economic significance of nanotechnology

The International Council on Nanotechnology (ICON) estimates that global sales of nanomaterials could exceed US$1 trillion by 2015 (see ICON Nanotech Survey, 2006). According to manufacturer claims, nanotechnology is already used in over 600 consumer products on the market today, such as sporting goods, cosmetics and food packaging. Lux Research projects that US$2.6 trillion worth of global manufactured goods, or about 15% of the global total, will incorporate nanotechnology by 2014.

Nanotechnology based semiconductor production: market size of US$500bn expected by 2015

One sector that is rapidly entering into the era of nanotechnology is the semiconductor industry. The 'shrinking' of conventional technologies is reaching its limits; further miniaturisation is only possible with the help of nanotechnology. The density of bits on a chip that can be achieved is several orders of magnitude greater than what we have today in complementary metal oxide semiconductors. The Allianz Centre for Technology and Allianz Global Risks, in co-operation with the OECD International Futures Programme, estimates that about US$300bn worth of semiconductor production worldwide will be

based on nanotechnology (including nanocomponents such as nanolayers, nanoscale treated materials or other nanostructures) by 2010, and about US$500bn by 2015.

Nanotechnology presents new challenges for measuring, monitoring, managing and minimising contaminants in the workplace and the environment. The properties for which novel nanoscale materials are designed may generate new risks to workers, consumers, the public and the environment. Some of these risks can be anticipated from experience with other synthetic chemicals and with existing knowledge of ambient and manufactured fine particles. However, novel risks associated with new properties cannot easily be anticipated based on existing data.

Health concerns focus on free manufactured nanoparticles

Epidemiological studies on ambient fine and ultra-fine particles incidentally produced in industrial processes show a correlation between ambient air concentration and mortality rates. The health effects of ultra-fine particles on respiratory and cardiovascular endpoints highlight the potential health risks of intentionally manufactured nanoparticles.

New study shows that inhaling multi-walled carbon nanotubes may result in asbestos-like health effects

A new study published in 'Nature Nanotechnology' (May 2008) suggests that some forms of carbon nanotubes could be as harmful as asbestos if inhaled in sufficient quantities. The study used established methods to see whether specific types of nanotubes have the potential to cause mesothelioma – a cancer of the lung lining that can take 30-40 years to appear following exposure. The results show that long, thin multi-walled carbon nanotubes (MWCNTs) that look like asbestos fibres, behave like asbestos fibres. Asbestos fibres are harmful because they are thin enough to penetrate deep into the lungs, but are long enough to confound the lungs' built-in clearance mechanisms for getting rid of particles. Widespread exposure to asbestos has been described as the worst occupational health disaster in US history, and the cost of asbestos-related disease could exceed US$200bn, according to the major US think tank RAND Corporation.

Use of carbon nanotubes in the ICT industry

MWCNTs are currently designed to produce strong, lightweight composite materials; to make plastics more suitable for use in environments where chemical cleanliness is critical, in silicon chip manufacture and in computer disc drives; and to improve the performance of electronics by providing smoothness to, and uniform conductivity throughout, the polymer composite. MWCNTs are also expected to have applications in high-intensity emitters in flat panel displays, advanced batteries and fuel cells, high performance metals and plastics, and electronics (such as carbon nanotube resistors and wires).

With respect to health, environmental and safety risks, almost all concerns that have been raised are related to free rather than fixed manufactured nanoparticles. Manufactured nanoparticles have shown toxic properties in initial studies. They can enter the human body in various ways, reach vital organs via the bloodstream, and possibly damage tissue. Due to their small size, the properties of nanoparticles not only differ from bulk materials of the same composition but also show different patterns of interaction with the human body.

Tightening of regulatory environment to be expected

Nanoparticles raise a number of safety and regulatory issues that governments are now starting to tackle. Regulators have not yet taken account of the special properties of nanoparticles with respect to health and safety (e.g. they are not addressed by REACH). Labelling requirements for nanoparticles do not exist. We expect increased regulatory pressure over the next few years as more and more consumers become exposed to

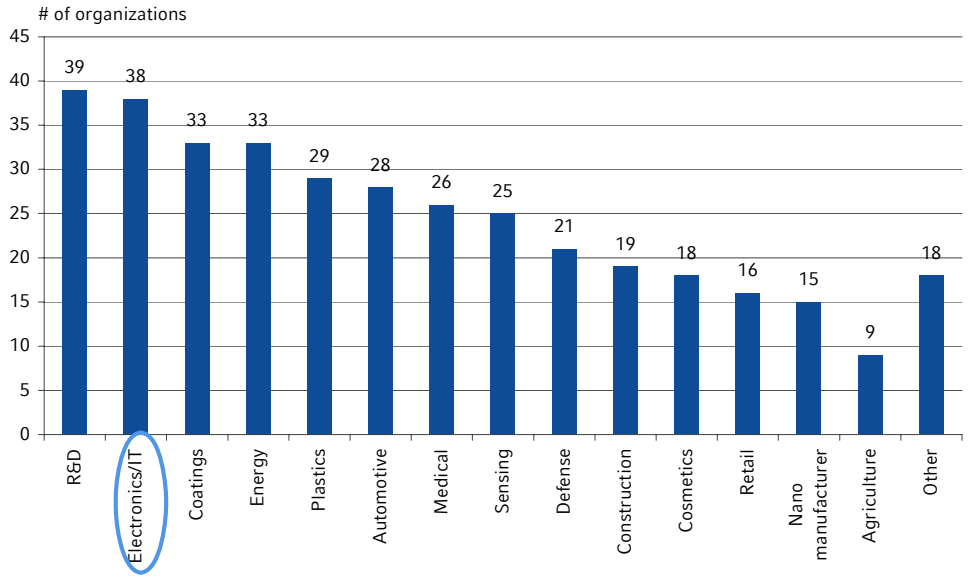
manufactured nanoparticles. The health risks of nanoparticles could be an ongoing source of litigation and reputational risk to the ICT hardware industry (comparable to those of asbestos to other industries).

At present, the exposure of the general population to nanoparticles originating from dedicated industrial processes is marginal in relation to those produced and released unintentionally via e.g. combustion processes. Exposure to manufactured nanoparticles so far is mainly concentrated on workers in nanotechnology research and at nanotechnology companies.

International survey on current practices in nanotechnological sectors

Due to the lack of specific information concerning the hazards associated with new nanomaterials, nanotechnological manufacturing industries may be implementing workplace safety and product stewardship practices that are both inspired by existing knowledge and, in some cases, in response to anticipated hazards. Such practices could lay the foundation for industry standards, either voluntary or regulated. An appraisal of current practices in nanotechnological sectors is thus of critical importance. A helpful input for this has been delivered by ICON, which conducted an international survey of current environmental health and safety (EHS) and product stewardship practices in the global nanotechnology industry in 2006. Of the 337 organisations that were invited to participate, 64 responded (7 out of these are from the 'Electronics/IT' sector).

ICON nanotech survey – Respondents' customers industries:
Electronics/IT is one of the most important nanotech target industries

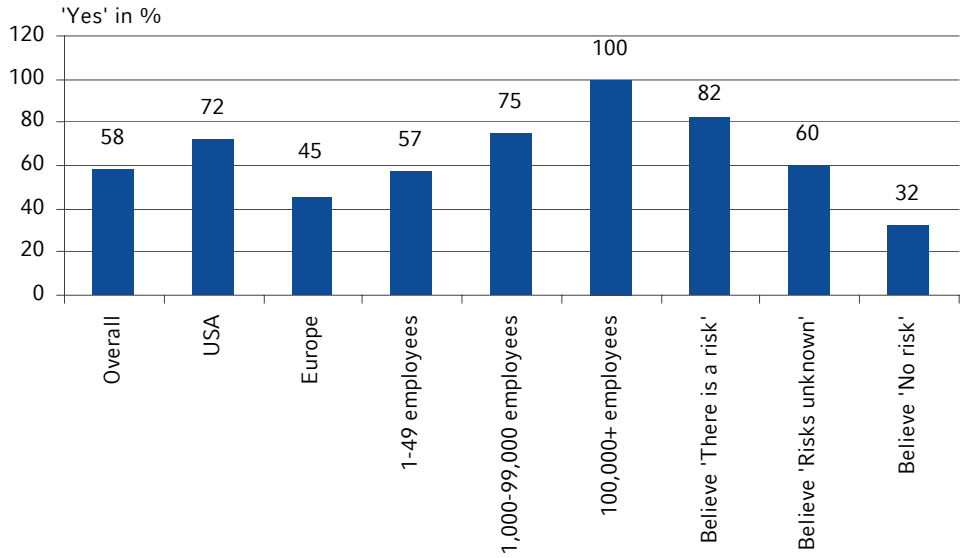


Source ICON, 2006

Do organisations believe that there are special risks relating to nanomaterials?

In general, surveyed organisations reported that they believe there are special risks relating to the nanomaterials they work with, that they are implementing nano-specific EHS programmes and that they are actively seeking additional information on how to best handle nanomaterials.

ICON nanotech survey: Nano-specific EHS programme in place?

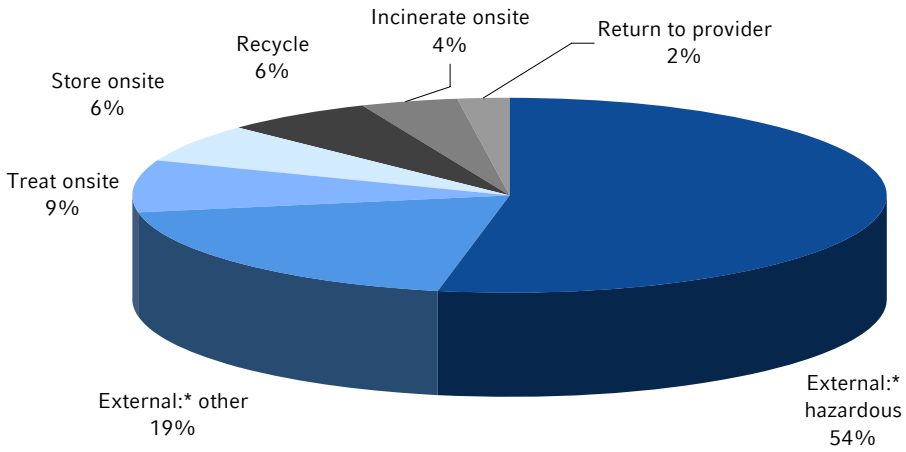


Source ICON, 2006

Reported EHS practices do not depart significantly from conventional safety practices

However, reported EHS practices, including selection of engineering controls, personal protective equipment (PPE), clean-up methods and waste management, do not depart significantly from conventional safety practices for handling chemicals. In fact, practices were occasionally described as based on the properties of the bulk form or the solvent carrier, and not specifically on the properties of the nanomaterial. Additionally, few organisations reported monitoring the workplace for nanoparticles or providing formal guidance to downstream users on the safe disposal of nanomaterials. When asked, organisations generally recommended disposal of nanoproducts as hazardous waste, though not many reported that they passed this information to their customers.

ICON nanotech survey: Waste disposal



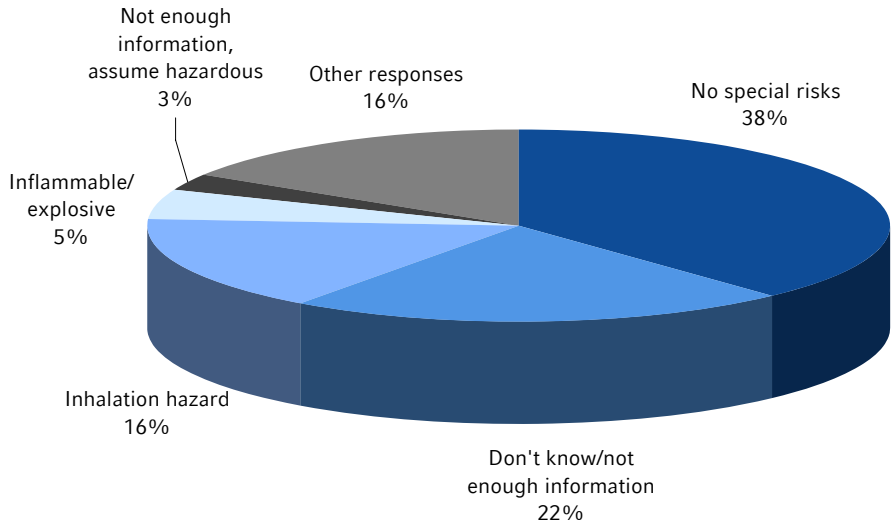
* External: Outsourced to a waste management company

Source ICON, 2006

'By default' use of conventional practices for handling nanomaterials

Reported practices in the handling of nanomaterials are, with some exceptions, based on criteria unrelated to any perceived risks stemming specifically from working with nano-scale materials. The 'by default' use of conventional practices for handling nanomaterials appears to stem from a lack of information about the toxicological properties of nanomaterials, and from the nascent state of regulatory guidance on EHS practices. Indeed, most organisations reported that the biggest impediment to improving their nano-specific EHS programmes was a lack of information; nearly half of the organisations that reported implementing a nano-specific EHS programme described it as a precaution against unknown hazards.

ICON nanotech survey: Attitude towards risk



Source ICON, 2006

Intel supports several initiatives aiming to minimise health and safety impacts of nanomaterials

Case study: Intel

Intel is working on a project, in collaboration with multiple stakeholder groups, to define, characterise, and manage the EHS implications of nanoelectronics – the manufacture of extremely small transistor devices – in the semiconductor industry. Intel representatives took the lead in developing EHS standards on nanotechnology in several standards development organisations, including American Standards Testing Materials International and the International Standards Organisation (ISO). Additionally, an Intel employee is heading ISO Technical Committee 229 on Nanotechnology, which is developing ISO health and safety standards. Intel continues to support the International Council on Nanotechnology (ICON). The company has also led an ICON project that is performing toxicological assessments of nanomaterials. Intel is a member of the Nanoparticle Occupational Safety and Health (NOSH) Consortium, a multi-stakeholder group of industry, academic and government institutions that is performing basic research on nanoparticle generation and characterisation. The NOSH project is intended to lay the groundwork for better monitoring of potential occupational exposure to nano-sized materials, and ways to minimise such occurrences.

End of life cycle

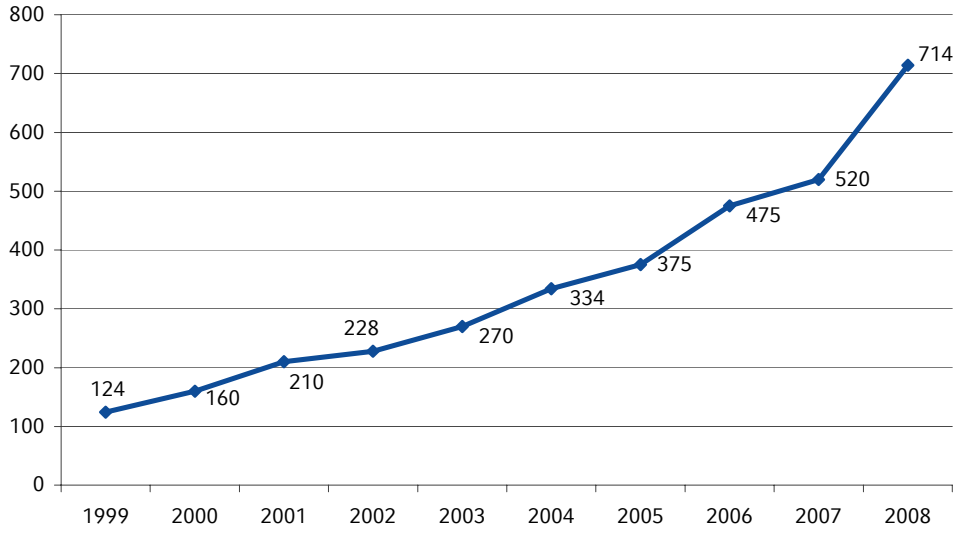
The ICT sector is one of the largest and fastest-growing industries worldwide. Technological innovation and intense marketing engender a rapid replacement process

of ICT equipment. Personal computers are discarded every two to four years on average, for example. Mobile phones in industrialised countries have a life cycle of less than two years.

E-waste is generated at alarming rates

We estimate that 40-50m tons of electrical and electronic equipment waste ('e-waste') per year are generated worldwide. We estimate that 400m PCs and 714m mobile phones (up from 160m in 2000) will be replaced worldwide in 2008 alone. Europe produces 10.3m tons of e-waste a year, around a quarter of the world's total, and we expect this amount to rise to 12.3m tons per year by 2020.

Mobile phones – total replacement sales (m units)

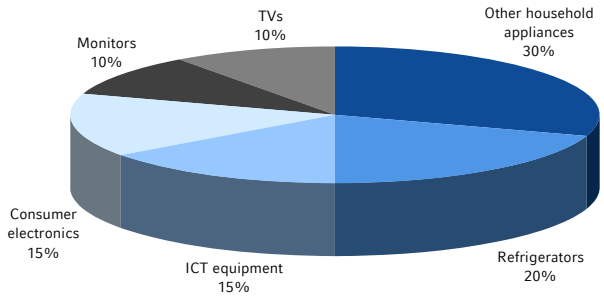


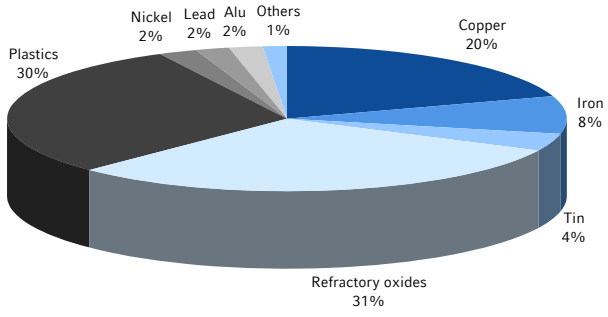
Source WestLB Research

Storage and re-use

The steps towards the end of the life cycle of a device are storage, re-use and recycling, before it ends as e-waste. The United Nations Environment Programme (UNEP) points out in a report on e-waste issues that consumers in the USA have, on average, two to three obsolete computers in their garage, closet or other storage space (UNEP, 2005). It also quotes other research that estimates that 75% of all computers ever sold in the USA remain stockpiled, awaiting re-use, recycling or disposal. Obsolete devices from industrialised countries can find their way to developing countries, where old computers and mobile phones are often used for a few more years.

The type and composition of e-waste





Source Basel Action Network

Recycling

Shrinking the waste stream

As stated above, ICT equipment contains valuable recyclable resources such as gold, silver, palladium and platinum, as well as other useful metals like aluminium and copper. According to the US Government Accountability Office (GAO), the US Geological Survey reports that 1 ton of computer scrap contains more gold than 17 tons of gold ore. Recycling these resources can help shrink the waste stream, conserve natural resources and, at the same time, capture value for the enterprise.

In addition to these valuable materials, e-waste also contains harmful elements, including lead, cadmium, mercury, chromium and halogen-based flame retardants. A typical computer monitor (cathode ray tube) may contain more than 6% lead by weight.

Mostly unregulated

ICT equipment 'recycling' is a misleading characterisation of many disparate practices, including de-manufacturing, dismantling, shredding, burning and exporting. Recycling is mostly unregulated, and often creates additional hazards in itself. Although the amount of e-waste is rising steadily, the industry has not yet developed sophisticated or automated recycling procedures. In 2001, only 11% of personal computers retired in the USA were recycled. Nevertheless, modern recycling plants can recover 80% of the materials, and use a further 15% for burning; only 5% finishes as waste. These numbers show that recycling has the potential to significantly contribute to reducing the overall resource use of the system. This potential is by no means fully exploited yet.

'Percentage of products sold and their packaging materials that are reclaimed by category', as reported by companies*

Company	Definition in respective company report	2007	2006	2005	2004	2003	2002
Ericsson	*NA*						
Nokia	*NA*						
Cisco	*Website with text but no clear figures*						
IBM	% of reclaimed products and their packaging materials (Category of product sold: IT products)		49.2	43.6	27.1		
Dell	*NA*						
HP	*(no clear link to tables)*						
	HP LaserJet print cartridge recycling (total in t)	15,000.0	13,600.0	11,100.0			
	- % of LaserJet market covered by program	88%	88%	87%			
	- Materials recycled into new products	59%	63%	60%			
	- Energy recovery	41%	37%	40%			
	HP Inkjet print cartridge recycling (t)	2,000.0	700.0	440.0			
	- % of LaserJet market covered by program	89%	88%	80%			
	- Materials recycled into new products	53.0%	60.1%	56.5%			
	- Energy recovery	21.0%	23.2%	24.0%			
Toshiba	Weight recycled (t)		67,351.0				
	Weight of end-of-use products recovered (t)		87,827.0				
	Amount of materials recycled from end-of-use products		67,351.0				
	- TVs		14,277.0	10,000.0	9,100.0	8,600.0	
	- Refrigerators		16,827.0	16,600.0	16,000.0	15,300.0	
	- Washing machine		14,746.0	13,900.0	11,600.0	10,900.0	
	- Air conditioners		7,313.0	8,100.0	7,400.0	6,600.0	
	- PCs		508.0	200.0	100.0	100.0	
	- Medical equipment		5,000.0	4,300.0	3,600.0	3,600.0	
	- Commercial equipment		8,700.0	12,000.0	13,100.0	10,500.0	
STM	*'These indicators are not reported because we do not yet have reliable enough systems in place to provide the data.'*						
ASML	*only text*						

* Based on all available GRI (G3 only) company reports (G3 performance indicator: EN27)

Source WestLB Research, company reports

Case study: IBM

End-of-life cycle management

IBM began offering product take-back programmes in Europe in 1989 as part of its product end-of-life management (PELM) activities, and has extended and enhanced them over the years. IBM's Global Asset Recovery Services organisation now offers asset recovery solutions to commercial customers in 21 countries worldwide, and is making efforts to extend them. These solutions include the management of data security and disc

overwrite services, a worldwide remarketing network for product resale, and state-of-the-art refurbishing and recycling capability for IT equipment. Additionally, IBM offers solutions to household consumers in many countries for the end-of-life management of computer equipment, through either its own initiatives or country programmes in which the company participates.

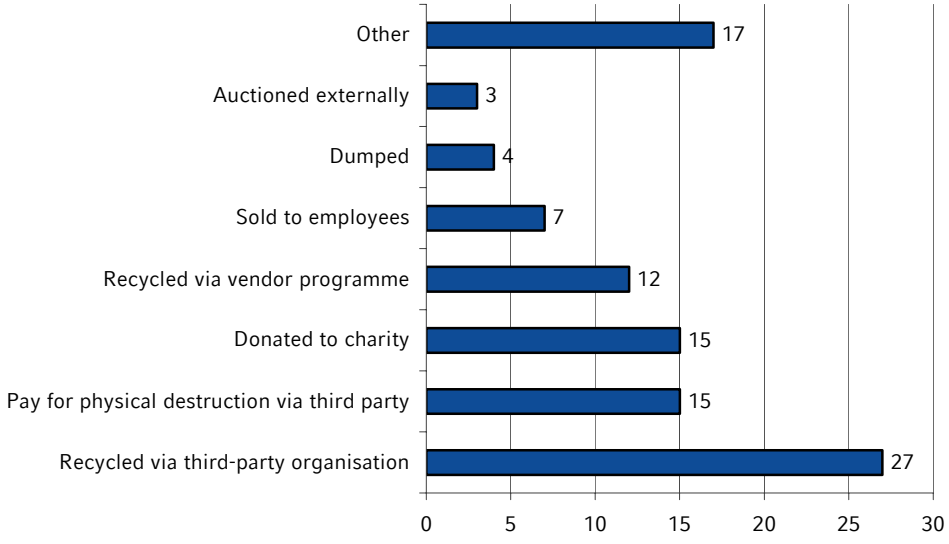
In 2005, IBM PELM operations worldwide processed 59,653 tons of end-of-life products and product waste, sending only 1.43% of that total to landfills and outperforming the company's PELM goal, which is to maintain a landfill rate below 3%. Over 94% of the total volume processed in 2005 was either resold, reused or recycled.

Disposal in landfill

Even the best 'state of the art' landfill sites are not completely sealed throughout their lifetimes

According to the Silicon Valley Toxics Coalition (SVTC), 70% of heavy metals found in landfill, including mercury and cadmium, come from electronic equipment discards. According to the US Environmental Protection Agency (EPA), more than 4.6m tons of e-waste ended up in landfill nationally in 2000. Lead has been found to leach into groundwater and contaminate workers' clothes. Even the best 'state of the art' landfill sites are not completely sealed throughout their lifetimes; a certain amount of chemical and metal leakage will occur. The situation is far worse for older or less stringently controlled sites. The vaporisation of mercury is also of concern. This can cause uncontrolled fires to break out at landfill sites, posing additional health and environmental risks.

How does your organisation primarily dispose of its obsolete IT equipment?
% respondents



Source EIU survey, July 2007

Export of e-waste

'Computers for the poor'

Most e-waste is exported to developing countries, hidden under the umbrella of charity ('computers for the poor'). Some 70% of global e-waste is dumped in China, with most of the rest going to India and to African nations, according to Global Action Plan. Another study by Toxics Link (2004) found that 70% of e-waste collected at recycling units in New Delhi was actually exported from or even dumped by developed countries. The

recycling and disposal of computer waste in developing countries is becoming a serious problem, since treatment practices remain rudimentary.

The treatment practices for e-waste in developing countries pose grave environmental and health hazards. For example, the deterioration of local drinking water can result in serious outbreaks of illness. A water sample from the Lianjiang River near a Chinese 'recycling village' revealed lead levels that were 2,400 times higher than the World Health Organisation's Drinking Water Guidelines. Often, workers in e-waste recycling operations in developing countries face dangerous working conditions, as they may be without protection (no masks or gloves, for example). Released gases, acid solutions, toxic smoke and contaminated ashes are some of the most dangerous threats to these people and to the local environment.

Solving the e-waste equation

Stricter regulation is an important catalyst for change

It would certainly be beyond the scope of this research note to discuss all aspects of the e-waste issue, including possible solutions to the dilemma. So we limit ourselves here to two concluding observations. Firstly, it is clear that regulation plays an increasingly important role in this area, challenging brand companies to improve their supply chain management (see p. 16) and significantly increasing their compliance costs (see p. 65). We consider new regulations, such as the EU's RoHS and WEEE Directives (see p. 67 ff) to be effective catalysts of a fundamental change in industry attitudes vis-à-vis ESG issues. Secondly, we would repeat a point that we have made above: that one attractive way to reduce the environmental footprint of the sector is to extend the useable lifespan of ICT equipment. This would mean reduced use of resources, a less serious disposal problem, and lower CO_2 emissions.

'Best practice' e-waste and recycling policy

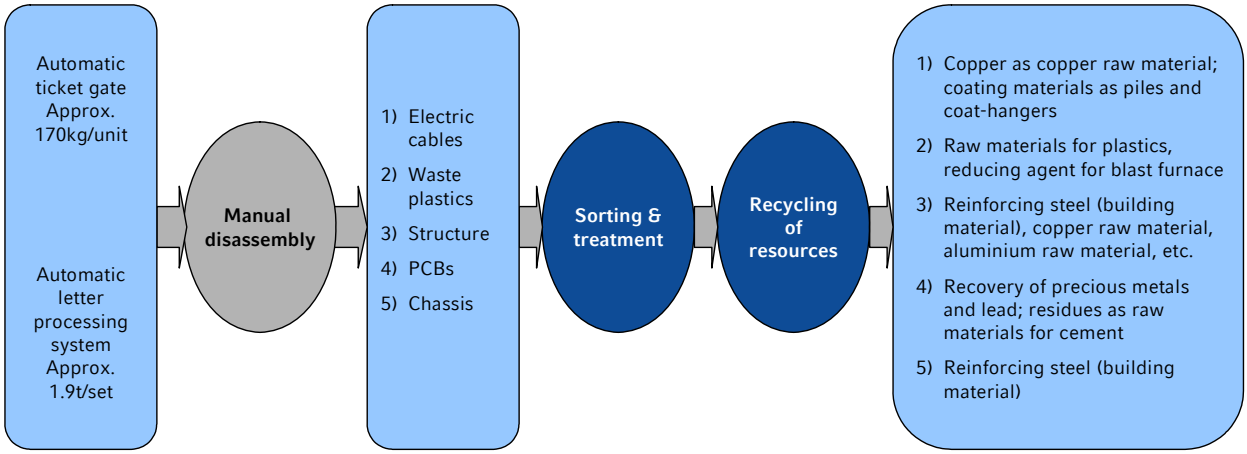
Case study: Toshiba

Toshiba has been assessed by Greenpeace as a 'top company' (together with Samsung) with regard to green electronics due to its 'continued improvement, especially on e-waste and recycling policy'. Toshiba itself states that besides resource-saving design, the company is emphasising greater use of modules so that repairs and upgrades of products are performed simply by replacing modules. Reduction of the number of parts to facilitate disassembly and recycling is another priority. It is also promoting use of recycled resources in products.

By promoting recovery of end-of-use products and material recycling, Toshiba claims to be making a greater contribution to resource recycling with every passing year. In Japan, besides products covered by the Home Appliance Recycling Law and the Law for Promotion of Effective Utilization of Resources, the company has established its own schemes for collecting medical equipment, elevators and point-of-sale systems. In accordance with customers' requests, Toshiba's Term Corp conducts manual disassembly of end-of-use automatic ticket gates and automatic letter-processing systems in compliance with the Waste Management Law, achieving a recycling rate of over 99% and optimising resources. Because of manual disassembly, energy used during disassembly is minimal, thus contributing to suppression of CO_2 emissions.

Toshiba case study: Manual disassembly of products and equipment for recycling (Term Corp, Japan)

Process flow



Source WestLB Research, SiRi

Focus on Europe and the USA

In Europe, Toshiba is promoting recycling of end-of-use products to fulfil producer responsibility by ensuring compliance with the WEEE Directive. In the USA, it is engaged in voluntary recycling that goes beyond the legal requirements of individual states. At the beginning of 2008 it started a recycling venture, Electronic Manufacturers Recycling Management (MRM), and is now focused on making MRM successful in providing manufacturer-led management of the e-waste issue in the USA in an 'efficient, cost-effective, and consumer-friendly manner'.

In addition, implementation of recycling schemes in Asia/Oceania and China is underway, according to the company. In fiscal 2006 Toshiba recovered 88,000 tons of products worldwide, and 67,000 tons of materials was recycled. The target for fiscal 2006 was to increase the weight of materials recycled by 145% from the fiscal 2001 level; the actual result was a 147% increase. Toshiba's efforts were acknowledged by its receipt of the Encouragement Award, Resource Recycling Technologies and Systems Commendation from the Clean Japan Centre in 2006-07.

Company rankings: WestLB 'Green ICT' sub-indicator 'Waste'

Minimising waste

It is very difficult, if not impossible, to compare companies with respect to 'Waste', based solely on the quantitative information that they themselves disclose. The example below shows the data disclosed by companies in the 'Semiconductors' sector (for more information on other ICT sub-sectors, see p. 95 ff and appendix).

'Waste' indicator displays a rather complex structure

The lack of comparable quantifiable information disclosed by companies demonstrates the necessity and usefulness of extra-financial rating systems – and this brings us back to our 'Green ICT' sub-indicator 'Waste'. This indicator has a more complex structure than the other sub-indicators discussed above. It is a combination of two building blocks, one with generally applicable items and one with sector-specific ones (see after table on top of next page).

'Total weight of waste by type and disposal method' as reported by companies*

Company	Definition in respective company report	2007	2006	2005	2004	2003	2002
Toshiba	**Waste, total amount generated (t)**		**235,962.0**				
	Amount recycled (t)		208,732.0				
	Amount for final disposal (t)		10,370.0				
	Final disposal rate		4.4%	5.0%	6.0%	6.8%	
	Total amount of waste generated / final disposal ('000s t)		236.0	239.0	252.0	242.0	
	- metal chips ('000s t)		78.0	77.0	87.0	85.0	
	- waste acid ('000s t)		21.0	27.0	41.0	35.0	
	- sludge ('000s t)		42.0	37.0	36.0	34.0	
	- waste paper ('000s t)		36.0	35.0	30.0	28.0	
	- waste plastics ('000s t)		18.0	20.0	20.0	21.0	
	- glass ('000s t)		7.0	6.0	7.0	9.0	
	- others ('000s t)		34.0	37.0	31.0	30.0	
	Weight recycled (t)		67,351.0				
	TVs		14,277.0				
	Refrigerators		16,827.0				
	Washing machine		14,746.0				
	Air conditioners		7,313.0				
	PCs		508.0				
	Weight of end-of-use products recovered (t)		87,827.0				
STM	Landfill waste (% of total waste)		4.8%	8.3%	6.7%	5.9%	14.8%
	Waste recycled (%)		80%	78%	80%	73%	65%
ASML	Total waste materials disposed ('000s kg)	1,277.0	1,033.0	942.0			
	Non-hazardous waste materials ('000s kg)	1,149.0	960.0	894.0			
	Hazardous waste materials ('000s kg)	128.0	73.0	48.0			
	Total waste materials disposed / net sales (kg/m Euros)	335.0	287.0	372.0			

* Based on all available GRI (G3 only) company reports (G3 performance indicator: EN22)

Source WestLB Research, company reports

First, we have taken four items into consideration that are relevant and available for all companies within the six sectors we have looked at. These are:

- Controversies over soil/water/air/noise pollution
- Controversies over waste
- Targets and programmes to phase out the use of hazardous substances
- Targets and programmes to reduce the impact of product at the end of the life cycle

Then, we have included four other items by which to rank the companies in 'Semiconductor Equipment' and 'Semiconductors'. These are:

- Targets and programmes to reduce the generation of hazardous waste
- Targets and programmes to reduce discharge to water
- Data on generation of hazardous waste
- Data on discharge to water

Much room for improvement for semiconductor companies

Both semiconductor sectors score poorly on 'Waste', which shows that there is much room for improvement by companies in these sectors going forward. Best in class here is ASML, with a positive score of 0.56. NEC and Seiko Epson score highest across all six ICT sectors.

'Green ICT' sub-indicator 'Waste' – best and worst scores in class

GICS sector level 4	number of companies	waste score avg	waste score max	waste score min	company with ... highest scores	lowest scores
Communications Equipment	11	0.15	0.95	-0.50	Nokia	Juniper Networks, Nortel, RIM
Computer Hardware	9	0.97	1.57	0.32	NEC Corporation	Wincor Nixdorf AG
Computer Storage & Peripherals	6	0.39	1.57	-0.50	Seiko Epson Corp.	SanDisk
Office Electronics	6	0.74	1.36	-0.09	Konica Minolta, Ricoh Co Ltd	Neopost SA
Semiconductor Equipment	7	-0.77	0.53	-1.54	ASML Holding	KLA Tencor Corp, Lam Research
Semiconductors	18	-1.00	-0.19	-1.54	STMicroelectronics	Arm Holdings , Broadcom, Marvell Technology, Microchip Technology, NVIDIA Corp.

Source WestLB Research, SiRi

ICT and the environment: Part of the problem, but also part of the solution

The positive role of ICT in making the overall economy more efficient

So far we have talked only about the direct environmental footprint of the ICT sector, implicitly questioning what the industry can do to reduce it. This is the subject of public debate, and rightly so. Each part of society needs to bear its own responsibility, as defined by its respective sphere of influence. It is no surprise that industry lobbyists try to give the debate a different twist by stressing the indirect economy-wide productivity benefits that 'generate the largest energy savings to the benefit of businesses, consumers and the environment' (source: American Council for an Energy-Efficient Economy (AeA), 2007). We fully agree with the view that the positive role of the ICT sector in making an economy more efficient (i.e. less energy-intensive) needs to be recognised, and the opportunities for this need to be fully exploited. However, it is not appropriate to weigh this matter against the sector's own responsibilities and actions, which form the core of the 'Green ICT' debate and are the main subject of this research note.

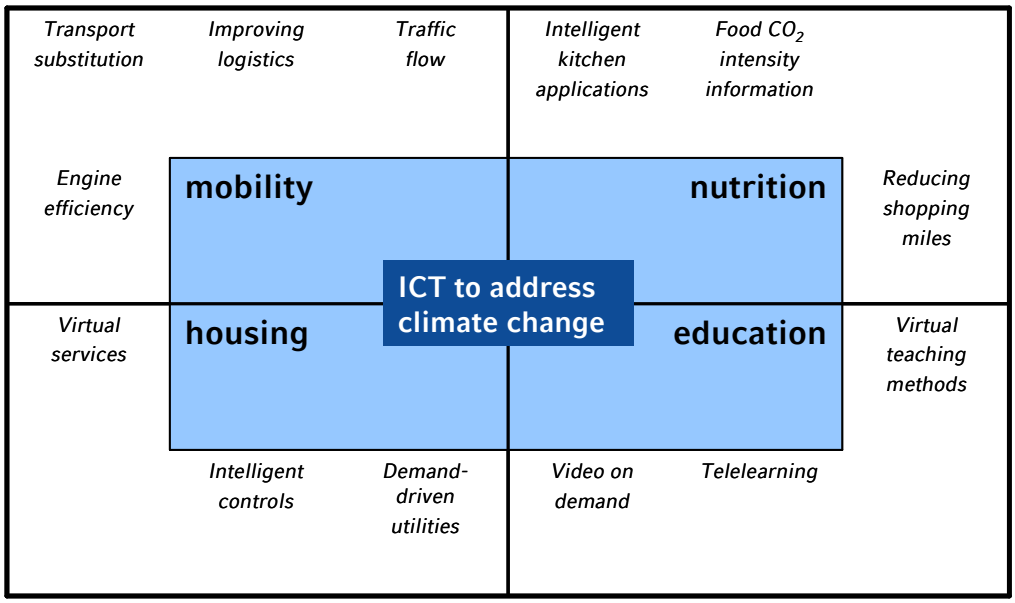
ICT – paving the way to a 'low(er)-carbon economy'

Nevertheless, it appears worthwhile to recapitulate briefly on what opportunities there are to make the entire system, i.e. the economy, more energy-efficient – in other words, to help pave the way to a 'low(er)-carbon economy' that is needed to achieve the goal of the European Energy-Efficiency Action Plan to reduce total energy use by 20% by 2020. For instance, e-commerce and telecommuting can reduce energy use for both freight and passenger transport. However, it is hard to say at present whether these indirect gains will actually exceed the incremental energy consumption caused by the sales growth and market penetration of ICT equipment and infrastructure. Much more research needs to be conducted in this area to get a better understanding of the net impact of the ICT sector. One must bear in mind, however, that technology and the ways in which it is used are subject to dynamic changes, which makes forecasts of developments over the medium to long term a complex and difficult task, one that goes well beyond the scope of our note. Hence, we limit ourselves to offering a couple of concrete examples that show the indirect positive system-wide effects of increased ICT usage that need to be balanced against incremental direct energy consumption.

A look at the full range of impacts

Before we start with the example of telecommuting (or teleworking), we take a quick look at the full range of impacts that the ICT sector is considered to be having on climate change as seen by the Global e-Sustainability Initiative (GeSI). GeSI is an industry initiative that is supported by the United Nations Environment Programme (UNEP) (for more information about GeSI, see p. 77).

GeSI: Companies in the ICT industry are contributing to climate protection through various consumer- and industry-focused activities



Source GeSI 2007

Telecommuting – an alternative to work-related road and rail transport

Reducing transport-related CO_2 emissions

High-tech communication technologies offer an alternative solution to growing levels of congestion, energy consumption and CO_2 emissions within the transport and buildings sectors. To provide an indication of the energy-savings potential associated with e.g. teleworking, it is important to note that transport-related energy consumption alone is estimated by the European Commission to be responsible for nearly one-third of the EU-25's total energy consumption. And a significant share of road and rail transport is work related. Teleworking offers a means of reducing work-related travel while also reducing the amount of building space required to house employees (our June 2006 note 'Mobility in a flat world', June 2006, gives an overview of all kinds of sustainable transport issues). Telecommuting, videoconferencing and telepresence can reduce:

- The number of total kilometres travelled
- Traffic congestion (and therefore unnecessary local air pollution)
- The amount of building-related energy used, by reducing the amount of office space required to house employees

If just 10% of the EU employees became flexi-workers, another 22m tons of CO_2 might be saved annually

Many early versions of videoconferencing technologies were somewhat slow and unreliable. However, the new generation of computers with digital cameras and videoconferencing equipment, together with improved access to faster and more reliable internet connections, has generated renewed interest in the use of videoconferencing and the popularity of telecommuting. One study completed by the European Telecommunications Network Operators Association (ETNO) and the World Wide Fund for Nature (WWF) concluded that if 20% of business travel in the EU-25 were replaced by non-travel techniques such as audio- or videoconferencing or telepresence, then by 2010 around 25m tons per year of CO_2 emissions might be saved. The study also found that if just 10% of EU employees became flexi-workers, a further 22m tons per year of CO_2 emissions might be saved. However, is not

clear to us whether these estimates properly reflect incremental usage of heat and lighting energy use in homes rather than in office buildings. Research conducted by the Oxford University Centre for the Environment (OUCE) found that the extra heating and lighting that would be needed in homes would wipe out 80% of energy savings accrued through not commuting. This shows that any precise estimates given in this area need to be interpreted with caution.

Teleworking initiative by the ICT industry itself

The potential efficiency gains offered by telecommuting have been adjured for quite some time now. Actual changes in overall systemic behaviour, however, have not been dramatic so far, despite some successes claimed by telecom service vendors here and there (e.g. T-Mobile claims on its website homepage that it has run 40,000 videoconferences so far, saving 7,000 tons of CO_2, but the company does not tell the reader over what period this seemingly high number of 'virtual meetings' took place). Two main obstacles to broader acceptance of telecommuting (or teleworking) are (1) the difficulty of changing habitual human behaviour and (2) limited opportunities and options offered by employers. Since the ICT industry certainly has an interest in seeing the market for teleworking solutions grow, it does not surprise us that it has launched an initiative to encourage and help companies within the sector to assess and implement teleworking programmes themselves. In 2004 the Electronic Industries Alliance (EIA) together with the World Resources Institute (WRI) published a new guide for businesses, providing information and tools to assess the effectiveness of teleworking programmes. According to an EIA survey of member companies, several high-tech firms, including Apple, AT&T, HP, IBM, Intel, Motorola, Nortel Networks, Sun Microsystems and Texas Instruments have instituted formal teleworking programmes.

Case study: Microsoft

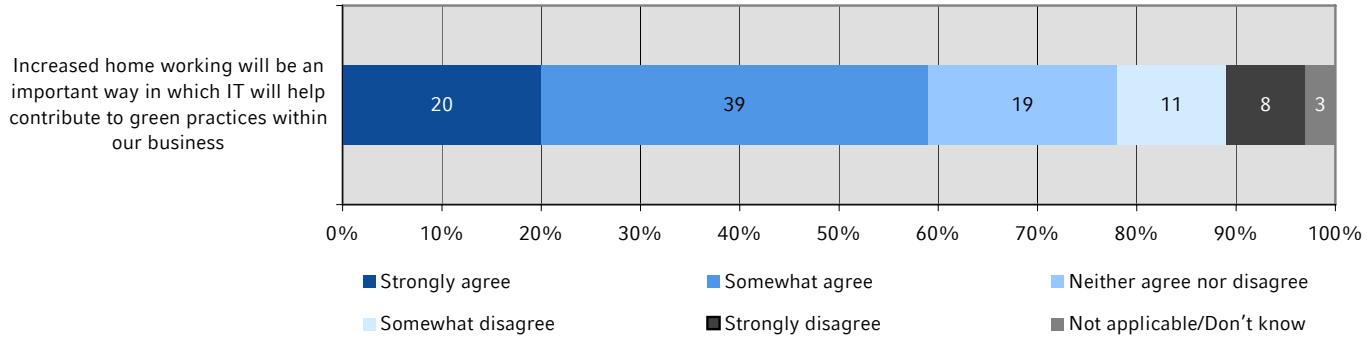
Microsoft develops collaboration solutions, such as Microsoft® Office Live Meeting, SharePoint®, and Microsoft Office Groove® 2007. These technologies enable virtual meetings, thereby reducing the need for business travel and for the physical transfer of documents.

Scepticism still prevails

Returning to the findings of the survey of ICT executives that we discussed above, we note that it reveals some scepticism among respondents about the importance of telecommuting. Only 20% strongly agree with a statement formulated along those lines.

To what extent do you agree or disagree with the following statements, in terms of how they apply within your organisation?

% of respondents



Source EIU survey, July 2007

Other examples of reducing travel-related CO_2 emissions are e-health initiatives and e-government projects such as those supported by Deutsche Telekom, for example.

E-health initiatives and e-government projects

Case study: Deutsche Telekom

Deutsche Telekom enables citizens to carry out bureaucratic processes more easily through e-government projects in cooperation with various state and local authorities, for instance the state governments of Saxony and Baden-Württemberg. T-Systems, Deutsche Telekom's Business Customers business unit, developed and now operates the 'CAT 365' community portal on behalf of the government of the Spanish province of Catalonia – the portal is a central part of the province's e-government initiative. These initiatives aim to save first and foremost on paper and on journeys to and from local administration offices.

With regard to e-health solutions, Deutsche Telekom is testing new ICT solution modules in clinical practices through cooperative ventures such as that with the Johanniter hospital in Bonn. T-Systems is actively involved in a number of e-health projects, including electronic patient cards, health professional cards for physicians, and electronic prescriptions.

Freight movements – new logistics and warehousing

Integrating high-tech supply chain logistics

Over the past 10 years the EU-27 has witnessed continued growth in the transport of goods, reaching 2,401bn ton-kilometres in 2005 (see our June 2006 note 'Mobility in a flat world'). As a result, governments and businesses are increasingly looking to integrate high-tech supply chain logistics and warehousing technologies. Advanced logistics technologies can help companies reduce fuel use, costs and carbon emissions through:

- Intermodal transport strategies that use a variety of modes of transport, including rail, resulting in reduced traffic congestion and idling time, and allow more flexibility in choosing transport modes, allowing shippers to choose the most fuel-efficient, cost-effective, reliable and timely mode.
- Improved truck tracking and logistics management to improve scheduling the picking up and delivery of goods so as to reduce waiting times, maximise the size of truck loads, and reduce the number of wasted 'backhaul' of empty trailers.
- Improved traffic routing information that provides real-time information about the quickest routes, to reduce travel time and idling.
- Improved tracking and management of store and warehouse inventories to improve the management and flow of goods and to increase the viability of intermodal transport opportunities.

Case study: Deutsche Telekom

According to Deutsche Telekom, many business processes in the consumer goods industry and in the merchandise and transport logistics sector could be made more efficient, and thus cheaper and more environmentally friendly, with the aid of radio frequency identification (RFID) technology. For example, automobile manufacturers and suppliers can control their supply chain in a more efficient and transparent way with T-Systems' RFID solutions.

Smart grid – new efficiencies in electricity generation

Smarter energy systems can increase the energy efficiency of electricity production, distribution and consumption. These intelligent energy networks, known as smart grids, use advanced ICT and sophisticated sensing and monitoring technologies to monitor and manage energy supplies, demand and transmission. Essentially, a smart grid is an

intelligent electricity network that connects energy suppliers and consumers through the use of sophisticated technologies.

Managing energy demand, choosing energy providers, or scheduling energy use for off-peak periods …

Smart grids save energy and reduce carbon emissions by developing an interactive network that links multiple energy providers with numerous energy users using advanced technologies. Unlike traditional systems in which energy flows from utility to consumer, smart grid systems allow both information and energy to flow in either direction. Data on energy production, costs, sources and consumption are made available to both producers and consumers. These data can then be used as inputs into automated or managed decision-making processes to manage energy demand, choose energy providers, or schedule energy use for off-peak periods.

Among the benefits of smart grid systems is their ability to integrate electricity supply from distributed energy sources including combined heat and power (CHP) systems, wind turbines, photovoltaics, and fuel cells. The integration of distributed energy sources supports the development of low-carbon sources of electricity that currently lack the means to connect to traditional power grids. The efficiency of new CHP systems approaches 75%, compared with a mere 37% (or worse) for conventional steam production systems. If smart grid technology facilitated a mere 5% increase in electricity generation capacity from the more energy-efficient CHP systems, CO_2 emissions could be reduced by as much as 20m tons per year (source: AeA, 2007).

… allowing electric utilities to retire the dirtiest and least-efficient sources of power

Smart grids also broaden consumer energy choices and enable advanced demand-side management of energy consumption. When coupled with smart meters and intelligent building systems, smart grids allow energy consumers to make 'smart' decisions using real-time information. Moreover, increasingly sophisticated, digital, microprocessor-controlled appliances and devices can employ advanced sensors, metering, controls and communications over the grid to monitor and switch power flows, enhancing demand-side management applications. Together, energy management and intelligent building systems can reduce energy consumption and peak load demand, allowing electrical utilities to retire the dirtiest and least efficient sources of power, thereby reducing the carbon footprint of each kilowatt-hour of electricity consumed.

Case study: IBM

IBM is one of the big players in the field of smart grids and 'intelligent utility networks', using ICT to improve the management – and thus the performance – of electricity grids. In April 2007 IBM launched a new coalition to accelerate the adoption of intelligent utility network (IUN) technologies and solutions on a global basis.

Building optimisation – opportunities for system improvements

Achieving energy efficiency through the smart scheduling of the operation of major equipment

Within the EU, buildings are currently responsible for over 40% of greenhouse gas emissions, or approximately 1,300m tons or more of CO_2 per year. A variety of information technologies provide the means for what have become known as intelligent building systems and building energy management systems (BEMS). Intelligent buildings and BEMS use electronics and other high technology to reduce energy use while maintaining or even improving previous levels of comfort and services. The complexity of the systems varies considerably, from those that allow the operator to simply monitor the operational status of heating, ventilation and air conditioning (HVAC) systems, to sophisticated direct digital control (DDC) systems that monitor, manage and optimise

building systems and energy use without human oversight through the use of wireless and remote microprocessor-based controls.

The key components of BEMS include sensors, transmitters, data acquisition and data processing performed at the user (building) level, and global data and control systems for larger campus-control schemes. Currently BEMS technology facilitates the 'smart' management of energy use, achieving energy efficiency through the scheduling of the operation of major equipment including chillers, boilers, packaged air conditioners, heat pumps and lights. Since most buildings are not occupied 24 hours a day, air conditioning, ventilation and lighting services can be reduced or shut down when buildings are unoccupied, reducing energy costs and minimising wear and tear on equipment.

Monitoring and controlling lighting and electronics in unoccupied hotel rooms and offices

Hotels and office buildings too have begun integrating sensors and wireless technology to monitor and control lighting and electronics in unoccupied guest rooms and offices. For example some hotels, on learning that guest rooms were left unoccupied for an average of 11.5 hours per day, have installed small infra-red sensors to detect when no-one is in a room, and the room temperature is automatically reduced by e.g. 3 degrees after 30 minutes. Such technologies have saved as much as 37% of hotel heating costs. Similarly, motion sensors in light ballasts turn off lights when no one is present, and daylight sensors turn off lights in office buildings when artificial light is not needed.

Future systems are likely to include more sophisticated BEMS that will include demand limiting, load shifting and event-initiated controls. Such programmes will require advanced meters that record and communicate actual electricity use and will then adjust electricity use based on time of day or on on-peak/off-peak or other billing rates. The potential carbon savings provided through the adoption of BEMS has been estimated by the AeA (2007) to be as high as 20%. If that number holds for the near future, then we might be looking at total annual savings of 260m tons of CO_2 – all of it significantly enabled through BEMS.

Manufacturing process controls: improving products and processes

Despite the growing importance of services in the 'post-industrial' economies of OECD countries, manufacturing processes in the EU continue to generate 21% of GDP and approximately 18% of all jobs. Industrial manufacturing tends to require more energy per unit of output than other sectors of the economy.

Improving energy efficiency and boosting productivity

Among the most effective means of reducing industrial energy consumption is the application of manufacturing process controls (MPCs). These include all systems and software that monitor and control production processes. Such control systems include energy management information systems, advanced sensors and automatic controls systems, inferential process controls, process heating sensors and automatic controls, software assessment tools, and wireless sensor networks and micro-electromechanical systems (MEMS).

Process controls provide real-time data generated by production machinery and, in some cases, allow machines to 'learn' and be instructed. When combined with plant-wide ICT systems, real-time data allow manufacturers to improve productivity, maximise quality, reduce waste, increase production flexibility, and increase innovation. Integrated energy management information systems detect, measure and store data, and benchmark

energy use. Integrated measurement devices linked to intelligent control systems and process automation improve plant energy efficiency while also boosting productivity by increasing throughput, yield and product quality. Moreover, sensors and controls can significantly improve energy efficiency in process heating, providing significant reductions in total energy consumption.

Machine-to-machine communications

In the future, MPCs will increasingly involve machine-to-machine communications of real-time data and automated problem resolution. Networks of smaller, 'smarter' sensors are a critical element in the shift toward automated, self-correcting production systems. As currently envisioned, sensor networks would comprise minute sensor nodes that include sensing components, data-processing capabilities, and ICT. This type of technology would use thousands or even millions of small sensors to form self-organising wireless networks that could revolutionise manufacturing systems.

The continued development and application of MPCs and other ICT-based manufacturing technologies will provide opportunities for continued improvements in energy efficiency and productivity. Assuming that productivity improvements might also reduce industrial energy use by 20% per dollar of shipments, CO_2 emissions from within the EU might be reduced by about 200m tons per year.

Integrated telephony

Power consumption of the entire phone system can be effectively reduced to zero

Innovation in internet protocol-based telephony (VoIP) solutions (see p. 58) will present opportunities to replace traditional telephone equipment that will generate savings in power usage and call costs. It is important to note, however, that this does not apply to replacements on a stand-alone for stand-alone basis, because stand-alone IP phones draw 5-7W of power whereas traditional digital or analogue handsets use only 1-2W when in use. The major opportunity for reductions through the use of IP telephony is when the stand-alone handset is replaced by a soft phone client on the computer workstation. Indeed, if the communications server is combined on to existing servers using virtualisation technology, then the power consumption of the entire phone system can be effectively reduced to zero.

Industry estimates that ICT could deliver 50% of the goals set within the EU Energy Efficiency Plan

390m tons of CO_2 reductions will be enabled by ICT applications

Many different energy efficiency investments will be necessary to achieve the 20% savings target of the EU Energy Efficiency Action Plan: applications and system improvements ranging from improved lighting systems and more energy-efficient consumer products to optimised manufacturing processes, enhanced transport patterns, and smart meters and intelligent grid systems. When we think these through it becomes evident to us that digital controllers, smart sensors, and adaptive software and operating systems will play an increasing role in delivering energy efficiency gains. With the examples listed above in mind, the AeA estimates that at least half of the anticipated 780m tons of CO_2 savings identified in the action plan will be enabled by the broad array of advanced ICT applications and other technologies. In other words, the enabling role of ICT and other advanced technologies can deliver more than 50% of the goals set within the EU Energy Efficiency Plan.

Certainly, this estimate appears to us to be biased to the upside, which does not surprise us since it comes from an industry lobbying organisation. Nevertheless, we agree that it ICT equipment and infrastructure will play a significant enabling role in making

developed economies more energy-efficient. Hence, we can only stress once again that the positive role of the ICT sector needs to be recognised, and that all of the technological options it offers need to be fully exploited. However, we repeat that it is not appropriate to weigh this matter against the sector's own responsibilities and actions, which are the main subject of this research note.

Change – Going 'green' becomes essential for industry leaders

Sea-change is necessary

Gartner Inc., the benchmark industry consulting firm, recently put 'Green ICT' at the top of its agenda for 2008, saying that the industry accounts for approximately 2% of global CO_2 emissions, the same amount as the aviation industry. Gartner concludes that this is unsustainable, notwithstanding the positive overall environmental value of ICT, and that the topic needs to be put at the top of the sector's management agenda (on both the buy and sell sides). We fully agree with this, but we have our doubts that this will happen as quickly as projected by Gartner. Nothing less than a sea change will suffice, since for the time being the topic does not play a significant role in business models or management strategies – whether on the part of buying organisations or of equipment and infrastructure vendors. Before we take a look at possible catalysts for change, which might indeed mark a tipping point in the system's behaviour, it is necessary to take stock of the situation as of today, and of the obstacles that need to be overcome for the sector to 'become greener' in future.

Obstacles in the past

A look at the buy-side attitudes

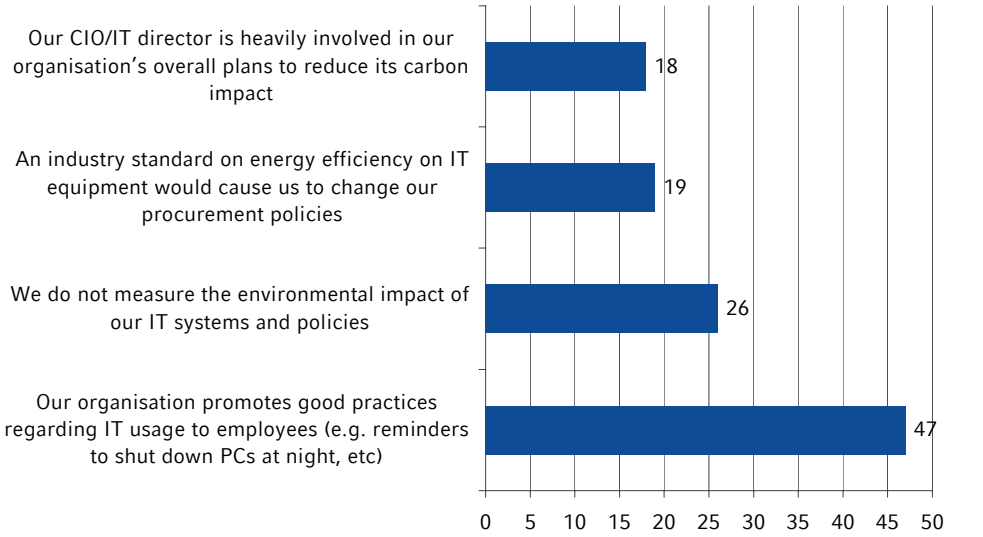
A natural way of looking at this is to adopt the perspective of organisations that are large buyers of ICT equipment and infrastructure. This involves the corporate sector and the public sector. The attitudes and preferences of those who are responsible for procurement processes give valuable insights into the current determinants of buying decisions, and this in turn enables us to understand the response of the supply side, i.e. of vendors of ICT equipment and infrastructure. These insights can cast some light on the degree to which it seems likely, from today's perspective, that the full energy savings potential of increased ICT use can actually be raised, as suggested above. Among the most commonly cited barriers to the adoption and implementation of 'greener' ICT systems are:

- The lack of awareness and information regarding the benefits, costs and availability of new technologies
- A mis-specified incentive system
- The perceived risks associated with early adoption
- The lack of standards for measuring energy savings

Supported by empirical studies

This is not only based on anecdotal evidence but also, by and large, well reflected in empirical studies. Certainly, one of the most recent and most comprehensive studies was conducted by the EIU during June and July 2007. Its findings are based on a major online survey of chief information officers and other senior ICT executives from around the world. In total, 213 executives from 17 different sectors took part in the survey.

To what extent do you agree or disagree with the following statements, in terms of how they apply within your organisation?
% of respondents, 'strongly agree' only



Source EIU survey, July 2007

The chart above summarises responses to variety of very different issues relating to the 'Green ICT' issue. The findings show:

- That there is a lack of involvement of ICT executives in managing companies' carbon footprints
- That many ICT executives acknowledge that their organisations do not measure the environmental footprint of their ICT systems at all
- That only a minority of ICT executives expects that an industry standard on energy efficiency would change their company's procurement policy

The lack of involvement of ICT departments

The lack of involvement of ICT departments in the overall sustainability strategies of organisations is confirmed by another survey conducted by Global Action Plan (GAP), a non-profit organisation, during September and October 2007. It too was aimed at key ICT decision makers of predominantly large organisations. The analysis of the 160 responses focused solely on the 120 from UK ICT professionals. Those respondents manage the ICT requirements of over 500,000 UK workers and have a combined ICT budget in excess of £475m. The survey showed that three-quarters of ICT departments are not integral to their organisation's social responsibility and sustainability strategy, though half of respondents are partly involved in the strategy. One-quarter of departments are not involved at all.

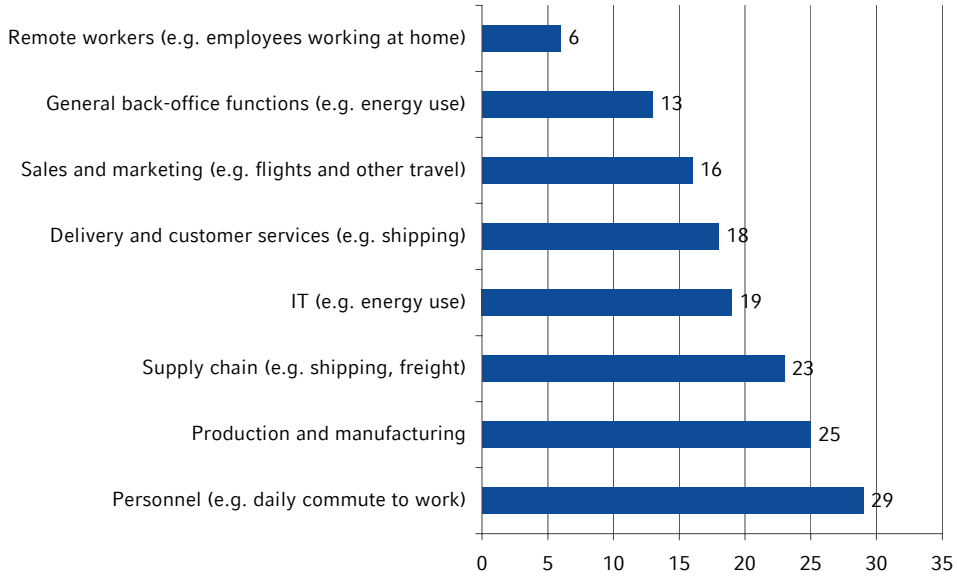
Lack of financial or personal incentive schemes

Furthermore, nearly half of those surveyed have not been invited by other departments to join an organisation-wide energy efficiency project. Only 6% of the organisations surveyed have financial or personal incentive schemes for their ICT departments to adopt environmentally friendly initiatives, although more than one-fifth would like to see such a scheme. The findings of the survey suggest that organisations are under-using a valuable asset by not fully involving their ICT departments in sustainability initiatives. The high energy consumption of ICT equipment means that there is significant room for improvement in their direct energy use. Perhaps more importantly, ICT departments have the skills and knowledge to greatly improve wider organisational efficiency in areas such as purchasing, travel and waste.

Lack of awareness about the environmental footprint of ICT

To return to the EIU study, another interesting finding is the relative importance attached by ICT executives to the environmental footprint (in particular carbon emissions) to their own organisations' ICT. Only 19% believe that its impact is significant, which is below the corresponding numbers for 'production and manufacturing' and for 'personnel', but ahead of 'sales and marketing' and 'delivery and customer services', both of which are characterised by significant amounts of transport-related emissions. We doubt whether these findings tell us much about the relative position of ICT in the perception of decision makers, but they tell us a lot about a general lack of awareness and knowledge of organisations' environmental footprints (all responses in the 'significant impact' category are below 30%).

In your view, how much of an impact does each of the following parts of your business have on the environment (considering their use of energy and resources and overall carbon emissions)?
% of respondents, 'strongly agree' only



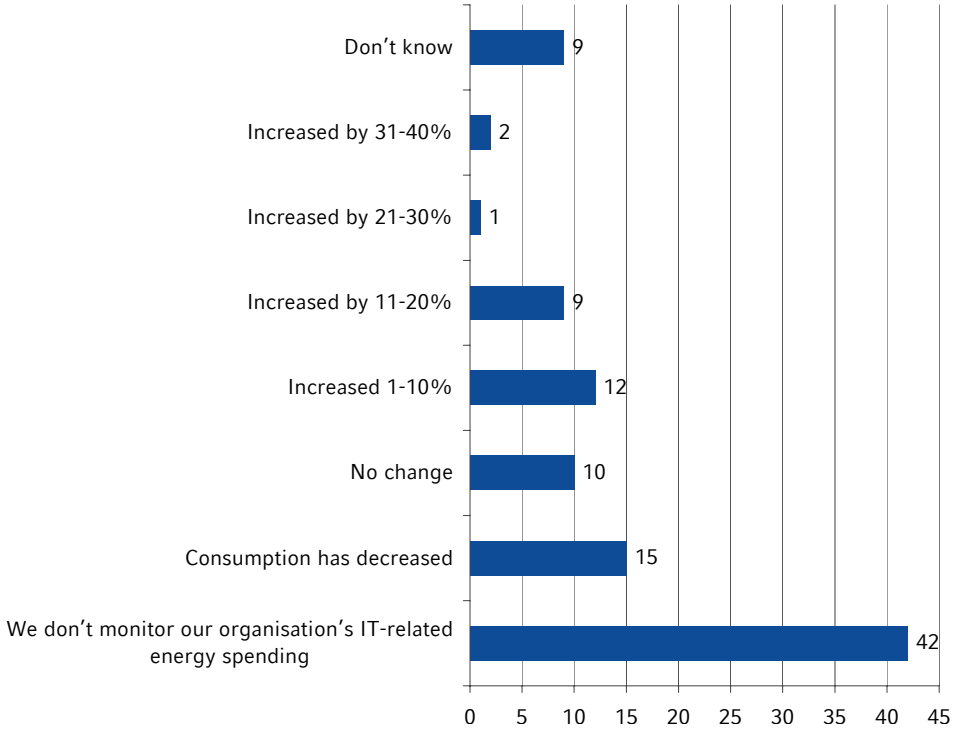
Source EIU survey, July 2007

The GAP survey conveys a slightly different picture. Almost all responding ICT professionals are aware that their ICT use has an impact on the environment, and just over half of them believe that that impact is significant.

Lack of monitoring of ICT-related energy consumption

Returning again to the EIU survey, although ICT consumes an enormous amount of power, few ICT bosses measure their departments' contribution to the energy bill. Some 42% of ICT executives polled say that their firms do not monitor ICT-related energy spending (and a further 9% do not know whether or not it has changed). Of those organisations that do monitor their ICT-related energy consumption, about one in four (24%) have seen their energy consumption increase over the past two years. However, measuring the cost clearly provides an incentive to change: 15% of respondents noted that their energy use had actually declined.

If your organisation monitors or audits its IT-related energy spending, how has this changed over the past two years?
% of respondents

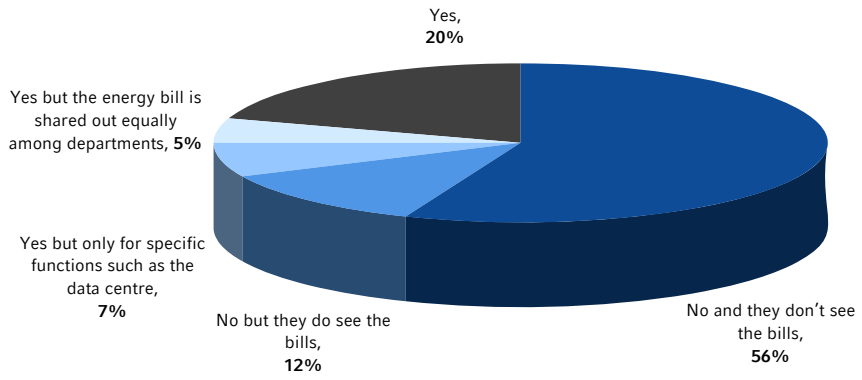


Source EIU survey, July 2007

86% of respondents do not know the extent of their carbon footprint

The findings of the GAP survey confirm our overall impression. The survey revealed that 86% of ICT professionals do not know the carbon footprint of their activities and only 15% are planning to calculate it, although a further 38% would like to know it but do not know how to determine the figure. Although ICT is a significant consumer of energy, the majority of ICT departments are not directly responsible for this cost. More than half of the ICT departments surveyed do not see their organisation's energy bills, and two-thirds do not directly pay their share of energy bills, which gives them no incentive to include energy efficiency criteria in their procurement policies.

Do ICT departments pay for the energy consumed by ICT equipment?
% of respondents

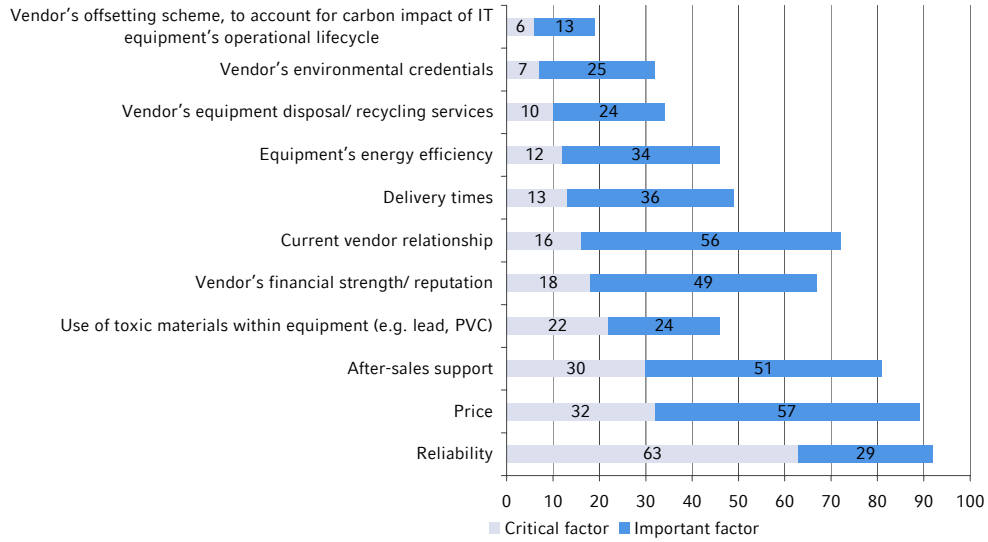


Source Global Action Plan, October 2007

Only 12% of respondents say that the energy efficiency of ICT equipment is a critical purchasing criterion

As we suspected on the basis of the lack of incentive structures, power consumption is not currently a significant criterion in ICT procurement. According to 63% of respondents to the EIU survey, reliability is the main deciding factor in buying ICT equipment; this is followed by price (32%) and then after-sales support (30%). Only 12% of respondents say that the energy efficiency of ICT equipment is a critical purchasing criterion. By comparison, 13% of executives rate delivery times as being a critical factor. Although it is unlikely that the power consumption of hardware will ever be a primary consideration, the operational costs of hardware are surely more important than delivery times.

When tendering for new IT equipment (e.g. PCs, servers), how much does each of the following factors play in your purchasing decision?
% of respondents, selecting 'Critical factor' and 'Important factor' only



Source EIU survey, July 2007

ICT professionals show willingness to tackle their carbon footprint, but require support and encouragement to do so

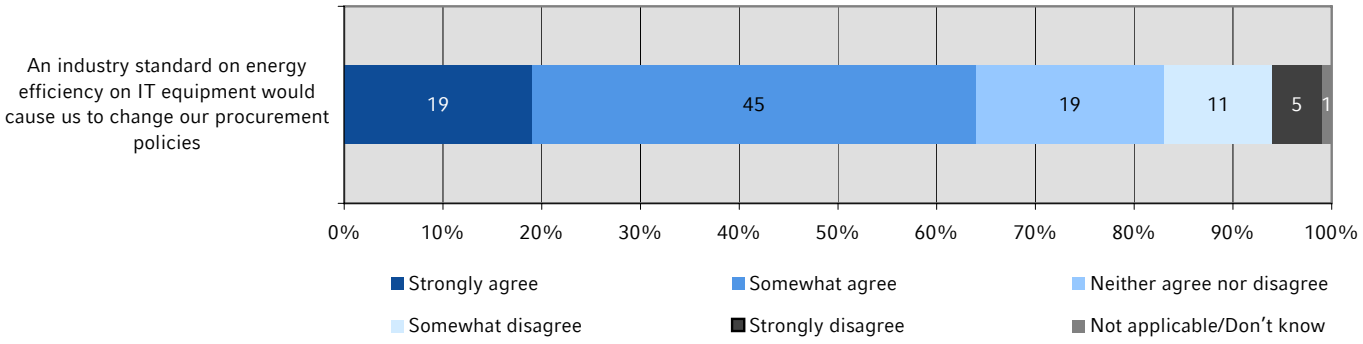
The findings of the GAP survey lead us to similar conclusions in revealing that the environmental performance of equipment is not a major consideration for ICT professionals in the UK, even though over half of respondents are aware of specific 'Green' technologies. Only 8% have purchased products purely on the basis of their environmental benefits. More than one-third do not consider environmental benefits at all when purchasing new products. Over half do consider such benefits, but only as a secondary, less important factor. ICT professionals show a willingness to tackle their carbon footprint, but they require support and encouragement to do so. To encourage ICT departments to be more energy efficient, they must at least be made more aware of how much energy they are using.

Part of the problem is that computer equipment is generally assessed on performance criteria: processor speed, memory size and so on. Environmental attributes, such as energy efficiency, ease of recycling or the use of toxic chemicals in the manufacturing process, are far harder to assess. Various initiatives have been launched to solve the dilemma of the lack of performance benchmarks and of comparability in general. For example, the Electronic Product Environmental Assessment Tool (EPEAT) in the USA helps businesses to compare the environmental credentials of desktops, laptops and monitors. A growing number of large procurement organisations, e.g. HSBC, one of the biggest global players in the financial sector, is using the system to help make its purchasing decisions (more about EPEAT on p. 70).

Energy efficiency standards could help a lot

Other schemes, such as ENERGY STAR (see p. 72), allow technology vendors to add their certification to any equipment that falls within a certain energy efficiency standard. As such practices become more common, it will become far easier to make comparisons between equipment from different suppliers. And the majority of ICT executives (64%) polled by the EIU agree that such schemes would cause them to change their procurement policies.

To what extent do you agree or disagree with the following statements, in terms of how they apply within your organisation?
% of respondents



Source EIU survey, July 2007

Finally, we return to the starting point of this chapter, i.e. the factors that have so far prevented the ICT sector from becoming 'Green'. In the GAP survey ICT professionals cited time pressures, costs, and a lack of corporate commitment as the biggest obstacles to implementing new 'Green ICT' technologies. Other significant barriers are the scarcity of information and a lack of knowledge within the organisation.

Improvement in the impartiality and robustness of environmental information provided by ICT vendors

When asked what would be the most important support required to implement environmental improvements, ICT professionals overwhelmingly called for recognised industry standards and incentives such as tax allowances for organisations that adopt 'Green ICT' practices. Nevertheless, the majority of responding decision makers in the UK still expect that environmental considerations will be important to their ICT purchasing decisions over the next two years. But what do they expect from the sell side? In reviewing the offer from the ICT market, most ICT professionals would like to see an improvement in the impartiality and robustness of environmental information provided by ICT vendors. Some 60% considered such information to be poor or confusing; only 1% rated such information as excellent. One in 20 professionals think that vendors are not genuinely concerned about the environment and regard 'Green ICT' as just another sales gimmick.

Summing up

To sum up, based on the two surveys we have discussed one could say that ICT professionals display concern for the impact of ICT on the environment, but that this impact is not well understood. Furthermore, ICT is not sufficiently integrated in the overall efforts of companies to reduce their environmental footprints. Heads of organisations, governments and ICT equipment vendors must create a situation in which ICT departments are motivated and better assisted to implement 'Green ICT' solutions.

Catalysts for change

'Being green' has not been a priority in the ICT sector so far

It is fair to say that 'being green' has not been a priority in the ICT sector so far. Companies that are both aware and concerned about the topic still represent a small minority. Obviously, this is in sharp contrast with the predictions with regard to the 'Green ICT' future. The question that arises is what are the factors that will make the industry change course? In general terms three major structural drivers can be noted:

- Increasing energy and carbon costs
- The impact of climate change and other environmental issues on brand values and customer behaviour
- Government and regulatory measures (including carbon-trading schemes)

Will environmental aspects belong to the top buying criteria for IT-related goods and services soon?

The climate change topic and the increasing pressure exerted on companies to tackle the issue have come to the fore and are acting as a kind of catalyst for an overall change. Gartner, for example, believes that with increasing industry maturity and sophistication over how to tackle energy efficiency that a paradigm shift will occur in the majority of companies until 2010. The consultant firm claims that it has already witnessed a 'real and sustained change in the priorities attributed to environmental issues, as demonstrated by the positions being taken by large enterprises such as Tesco, Wal-Mart, Marks and Spencer, BT Group, GE, utility companies and others' and predicts that by 2009, more than one-third of IT organizations will have one or more environmental criteria in their top six buying criteria for IT-related goods and services. This will include compliance with relevant eco-labelling standards or will specify selected criteria covered by the eco-labels – in particular, EPEAT and ENERGY STAR (see p. 70 ff).

This is not far off becoming reality, and, if it occurs, would certainly put a lot of pressure on vendors of ICT equipment and infrastructure to prove their green credentials. For industry leaders it will certainly not suffice just to have a green marketing message in place. Companies who still believe that will lose competitiveness and market share.

Direct and indirect effects

Since it is obviously difficult to prove empirically the new pressures coming from the buy side, despite plenty of anecdotal evidence, we will focus on the regulatory pressures that have been building up recently and that will continue to increase going forward. These regulatory pressures have an effect either directly by targeting the vendors or indirectly by having an influence on the procurement policies of buy-side ICT organizations.

Regulatory pressure, increasing compliance costs

European Union is most advanced

No doubt, regulation and legislation will constitute a strong driver for change. The European Union is most advanced here, and is certainly setting the benchmark for other countries or regions worldwide. China, for example, has started to copy regulatory schemes like the RoHS (Reduction of Hazardous Substances), and in some parts even proposes going beyond the European blueprint. It also has a direct impact that is global, because production for the European market is global and the market size is significant. Companies who want to have a say on that market feel the increased compliance pressure and costs.

Increasing compliance pressures and costs

That increasing compliance pressures and costs are a material concern for companies is reflected by the increased activity of industry initiatives. One example is the recent teaming-up of the 'Electronic Industries Alliance (EIA) and the 'Electronic Components Certification Board' (ECCB) to tackle the growing environmental compliance costs affecting the electronics industry in the US.

The project not only refers to the new national environmental regulations, like the executive order signed by US president Bush in 2007, that at least 95% of computers purchased by federal agencies must meet a new environmentally friendly standard, known as IEEE1680. It also explicitly refers to European legislative initiatives, like the RoHS (Restriction of the use of certain Hazardous Substances in electrical and electronic equipment) directive, setting a new environmental standard for products sold in EU nations. This initiative attempts to address the fact that scores of different compliance approaches have emerged, confronting all parts of the supply chain with paperwork and testing regimes that vary dramatically from company to company. To reduce that burden, the EIA and the ECCB developed the QC 80000 compliance protocol – a standard process applicable to companies of all sizes. The need for standards is most prevalent in the United States and Europe. In Asia, a uniform standardisation process has already been implemented and use of the QC 80000 is common, giving those companies an advantage over their global competitors.

The ECCB serves as the U.S. body of the International Electrotechnical Commission's certification program for electronic components, processes and related materials (IECQ), an internationally recognized conformity assessment program. Its board is made up of small and medium-sized component makers as well as the companies they supply, including Boeing, Northrop Grumman and Phillips Semiconductors.

World-wide impact of European regulatory initiatives

The European standards set by the WEEE and RoHS directives have a worldwide impact, which is reflected in Chinese trade statistics: the Electronics Imports & Exports Corp. indicates that products falling under the directives account for about 70% of the country's export to the EU market. Significant levies are due on every product exported into the EU which does not comply. ICT and other electronics OEMs selling on the EU market have started to ask their suppliers worldwide to meet the EU directives and will have them checked for compliance. These new costs place a heavy burden on Chinese firms, and companies will therefore be motivated to take appropriate measures.

Overview EU regulation/legislation

Concerns over the growth of hazardous waste had been the driver behind two EU directives

In 1998, the European Union discovered that alarmingly large amounts of hazardous waste from electrical and electronic devices were being dumped into landfill sites. Trends also indicated that the volumes were likely to grow 3-5 times faster than average municipal waste. This highlighted a massive, and growing, source of environmental contamination. To mitigate this dramatic situation, the European Commission issued two directives in 2002, closely related, one to minimise the toxicity of the products, the second to provide responsible disposal of the products at the end of their life.

The concept of Extended Producer Responsibility (EPR)

The common element in all legislative environmental initiatives is the concept of Extended Producer Responsibility (EPR). It describes the eventual requirement of producers of electronic and electrical equipment to assume financial and legal responsibility for their products throughout their entire lifecycle – including the 'takeback' and disposal of products. This legislation has started to dramatically change

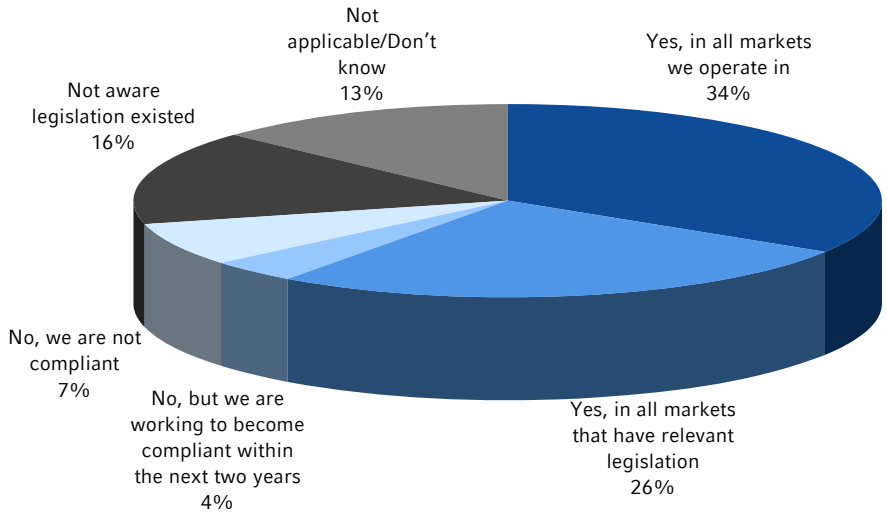
business models in the ICT and electronics industry. Embracing EPR will cost hundreds of millions of dollars every year and these investments will eventually show up in the price of ICT products.

EU directive on Waste Electrical and Electronic Equipment (WEEE)

WEEE sets strict guidelines on the disposal of ICT equipment

The EU has already imposed regulation on how firms dispose of obsolete equipment. In February 2003, it agreed on the Waste Electrical and Electronic Equipment Directive (WEEE), which sets standards for how firms should dispose of obsolete electronic equipment. After many years of deliberating, the directive was implemented by the EU member states in 2007. The WEEE sets strict guidelines on the disposal of computers and other electronic equipment. It explicitly prioritises the re-use of PCs over recycling, which is important given the environmental impact of manufacturing PCs. Besides ICT equipment (e.g. PCs, photocopiers, telephones), the WEEE sets recycling and recovery targets for 9 other categories of products from large household appliances (e.g. fridges and washing machines) to lighting equipment (e.g. fluorescent lamps) and medical equipment systems (e.g. radiotherapy).

Is your organisation compliant with any legislation regarding disposal of electronic goods (eg, European WEEE directive)?
% respondents



Source Economist Intelligence Unit survey, July 2007

The results of the EIU survey conducted in June/July 2007, i.e. during the year of the directive's implementation, show that the industry is not yet well prepared to deal with it. Only 60% of the companies say that they are already compliant in all relevant markets. 16% of respondents were not even aware that it existed.

Intended to change the initial design processes

The shift in responsibility towards the producers is also intended to change the initial design processes, resulting in products that are easier to dismantle and recycle. Manufacturers must modify supply chain systems to report product information for recyclers as part of WEEE. Details down to the material composition level will be required. The European directive WEEE has not been designed to suit every European country harmoniously. These geographical differences add another hurdle for companies as they try to comply with the directive.

EU directive on Reduction of Hazardous Substances (RoHS)

Traceability is key

In order to comply with the EU ROHS legislation, all of these substances must either be removed, or must be reduced to within maximum permitted concentrations, in any products containing electrical or electronic components that have been sold within the European Union since 1 July, 2006. It places a ban on four heavy metals (lead, cadmium, mercury and hexavalent chromium) and the Brominated Flame Retardants (BFR) PBB and PBDE. Manufacturers in the ICT and electronics sector have hundreds or thousands of suppliers, and all of them must be checked for compliance. Traceability is a key part of the ban on the 4 heavy metals and 2 BFRs. Documenting the traceability of parts is required because it is necessary to show that parts are compliant with the European directive. The positive side-effect of this is the increasing transparency of the supply chain.

REACH

Protecting the environment through the better and earlier identification of the intrinsic properties of chemical substances

The REACH legislation (Registration, Evaluation, and Authorisation of Chemicals) requires companies to test the safety of more than 30,000 chemicals already on the market. The new law came into force on 1 June 2007. It not only concerns the electronics sector but all sectors in which chemicals are used. The aim of REACH is to improve the protection of human health and the environment through the better and earlier identification of the intrinsic properties of chemical substances. REACH requires companies that produce and import chemicals to assess the risks arising from their use and to take necessary measures to manage this risk. This reverses the burden of proof as to whether chemicals are hazardous from public authorities to industry for ensuring the safety of chemicals on the market. Companies that manufacture or import a significant amount of chemical substances per year are required to register it in a central database, along with the outcomes of the risk assessment. The benefits of the REACH system will come gradually, as more and more substances are phased into it.

The Basel Convention

Multinational agreement on the control of trans-boundary hazardous waste movements

Another regulatory element that needs to be taken into account is multinational agreements. The 'Basel Convention on the Control of the Trans-boundary Movement of Hazardous Waste and Their Disposal' was adopted in 1989 and entered into force in 1992. It has 170 parties and was created to protect human health and the environment against the adverse effects resulting from the economically motivated dumping of hazardous waste from richer to poorer countries. The Basel Ban Amendment, adopted in 1995, prohibits all exports of hazardous waste from Parties that are member states of the EU, OECD and Liechtenstein to all other Parties to the Convention. However, as of 22 May 2006, the Ban Amendment had not yet entered into force. The United States is the only OECD country that has not ratified the original Basel Convention, nor the Basel Ban Amendment. The export of e-waste as has been witnessed with respect to China, India and Pakistan is in violation of the Basel Convention and the Basel Ban Amendment.

EU directive on Energy Using Products (EuP)

Coherent EU-wide rules for eco-design

The EU Directive on the eco-design of 'Energy-using Products' (EuP), such as electrical and electronic devices or heating equipment, was adopted by the European Parliament in 2005. The Directive provides coherent EU-wide rules for eco-design and ensure that disparities among national regulations do not become obstacles to intra-EU trade. The Directive does not introduce directly binding requirements for specific products, but does define conditions and criteria for setting requirements regarding environmentally-relevant product characteristics such as energy or water consumption, waste generation,

extension of lifetime and allows them to be improved quickly and efficiently. Products that fulfil the requirements will benefit both businesses and consumers by facilitating free movement of goods across the EU, and by enhancing product quality and environmental protection.

The directive enables the Commission to enact implementing measures on specific products

By encouraging manufacturers to design products with their environmental impact in mind throughout their entire life cycle, the Commission is implementing an Integrated Product Policy (IPP) and accelerating the move towards improving the environmental performance of energy-using products. The directive enables the Commission to enact implementing measures on specific products and environmental aspects (such as energy consumption, waste generation, water consumption, extension of lifetime) after impact assessment and broad consultation of interested parties. In the absence of valid self-regulatory initiatives by industry, the Commission may set eco-design requirements for specific energy-using products which have a significant impact on the environment. This is what is happening right now:

Energy consumption standards based on EuP

New standards for energy consumption for electric and electronic devices when they are in 'power-saving' or 'activated' mode

In October 2007, representatives from the industrial world, consumer associations and environmental organisations met in Brussels to give their opinions on a European regulation creating new standards for energy consumption for electric and electronic devices when they are in 'power-saving' or 'activated' mode. While consumption currently varies from 12 to 15 W/h depending on the product, the measure being proposed would require manufacturers to reduce this to 1 or 2 W/h within a year once the law was passed, and then to 0.5 to 1 W/h within 3 years for all new products. This initiative, which should become effective in September 2008, is one of 15 decisions that will be taken by the European Commission between May 2008 and March 2009, in applying the EuP Directive. Each decision will set up energy performance standards for a 'family of products', from public lighting to televisions, refrigerators and tea kettles, as well as computers. The goal is to reduce energy consumption by 20% before 2020.

Voluntary initiatives

Looking at initiatives driven by the ICT industry alone or in partnership with governmental organizations

In this part of the note we take a look at initiatives that are either driven by the ICT industry alone or in partnership with governmental organizations acting as independent, standard setting bodies. We do not take a look at the numerous NGO-driven initiatives that target 'Green ICT' issues, since this would be going beyond the scope of this note. Furthermore, we do not look at the many general sustainability initiatives that involve the corporate world, like the UN's Global Compact for example. We nevertheless acknowledge that many brand companies from the ICT sectors have joined the Global Compact initiative. Examples are Microsoft, Hewlett Packard, Philips, Fujitsu Siemens, Toshiba and Nokia.

Ecolabelling - a voluntary method of environmental performance certification

We begin this section by taking a look at 'ecolabelling' of ICT equipment. Ecolabelling is a voluntary method of environmental performance certification and labelling that is practised around the world. An 'ecolabel' identifies the overall environmental preference of a product or service within a specific product/service category based on life cycle considerations. In contrast to 'green' symbols or claim statements developed by manufacturers and service providers, an ecolabel is awarded by an impartial third party in relation to certain products or services that are independently determined to meet environmental leadership criteria.

The roots of ecolabelling can be found in growing global concern for environmental protection on the part of governments, businesses and the public. As businesses have come to recognise that environmental concerns may be translated into a market advantage for certain products and services, various environmental declarations/ claims/labels have emerged on products and with respect to services in the marketplace (e.g. natural, recyclable, eco-friendly, low energy, recycled content, etc). While these have attracted consumers looking for ways of reducing adverse environmental impacts through their purchasing choices, they have also led to some confusion and scepticism on the part of consumers.

Credibility only via guiding standards and investigation by an independent third party

Without guiding standards and investigation by an independent third party, consumers may not be certain that the companies' assertions guarantee that each labelled product or service is an environmentally-preferable alternative. This concern about credibility and impartiality has led to the formation of both private and public organizations providing third-party labelling. In many instances, such labelling has taken the form of ecolabels awarded to products approved by an ecolabelling program operated at a national or regional (i.e. multi-countries) level.

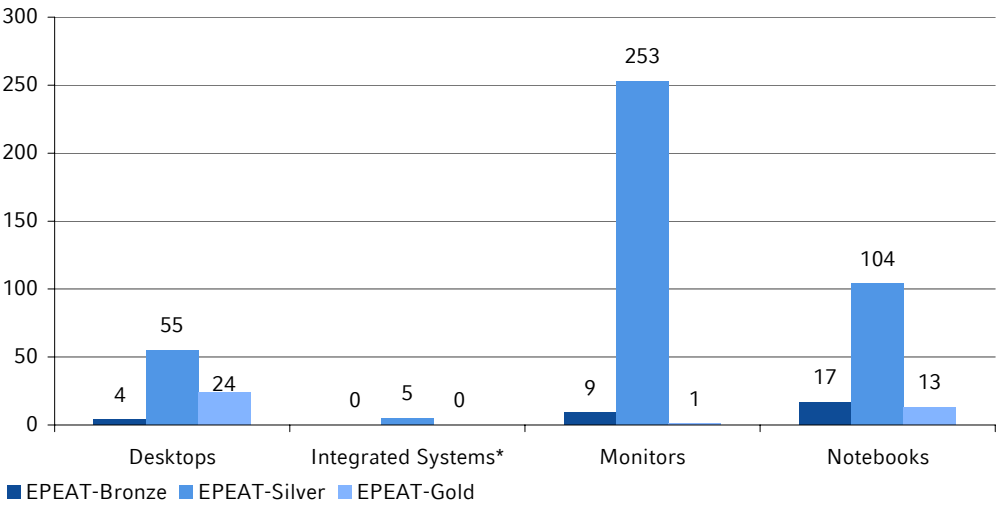
Electronic Product Environmental Assessment Tool (EPEAT)

EPEAT is a tool that evaluates the environmental impact of electronic products. It was created by American industrialists grouped together in the Green Electronic Council (GEC). The American administration made EPEAT mandatory for all purchases made by the Federal State, amounting to US$75bn per year.

Comprehensive set of environmental criteria

EPEAT is a system in which manufacturers declare their products' conformance to a comprehensive set of environmental criteria in 8 environmental performance categories. The operation of EPEAT and the environmental criteria are contained in a public standard IEEE 1680. The system is to help purchasers in the public and private sectors evaluate, compare and select desktop computers, notebooks and monitors based on their environmental attributes. EPEAT also provides a clear and consistent set of performance criteria for the design of products, and provides an opportunity for manufacturers to secure market recognition for efforts to reduce the environmental impact of its products. Institutional purchasers are encouraged to require EPEAT-registered products in their purchase specifications. In addition, EPEAT is increasingly being used by individual consumers. The GEC announced in July 2007, that EPEAT purchases in 2006 saved 13.7 billion kWh of electricity, avoided 1,070 metric tons of toxics, eliminated 41,100 metric tons of hazardous waste, and prevented 1.07 million metric tons of greenhouse gas releases. Up to February 2008, a total of 485 products have been registered according to three tiers of environmental performance – Bronze, Silver and Gold. These products are not evenly distributed across the product groups and the tier groups. 52.2% are monitors with a silver rating, followed by notebooks with a silver rating (21.4%).

EPEAT™ Registered Products
As of 18 Feb 2008



Source EPEAT, Feb 2008

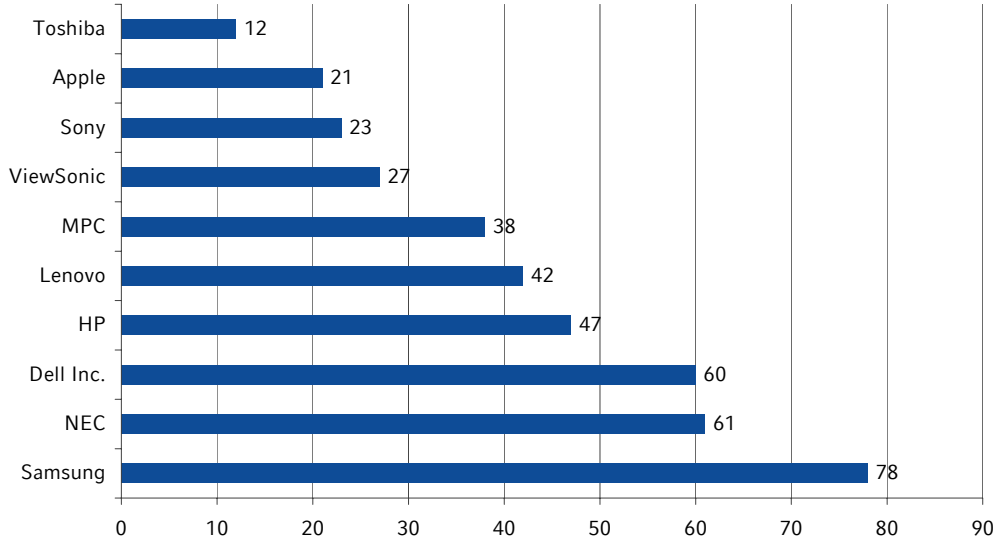
The complete set of performance criteria includes 23 required criteria and 28 optional criteria in 8 categories (for a full list of criteria, see appendix):

- Reduction/elimination of environmentally-sensitive materials
- Materials selection
- Design for end of life
- Product longevity/life cycle extension
- Energy conservation
- End of life management
- Corporate performance
- Packaging

To be EPEAT registered, products must meet all the required criteria. Products may then achieve a higher level EPEAT rating by meeting additional optional criteria, as follows:

- **Bronze:** Product meets all required criteria
- **Silver:** Product meets all required criteria plus at least 50% of the optional criteria that apply to the product type being registered
- **Gold:** Product meets all required criteria plus at least 75% of the optional criteria that apply to the product type being registered

EPEAT™ Registered Products (18 Feb 2008) – Top 10 vendors
All performance tiers



Source WestLB Research, EPEAT

The companies with the highest share in the Gold group (total of 38 registered products) are HP with 10 products (26.3%), followed by Dell and Toshiba with 7 products each (18.4%).

Case Study: NEC Corporation

NEC Display Solutions America, a leading provider of flat-panel desktop displays, has developed a solar-powered package for PC monitors. According to the company, the new package can be used for any of the company's displays and is highly valued in terms of both national and local green purchasing standards: the new product received the highest score among all products in the EPEAT monitor category, missing the EPEAT Gold rating by just 1/4 of a point.

ENERGY STAR program

Promoting investment in new energy-efficiency technologies

The U.S. Government's ENERGY STAR program is intended to promote investment in new energy-efficiency technologies. The new ENERGY STAR standard for desktops, laptops, and workstations, which takes effect in July 2007, requires power supplies to be at least 80% efficient for most of their load range.

ENERGY STAR key product criteria

The new specification establishes efficiency requirements for all modes of operation, which ensures energy savings when a computer is active and running basic applications, as well as when it is on stand-by. Newly qualified computers must also include an internal power supply that is at least 80% efficient. Under the new specification, only the most energy-efficient computer equipment, including desktop and notebook (or laptop) computers, game consoles, integrated computer systems, desktop-derived servers and workstations, can earn the ENERGY STAR label.

Intel and AMD have finally turned the corner

Compliance to these new standards has led to better ICT design by Intel and AMD. It seems that those companies have finally turned the corner and are now trying to switch from a practice that seemed to ignore entirely the high energy consumption levels of certain CPUs and mainboards. We suspect that public awareness of the energy costs of desktop computing (laptops are much more efficient) has induced this change.

ENERGY STAR key product criteria can be summarized in three bullet points (an overview over exact requirements can be found in the appendix):

- Use energy efficient power supply
- Operate efficiently in Standby/Off, Sleep, and Idle modes
- Include and enable power management features of the system and provide user education about these features

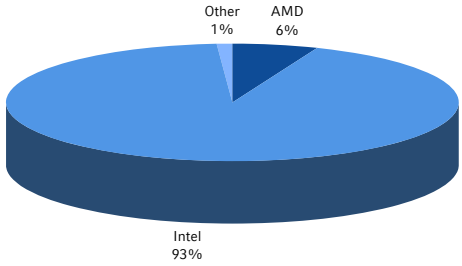
By requiring efficiency savings across operating modes, the new computer specification is expected to save consumers and businesses more than US$1.8bn in energy costs over the next 5 years and prevent greenhouse gas emissions equal to the annual emissions of 2.7 million vehicles. It will also be easier for consumers and businesses to find qualified computers and related equipment. Under the new specification, manufacturers must display the ENERGY STAR label on the product and its packaging, in product literature, and on Web sites to clearly indicate which products meet the new specification.

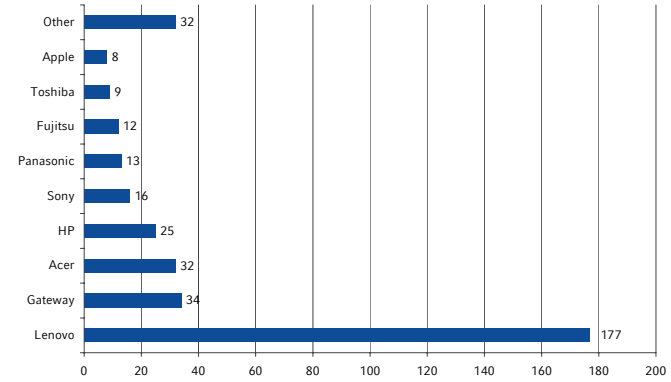
409 desktop products and 358 notebook products qualify

A look at the ENERGY STAR qualified product list as of the end of January 2008 allowed us to show the distribution of products across equipment vendors. In the notebooks segment Lenovo is leading the field by a wide margin. The company has a share of the ENERGY STAR notebook market of round about 50% (to be exact 49.4%). As previously mentioned, the others lag behind significantly, with Gateway being the number two on the list with a market share of just 9.5%. In the desktops segment the distribution is similarly unbalanced. The market leader here is HCL, with a share of 31.1%, followed by Zmax and Seanix (both 8.3%). The two big players on both markets, Dell and HP, both have a significant number of products that qualify, but are far from the ENERGY STAR leaders.

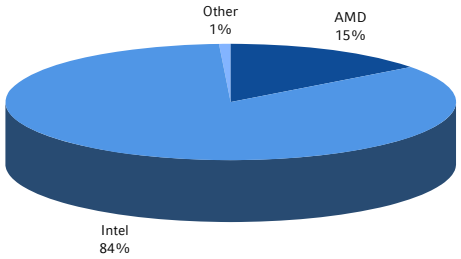
ENERGY STAR label – qualified product list (31 Jan 2008)

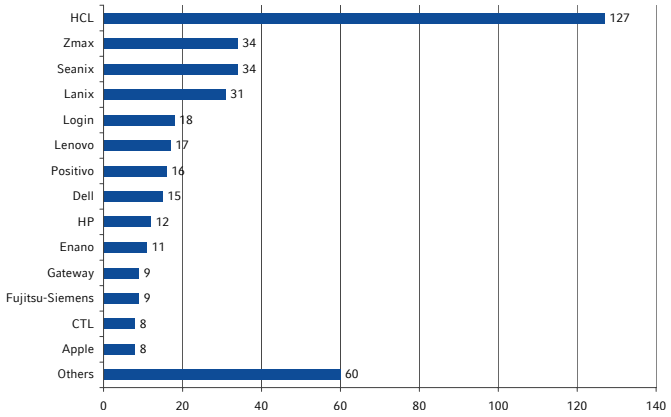
Notebooks





Desktops





Source WestLB Research, EPA

Use of the ENERGY STAR label in the EU

Computers were the first product to qualify for EPA's ENERGY STAR label in 1992. The United States now has more than 180 million computers in use that consume nearly 58 billion kWh per year, or about 2% of the nation's annual electricity consumption. ENERGY STAR was introduced by EPA in 1992 as a voluntary, market-based partnership to reduce greenhouse gas emissions through energy efficiency. The US Department of Energy joined EPA in this effort and today, the ENERGY STAR label can be found on more than 50 different kinds of products. Products that have earned the ENERGY STAR designation prevent greenhouse gas emissions by meeting strict energy-efficiency specifications set by the government. In 2001, the European Commission signed an agreement with Washington spreading the use of ENERGY STAR to computer equipment made and imported into Europe. Set up for five years, this agreement was renewed and widened on 28 December, 2006 for five more years.

Global Ecolabelling Network (GEN)

The German 'Blue Angel' label as an alternative

ENERGY STAR and EPEAT are not the only ecolabels relevant for the ICT sector. An overview of other important initiatives in this space worldwide is provided by GEN. GEN is a non-profit association of third-party, environmental performance labelling organizations founded in 1994 to improve, promote, and develop the 'ecolabelling' of products and services. As of today there are 20 national member organizations (+ 3 regional ones). An example is the German 'Blue Angel' label. It is the first and oldest environment-related label in the world for products and services. It was created in 1977 on the initiative of the Federal Minister of the Interior and approved by the Ministers of the Environment of the national government and the federal states. It was designed as an

instrument of environmental policy enabling the positive environmental features of products and services to be labelled on a voluntary basis. The 'Blue Angel' label for the product group 'computers' (system units, e.g. desktop PCs, portables, monitors, keyboards) aims at the following areas (the basic requirements are included in the appendix of this note:

- Avoidance of pollutants
- Emissions and waste
- Energy consumption
- Recycling

Climate Savers Computing Initiative (CSCI)

Bringing together industry, consumers, and the government

Another private initiative is the Climate Savers Computing Initiative (CSCI), launched in 2007 by Intel and Google. The initiative brings together industry, consumers, government, and conservation organizations to significantly increase the energy efficiency of computers and servers. As participants in this program, computer and component manufacturers commit to producing products that meet specified power-efficiency targets, and enterprise participants commit to purchasing power-efficient computing products. In addition, the initiative aims to educate consumers and IT personnel about power management of computers and show individuals how they can reduce the electrical footprint of their computers without any resulting loss of productivity.

By 2010, the initiative seeks to reduce the annual power consumption by computers by about 50%

By 2010, the initiative seeks to reduce the annual power consumption by computers by about 50%, which is equivalent to 54 million tons of CO_2 per year or the annual output of 11 million cars or 10-20 coal-fired power plants. Based on the current price of kWh in the United States, this would result in a savings of US$5.5bn dollars for the world energy bill. The targeted reduction in emissions is calculated based on IDC projections of desktop and server volumes in 2007-2011, using a baseline of 295 kWh/year energy consumption for a typical desktop in the first half of 2007, and assuming market penetration of 60% of desktop units shipped in 2010 being ENERGY STAR, 25% meeting the 85% PSU (Power Supply Unit) efficiency standard, 10% meeting the 88% standard, and 5% meeting the 90% standard; it also assumes that 80% of desktop PCs shipped in 2010 use power management features. Based on these assumptions, total power consumption for PCs shipped in 2010 will be reduced by over 50%, for a total savings of 62 billion kWh in 2010, worth over US$5.5bn (at an average cost of US$0.0885/kWh).

Details of requested purchase commitments

Minimum efficiency targets

The table below lists the minimum percentage of total procurement (PC only) requested from Initiative participants at each efficiency level in a given year. A table with the minimum efficiency targets and purchase commitment levels for volume servers is included in the appendix of this note.

CSCI requirements: Minimum PC efficiency targets and purchase commitment levels

	July '07 – June '08	July '08 – June '09	July '09 – June '10	July '10 – June '11
ENERGY STAR 4.0	100%	100%	100%	100%
85% PSU		≥20%	≥80%	100%
88% PSU			≥20%	≥80%
90% PSU				≥20%
Advanced Power Management	100%	100%	100%	100%

Source Climate Savers Computing Initiative, 2008

For example, in year 2 all of member purchases should fulfil the ENERGY STAR 4.0 requirements, and at least 20% of them should be at least 85% efficient.

The Electronic Industry Code of Conduct (EICC)

Improving conditions in the electronics supply chain

The Electronic Industry Code of Conduct (EICC) is a code of best practices adopted and implemented by some of the world's major electronics brands and their suppliers. The goal is to improve conditions in the electronics supply chain. EICC sets forth performance, compliance, auditing and reporting guidelines across five areas of corporate responsibility:

- Labour
- Health and safety
- Environment
- Management systems
- Ethics

Complex global production chain in the ICT sector

The code targets not only the Original Equipment Manufacturers (OEMs), but also the Electronic Manufacturing Services (EMS) firms and Original Design Manufacturers (ODMs) including contracted labour that may design, market, manufacture and/or provide goods and services that are used to produce electronic goods (see appendix). It explicitly asks participants to regard the code as a total supply chain initiative and requires them to extend its application to their next tier suppliers at a minimum. The code encourages participants to go beyond legal compliance, drawing upon internationally recognized standards.

Within the environmental part of the code, it is stipulated that 'adverse effects on the community, environment and natural resources are to be minimized' in manufacturing. Standards have been outlined with respect to 6 subjects (the full text can be found in the appendix):

- Environmental permits and reporting
- Pollution prevention and resource reduction
- Hazardous substances
- Wastewater and solid waste
- Air emissions
- Product content restrictions

The Electronic Industry Code of Conduct was initially developed by a number of companies engaged in the manufacture of electronics products between June and October 2004. Companies adopting the code and/or joining the Implementation Group include: Celestica, Cisco, Dell, Flextronics, Foxconn, HP, IBM, Intel, Jabil, Lucent, Microsoft, Sanmina SCI, Seagate, Solectron, and Sony.

The EICC has been criticized a lot, and rightly so, in our opinion

The EICC has been criticised a lot, and rightly so, in our opinion. The criticism has focused on the formulation of the standards which do not refer to internationally-accepted standards and which are not always clear, the lack of enforcement mechanism and verification requirements, as well as low level of commitment in making sure that the code is actually implemented by the suppliers. There is no common reporting framework. There is further lack of involvement of stakeholders, both locally and internationally, in every aspect of code drafting and implementation.

The Global e-Sustainability Initiative (GeSI)

Teaming up with UNEP

GeSI was born in 2001 to further sustainable development in the ICT sector. GeSI fosters global and open cooperation, informs the public of its members' voluntary actions to improve their sustainability performance, and promotes technologies that foster sustainable development. In alliance with GeSI's Secretariat, the United Nations Environment Programme (UNEP) and the International Telecommunication Union (ITU), GeSI supports companies and institutions across the ICT industry, including manufacturers, network operators, service providers, trade associations and associate organisations connected to the industry.

Current members of GeSI (corporates only)

- Alcatel-Lucent
- Bell Canada
- British Telecommunications
- Cisco Systems
- Deutsche Telekom
- Ericsson
- France Telecom
- Fujitsu Siemens
- Hewlett-Packard
- Intel
- KPN
- Motorola
- Microsoft
- Nokia
- Nokia Siemens Networks
- Nortel
- Sun Microsystems
- Telefónica O2 Europe
- Verizon
- Vodafone plc

Source GeSI

Specific areas of concern

GeSI's activities address a range of issues that intersect the ICT industry and sustainable development sectors. Work groups were created as a result of membership evaluation of worldwide sustainability issues and focus on the following specific areas of concern (a full description of these can be found in the appendix of this note):

- Supply chain
- Climate change
- Accountability
- e-waste
- Materiality

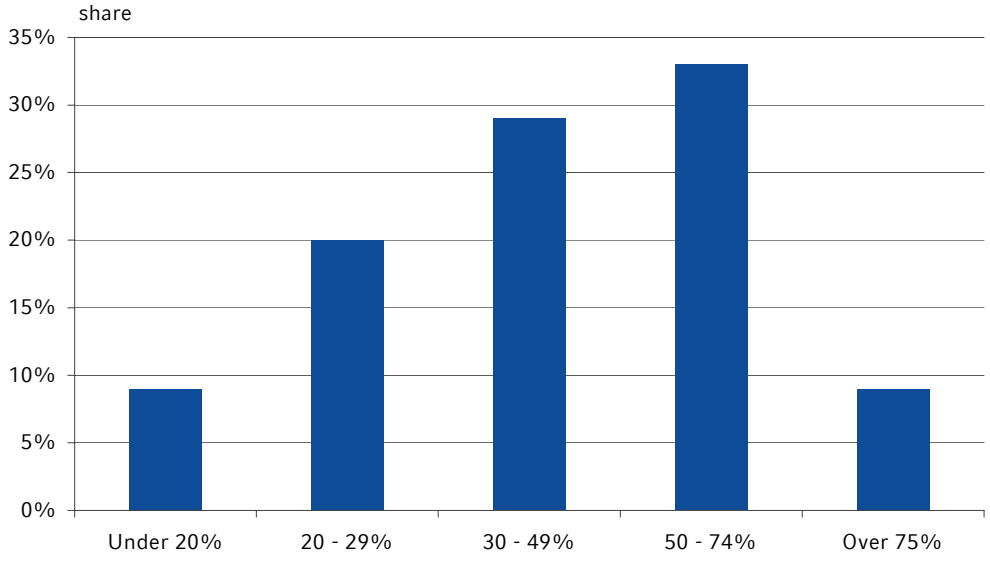
The GeSI has been criticized for its lack of involvement of international and local NGOs and trade unions, its general lack of transparency and the lack of clarity about what the working groups are setting out to achieve.

The Green Grid

Advancing energy efficiency in data centres

The Green Grid is a global consortium of information technology companies and professionals dedicated to advancing energy efficiency in data centres. To further its mission, The Green Grid is focused on the following: defining meaningful, user-centric models and metrics; developing standards, measurement methods, processes and new technologies to improve data centre performance against the defined metrics; and promoting the adoption of energy efficient standards, processes, measurements and technologies. The initiative points to the fact that implementing current best practices can lead to a significant 50% reduction of energy consumption by data centres.

Energy efficiency of data centres: under-utilisation of (average) server capacity



Source Global Action Plan, October 2007

Comprised of an interactive body of members who share and improve current best practices around data centre efficiency, The Green Grid's scope includes collaboration with end users and government organizations worldwide to ensure that each organizational goal is aligned with both developers and users of data centre technology.

More than 150 members

As of 20 Feb 2008 the Green Grid board of directors is comprised of the following member companies: AMD, APC, Dell, HP, IBM, Intel, Microsoft, Rackable Systems, SprayCool, Sun Microsystems and VMware. It also has 35 'contributor members' and 108 'general members'.

Other 'Green ICT' initiatives supported by industry

European Code of Conduct for Data Centres

The EU Code of Conducts for Data Centres is among the set of European initiatives to improve the energy efficiency of electrical equipment and systems while either off or in the stand-by states.

The Standard Performance Evaluation Corporation (SPEC)

The SPEC is a non-profit corporation formed to establish, maintain and endorse a standardized set of relevant benchmarks that can be applied to the newest generation of high-performance computers.

The Environmental Issues Council (EIC)

Engaged in compliance activities, public policy formulation, issue advocacy and standards development

The EIC was founded in 1990 by member companies of the 'Electronic Industries Alliance' (EIA). The EIA is the leading trade organization in the U.S. for the high-tech industry. Its 2,500 member companies provide products and services ranging from microscopic electronic components to state-of-the-art defence, space and industry high-tech systems, as well as the full range of consumer electronic and telecommunications products. The EIC is the recognized and respected voice of the electronic and high-tech industries on key environmental initiatives at the international, federal and state levels. It is actively engaged in compliance activities, public policy formulation, issue advocacy and standards development on the following key issues:

- Environmental product design
- Green procurement
- Electronics recycling
- Energy efficiency

Ecma-international

Environmentally conscious design standard for the ICT and consumer electronics industries

Ecma-international is an industry association founded in 1961 and dedicated to the standardization of both consumer electronics and information and communication technologies. In 2003 Ecma-international issued the world's first environmentally-conscious design standard for the ICT and consumer electronics industries taking the entire life cycle of ICT product into consideration, from conception to end-of-life treatment. This standard is aimed at the designer and provides pragmatic advice on how to reduce the environmental footprint of a product at the design stage.

Despite this effort, Ecma-international recognizes that the environmental design standard is incomplete when it comes to energy efficiency. For that reason Ecma-international was set up with a technical committee working group to determine how to measure energy efficiency so that appropriate standards and targets might be established on solid technical grounds. The initial focus of the Ecma-international working group is a system level for desktop and notebook computers.

Closing the circle……

Finally, we come to a special, very prominent initiative that is neither driven by the ICT industry itself nor particularly dedicated to it – the Carbon Disclosure Project (CDP). In looking at the CDP we somehow close the circle by getting back to our starting point in this note – the climate change debate. As we pointed out, it has now arrived at the ICT sector, a sector that has traditionally been considered to be a 'clean' one, but has now come under fire because of its significant contribution to global carbon emissions. It is estimated that the industry's share is approximately 2%, a figure equivalent to aviation. This number, however, includes the in-use phase of PCs, servers, cooling, fixed and mobile telephony, local area network (LAN), office telecommunications and printers. Behind it is the idea that it is necessary to take the full life cycle of ICT products into consideration when determining the carbon footprint of the sector. The CDP is much more limited in the sense that it targets those CO_2 emissions that are directly caused by the companies themselves. One could certainly argue that this is the more important part of the story, since the life cycle energy use of a computer, for example, is dominated by production (81%) as opposed to operation (19%). But is the CDP actually able to cover 80% of the CO_2 footprint of a computer product? This would only be the case if the very complex supply chain of ICT products is properly covered by the disclosed information. As of today, we are certainly still far away from this.

The Carbon Disclosure Project (CDP)

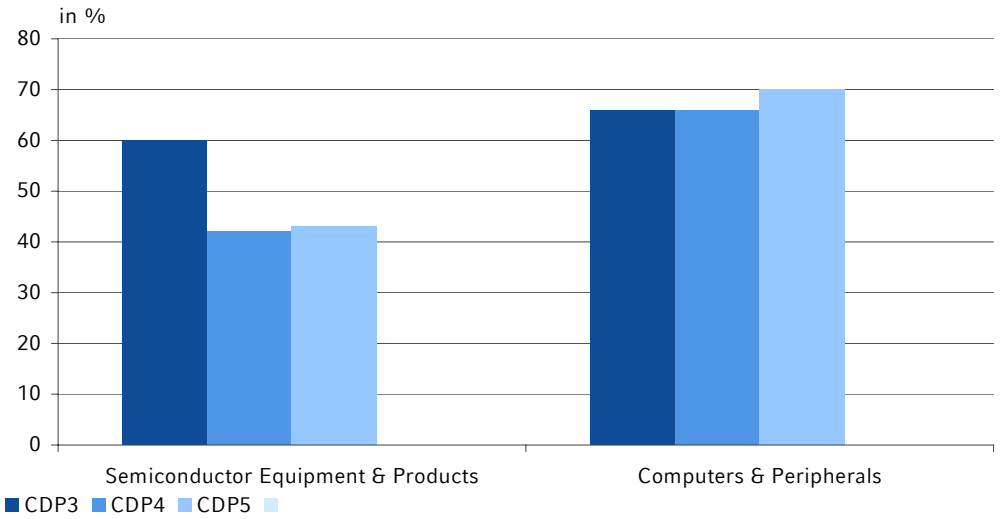
Backed by US$57trn of assets under management

The CDP is an independent not-for-profit organization aiming to create a lasting relationship between shareholders and corporations regarding the implications for shareholder value and commercial operations presented by climate change. Its goal is to facilitate a dialogue, supported by quality information, from which a rational response to climate change will emerge. The CDP provides a coordinating secretariat for institutional investors with a combined US$57trn of assets under management. On their behalf it seeks information on the business risks and opportunities presented by climate change and greenhouse gas emissions data from the world's largest companies: 3,000 in 2008. Over 8 years CDP has become the gold standard for carbon disclosure methodology and process. The CDP website is the largest repository of corporate greenhouse gas emissions data in the world. The CDP leverages its data and process by making its information requests and responses from corporations publicly available, helping catalyse the activities of policymakers, consultants, accountants and marketers.

Disclosure gaps still significant

The most significant challenge facing CDP remains a lack of disclosure. Although 79% of responding companies disclosed their emissions data, CDP5 yielded data for only 60% of the FT500 (299 out of 500). This represents a significant increase from 48% in CDP4. However, it also demonstrates the considerable gap that remains in overall disclosure. Carbon-intensive sectors such as Construction Materials, Chemicals and Electric Utilities have better disclosure rates (above 80%) than low-carbon sectors. This shows that the CDP has excelled in gathering data from companies in carbon-intensive sectors that have the most significant risk exposure. The ICT-related industry groups are all classified as 'low-carbon sector'. For 'Semiconductor Equipment & Products' the CDP5 disclosure rate is just above 40%, whereas for 'Computers & Peripherals' it is much higher at around 70%.

Emissions Disclosure Within Individual FT500 Sectors CDP3 – CDP5

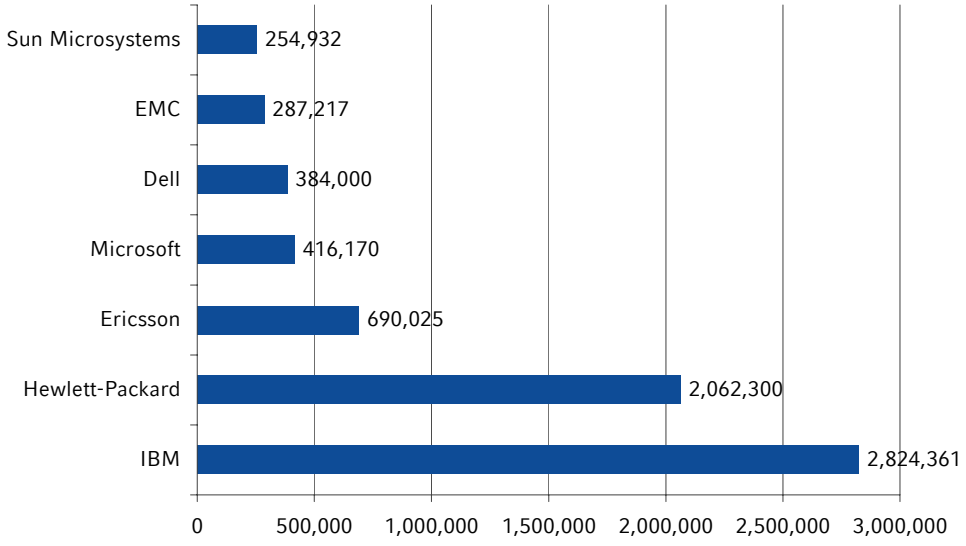


Source CDP, 2007

We have our doubts about the quality and the comparability of reported CO_2 data

The following chart shows the total of the reported direct and indirect emission by companies from the ICT sector in CDP5 according to the GHG protocol standard. The spread in reported emissions is huge. How well this reflects the true carbon of the companies, remains an open question. We have our doubts about the quality and the comparability of reported CO_2 data (see our note 'GRI reporting – Aiming to uncover true performance', September 2007).

Carbon Disclosure Project: Total Scope 1,2, and 3 emissions reported in CDP5*



* In tonnes CO_2 equivalents, Scope 1, 2, and 3 as defined by the GHG protocol

Source CDP, 2007

The 'Climate Disclosure Leadership Index' (CDLI)

Based on the responses of the companies the CDP computes the 'Climate Disclosure Leadership Index' (CDLI). The index comprises those FT500 companies in each sector that have developed the most comprehensive climate change disclosure practices. The assessment is based on an analysis and scoring of responses to the CDP questionnaire. For the 'low-carbon sectors', including all ICT-related industry groups, the following six questions are evaluated:

The company …

- Considers climate change to present commercial risks
- Recognizes commercial opportunities for both existing and new products and services associated with climate change
- Provides information on the strategies undertaken to manage risks and opportunities
- Has implemented emissions reduction program with formalized targets and timeline
- Emissions data disclosed
- Answered section 'B' of the questionnaire (additional questions, for example, with respect to emissions trading schemes)

Questions were weighted to create a 100 point scale. Companies with CDLI scores equal to or greater than 85 were included in this year's CDLI.

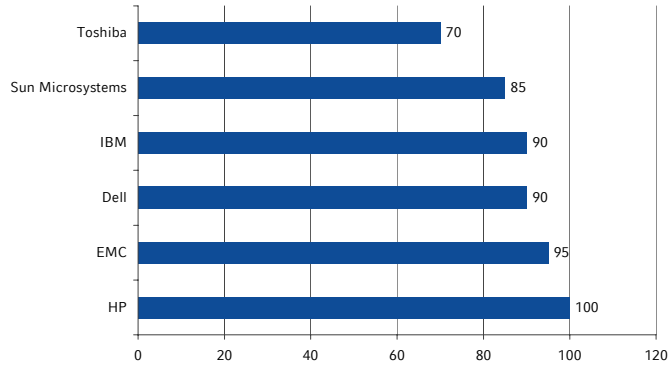
Very unbalanced picture across the four industry groups - 'Computers & Peripherals' clearly in the lead

Out of a total of 39 companies within the 4 ICT-related industry groups the CDP looked at, 7 have qualified for the inclusion in the CDLI, 5 out of 7 (71%) from 'Computers & Peripherals' (Sun Microsystems, IBM, Dell, EMC, HP), 1 out of 10 (10%) from 'Communications Equipment' (Ericsson), and 1 out of 15 (7%) from 'Software & IT Services' (Microsoft). Of the seven companies in 'Semiconductor Equipment & Products' none has qualified for the index. The average scores range from 25.3 ('Software & IT Services'), 42.1 ('Semiconductor Equipment & Products'), 47.5 ('Communications Equipment') to 75.7 ('Computers & Peripherals'). The differences are huge. This is down to perceived relative risk exposure. Nevertheless, we believe that it is fair to say that software vendors need to do much more to address the climate disclosure issue in an appropriate manner.

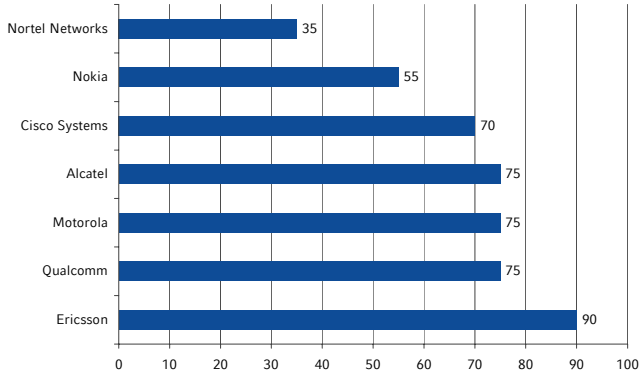
Out of the total of 39 companies, 9 either did not respond or declined to participate. These are Apple, Foxconn, RIM, Infineon, Accenture, Electronic Arts, The Western Union Company, Softbank, and Tata Consultancy Services.

Climate Disclosure Leadership Index (CDLI) – Scores (CDP5, 2007)

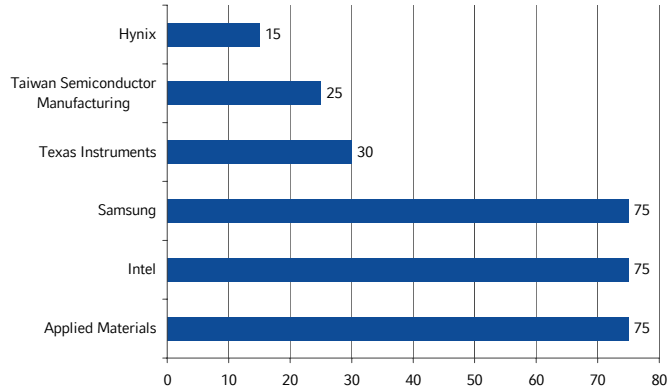
Computers & Peripherals[1]



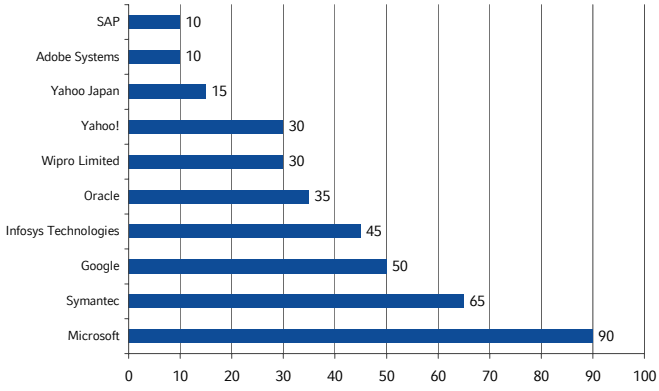
Communications Equipment[2]



Semiconductor Equipment & Products[3]



Software & IT Services[4]



[1]No response: Apple; [2]No response: Foxconn, RIM; Corning: CDLI score of zero; [3]Declined to participate: Infineon; [4]Declined to participate: Accenture, Electronic Arts, The Western Union Company; No response: Softbank, Tata Consultancy Services

Source WestLB Research, CDP

'Green ICT' – Corporate disclosure of environmental information

An important source of information for investors is the reports provided by the companies themselves. Following up on our note 'GRI reporting – Aiming to uncover true performance' (September 2007) we've thus analysed the extra-financial reports of the ICT companies we're looking at in this note. We found that out of the 61 ICT companies in our sample 34 have reported on extra-financial issues over the last two years with thirteen of them publishing their reports in accordance to the GRI guidelines. But do these reports deliver – as one would expect – usable and comparable data? To answer this question, we took a closer look at the self-reported performance indicators for the nine 'G3' reports in our sample. Our final step then was to actually try to benchmark companies based on some of the performance indicators we consider to be material within the 'Green ICT' debate – a mission that figured out to be more or less impossible.

About the current state of extra-financial reporting of ICT companies: A descriptive analysis

Out of the 61 companies in our universe, a total of 34 have reported on extra-financial issues

As a first step we took a look at the reporting behaviour of the 57 ICT companies that were included in our universe as of May 2008 (see p. 11) with regard to environmental ('Green ICT') issues. We based our analysis on the most recent extra-financial reports registered with CorporateRegister.com and on the information about the reports that is available there and on companies' websites. All registered reports we found were released between June 2006 and April 2008 (the deadline for our analysis). Only Micron Technology released its most recent report much earlier – namely in 2001 – so we did not take it into consideration.

Our analysis quarried that out of the 57 ICT companies in our universe, a total of 34 (59.6%) have reported on extra-financial issues, i.e. on environmental, social and governance (ESG) issues within the last two years. 23 ICT companies (40.4%) did not release such a report.

Extra-financial reporting by sub-sectors

GICS sector	Number of companies	reporting			GRI adherence	
		no	yes	%	number	%
Technology Hardware & Equipment	**32**	**10**	**22**	**68.8**	**9**	**40.9**
Communications Equipment	11	4	7	63.6	4	57.1
Computer Hardware	9	2	7	77.8	4	57.1
Computer Storage & Peripherals	6	3	3	50.0	0	0
Office Electronics	6	1	5	83.3	1	20.0
Semiconductors & Semicond. Equip.	**25**	**13**	**12**	**48.0**	**4**	**33.3**
Semiconductor Equipment	7	2	5	71.4	1	20.0
Semiconductors	18	11	7	38.9	3	42.9
Total	**57**	**23**	**34**	**59.6**	**13**	**38.2**

Source WestLB Research, CorporateRegister.com

Most reports are classified as 'Corporate Responsibility' (CR) or 'Sustainability' reports

Most of the reports – 21 in total (61.8%) – fall into the category 'Corporate Responsibility' (EHS/Community/Social) with one of these reports being a review. Eight are classified as 'Sustainability' reports (Environment/Social/Economics). The other five reports comprise two 'Environment, Health & Safety' (EHS) reports with one of them a short review, one 'Environment & Social Review', one 'Community Review', and one 'Annual (with Corporate Responsibility Section'.

Distribution by type of the report

Released by ICT companies between June 2006 and April 2008 (only most recent report)

Report type	number of reports	average # of pages
Annual (with Corporate Responsibility Section)	1	6
Community Review	1	7
'Corporate Responsibility' (EHS/Community/Social)	20	52.8
'Corporate Responsibility' Review	1	20
Environment & Social Review	1	7
Environment, Health & Safety	1	19
Environment, Health & Safety Review	1	8
'Sustainable' (Environment/Social/Economic)	8	52.5
Total	**34**	**45.4**

Source WestLB Research, CorporateRegister.com

The high number of 'Corporate Responsibility' and 'Sustainability' reports correspond to our findings in our overall report 'GRI reporting – Aiming to uncover true performance' (September 2007) where these two types of reports also account for the majority of extra-financial reports. For us a sign that within the ICT sector, too, a significant majority of reports follow a rather holistic approach of reporting on extra-financial issues.

Coverage of environmental issues

All 34 reports covered environmental issues, though to a very different degree of course. The three review type reports tend to be brief to very brief on the companies' environmental performance. The one annual report with a CR section we looked at touches on environmental issues only with respect to its product portfolio but is silent on the companies own 'green achievements'. For the descriptive analysis that follows we have taken all 34 reports into consideration. Afterwards we focus on 'G3' reports only, which guarantees a more or less sufficient coverage of environmental issues.

Extra-financial reporting – a matter of size?

Size-effect is present in the overall market

For the overall universe we analyzed in our aforementioned 'GRI reporting' note we found that come size seems to be correlated with the likelihood of reporting: The bigger the company the higher is the likelihood that it publishes an extra-financial report. And it appeared logical, since bigger companies have more resources to put into reporting and – because of the size of the company – are more exposed to controversial debates in the public and are more likely to become the target of pressure groups and activities.

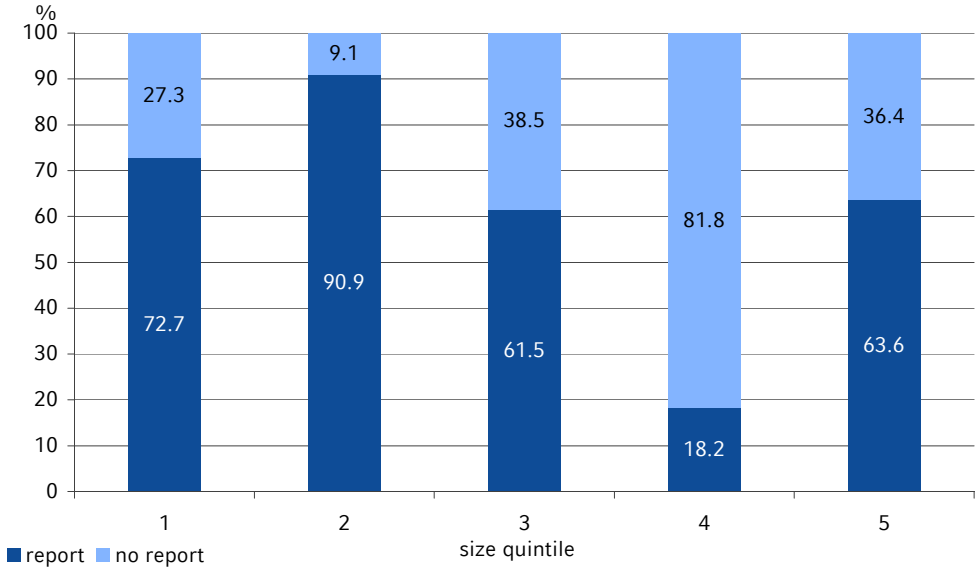
In order to detect possible size-effects within the sector we look at, we sorted the 57 ICT companies into equally dimensioned size-quintiles according to their free float market capitalisation as of 15 May 2008. Size-quintile '1' contains the 11 'largest' ICT companies according to our market cap measure and, accordingly, size-quintile '5' contains the 11 'smallest' ones. The 'middle' quintile comprises 13 companies.

No pervasive size-effect within the ICT sector

The results show that within the ICT sector the above mentioned relationship between company size and likelihood to report about extra-financial issues is confirmed only in tendency, but is less pervasive than in the overall market. Within the ICT sector, the

highest rate of reporting is observed for the second size-quintile with 90.9% (ten out of 11 companies) reporting on extra-financial issues. The first quintile follows with 72.7% (eight out of 11 companies) reporting. While the fourth quintile shows a rather low rate of reporting of 18.2% (two out of 11 companies), thus confirming the size-effect, the fifth quintile contradicts this conclusion with a report rate of 63.6% (seven out of 11 companies). The third quintile holds the fourth place where eight out of 13 companies report (61.5%).

Size effect within the ICT sector – propensity to report on extra-financial issues
% of extra-financial reports released between 06/06 and 04/08 according to size-quintile*



* Size-quintile according to market cap as of 15 May 2008

Source WestLB Research, CorporateRegister.com

Extra-financial reporting – a matter of regional provenance?

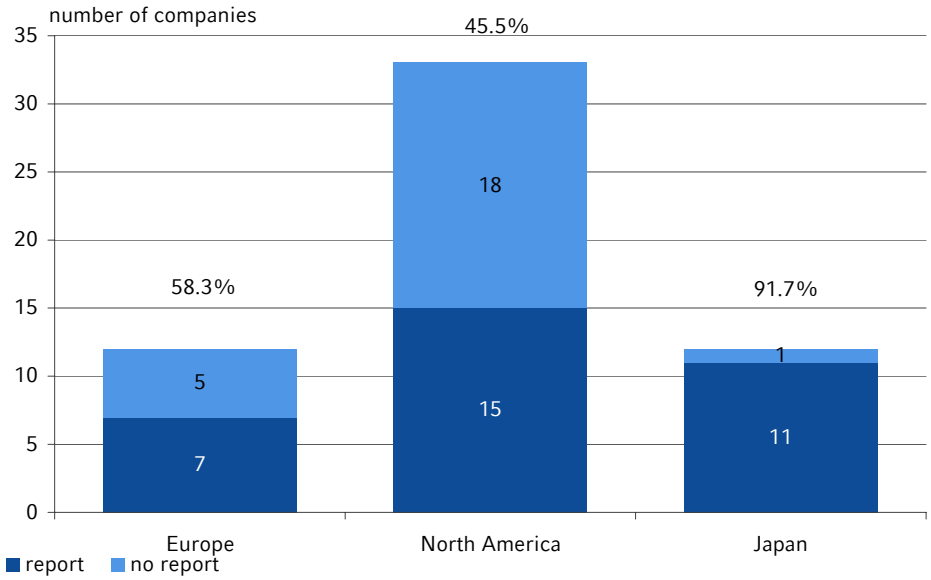
Reporting propensity in the US is much lower than in Europe and Japan

Another aspect that could determine reporting propensity is the regional provenance of the company. In our aforementioned 'GRI reporting' study we found that reporting rates are much higher in Europe and Japan than in the US. For the 57 ICT companies in our sample this result can be confirmed: While nearly 92% (eleven out of twelve) Japanese ICT companies and almost 60% (seven out of twelve) European companies delivered an extra-financial report, for North America the rate was just slightly above 45% (15 out of 33 companies).

A matter of culture?

A reason for these differences might be found in the different cultural backgrounds that work as driver and incentives for reporting. In some places, for example, strong labour forces and civil societies play an important role in demanding sustainability information and reporting from organizations, which consequently influences reporting propensity and the nature of what is reported. Another reason might be the question on who is the addressee of the report. A report that focuses mainly on investors will probably prioritise other issues and ways of reporting than one that focuses more on other stakeholder groups, like, for example, the employees of a company.

Reporting propensity according to regional provenance of companies
Number of companies and reporting rate



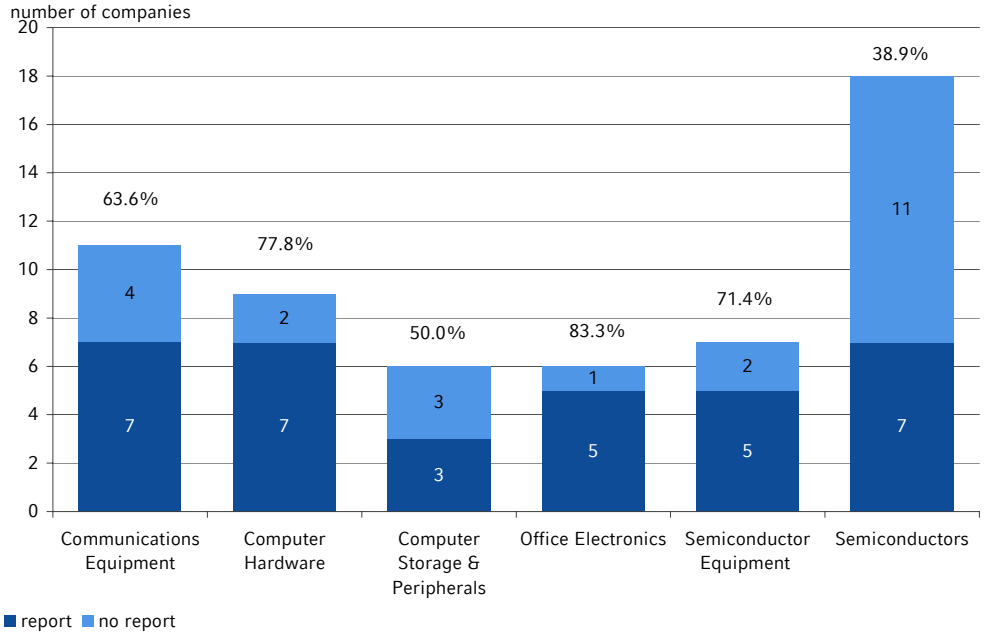
Source WestLB Research, CorporateRegister.com

Extra-financial reporting – breakdown at the sub-sector level

'Office Electronics' displays highest reporting rate

Another factor that seems to influence the propensity to report on extra-financial issues is the sub-sector the company belongs to: Most of the extra-financial reports we found were released in the sub-sector (GICS sector level 4) 'Office Electronics' with a reporting rate of 83.3% (five out of six companies), followed by 'Computer Hardware' with 77.8% (seven of the nine companies). In both cases, the comparatively high importance of brand value and its sensitivity vis-à-vis reputational issues can be expected to be a major driver behind this finding. While the result for 'Computer Hardware' could also be explained by a size-effect – nearly all of the companies are located in size-quintiles 1 and 2 – the high report rate for 'Office Electronics' might be influenced by the fact that it almost exclusively contains Japanese companies.

Reporting propensity – sub-sectoral breakdown
Number of companies and reporting rate



Source WestLB Research, CorporateRegister.com

We found a surprisingly high reporting rate for 'Semiconductor Equipment'

Surprisingly, 'Semiconductor Equipment' shows a rather high reporting rate of 71% (five out of seven companies) although reputational factors should be of lower importance for this sub-sector – particularly since 'Semiconductors' display a rather low reporting rate of only 39% (seven out of 18 companies). Here, a more meaningful explanation for the propensity to report is regional provenance: mostly it is the US companies within these two industry groups that do not report on extra-financial issues.

GRI adherence within the ICT sector

13 out of 34 ESG reports are in adherence with the GRI reporting guidelines

Out of the 34 ICT companies in our universe that released extra-financial reports, 13 structured there most recent report in adherence with the guidelines that were established by the GRI (Global Reporting Initiative). These guidelines began to take shape in the late 1990s and were released for the first time in 2000. A second version ('G2') was released at the World Summit for Sustainable Development in 2002. In October 2006 the GRI has released its third generation of guidelines ('G3'). These new principles have been used by five ICT companies while four companies declared to report according to the Draft version of the G3 guidelines. Another four companies referred to the older G2 guidelines by using the content index ('2002 CI').

GRI Content Index shows where to find the GRI indicators in the report

A report maker includes a GRI Content Index (CI), which is a requirement of the G3 standard, to show readers in a quick and easy way where they can find data or response to each disclosure requirement made in the guidelines. For a report to be considered aligned with the third version of the GRI guidelines, the report maker must declare the level to which it has applied the reporting framework – level: A, B or C (for details see our aforementioned note on 'GRI reporting').

ICT companies reporting in accordance with GRI guidelines

Company	GICS sector (level 4)	Country	Size q.*	G3 adherence	Report type	Publ. date	Pages
G3							
IBM	Computer Hardware	USA	1	G3 - A Self Declared (Web Index)	CR	Dec-07	46
Ericsson	Communications Equipment	Sweden	2	G3 - B+ Self Declared	Sustainable	Apr-07	41
Hewlett Packard Co	Computer Hardware	USA	1	G3 - B Self Declared (Web Index)	Sustainable	Apr-08	~*
ASML Holding	Semiconductor Equipment	Netherlands	2	G3 - B Self Declared	Sustainable	Mar-08	29
Dell Inc	Computer Hardware	USA	2	G3 - C Self Declared	Sustainable	Jul-07	83
G3 - Draft							
Cisco Systems Inc	Communications Equipment	USA	1	G3 Draft	CR	Nov-07	120
Nokia	Communications Equipment	Finland	1	G3 Draft	Sustainable	Apr-07	57
Toshiba Corp.	Computer Hardware	Japan	2	G3 Draft (Web Index)	CR	Aug-07	54
STMicroelectronics	Semiconductors	France	3	G3 Draft	CR	Jul-07	68
2002 CI							
Motorola Inc	Communications Equipment	USA	2	2002 CI	CR	May-07	49
Brother Industries Ltd	Office Electronics	Japan	5	2002 CI (Web Index)	CR	Sep-07	58
Advanced Micro Devices	Semiconductors	USA	5	2002 CI	CR	Jun-06	67
Intel Corp.	Semiconductors	USA	1	2002 CI (Web Index)	CR	May-07	75

* Size-quintile based on market cap as of 15 May 2008

Source WestLB Research, CorporateRegister.com

Particularly big companies released GRI reports

When looking at the companies that released reports according to the GRI guidelines, it's not very astonishing, that most of them are quiet big – five out of the 13 companies are among the 11 biggest companies in our universe, another five are assigned to size-quintile 2. However, at least two companies that released reports with a 'Content Index' according to the 2002 guidelines belong to the smallest 11 companies in our universe.

US companies lead the field when asked for GRI reports

While Japanese companies show the highest reporting rate in general, the rate of GRI reports compared to the total number of extra-financial reports is higher in the US: 7 of the 13 companies that reported according to GRI guidelines are from the US – that is 46.7% of all ESG reports released by US companies – while only two Japanese companies (18.2% of all ESG reports released by Japanese companies) followed the GRI guidelines. The highest rate of GRI-usage, however, can be observed for Europe: four out of seven European companies (57.1%) that report on ESG issues use the GRI framework – and they all use the G3 version.

IBM displays the highest reporting level

The company with the highest reporting level – GRI level A (self declared) – is IBM. IBM publishes a web index with information links to all GRI indicators. The information in the report itself appears rather limited compared to the extensive information accessible on IBM's website.

A look at the reported environmental performance indicators

'Average company' reports 64.7% of 'core indicators'

In the following we focus on the nine companies that released extra-financial reports according to the G3 guidelines (or their draft version). Specifically we took a closer look at the 30 environmental performance indicators required by G3, 17 'core indicators' and 13 'additional' indicators. According to the 'Content Indices' of the nine reports we looked at, the report rate for the 'core indicators' is 64.7%, i.e. an 'average company' reported on 11 out of the required 17 indicators. This is significantly higher than for the overall market (46.7%, see our aforementioned 'GRI reporting' note), which might be due to a stronger large cap bias in our ICT company sample ('additional indicators': 38.5% vs. 24.3% respectively). These results, however, should be treated with caution, since they tend to give an upwardly biased picture of the companies' reporting propensity. We found that companies tend to promise more in their CIs than they actually deliver in their reports or on their websites. A checkmark in the CI usually does not tell the user in what quality an indicator is actually reported (scope of the reported data, consistency of indicator definition with G3 and so forth). For example, sometimes one

finds a checkmark for a required quantitative performance indicator, but in the report (or on the website) the company only gives narrative information about the issue in question (see our 'GRI reporting' note for details). The following table gives an overview of the indicators and the respective number of companies that reported on them according to the CIs. In the last column we added information about where the respective indicator and the data points delivered by the companies can be found within this research note.

Environmental Performance Indicators and number of reporting companies within our G3 sample

Environmental Performance Indicators (G3)		Core/ Add.	reporting yes*	partial	no	see page**
Aspect: Materials						
EN1	Materials used by weight or volume.	C	4	1	4	22
EN2	Percentage of materials used that are recycled input materials.	C	1	1	7	-
Aspect: Energy						
EN3	Direct energy consumption by primary energy source.	C	9	0	0	(28,93),129
EN4	Indirect energy consumption by primary source.	C	6	0	3	129
(EN5)	Energy saved due to conservation and efficiency improvements.	A	6	1	2	94
(EN6)	Initiatives to provide energy-efficient or renewable energy-based products and services, and reductions in energy requirements as a result of these initiatives.	A	6	0	3	-
(EN7)	Initiatives to reduce indirect energy consumption and reductions achieved.	A	6	0	3	-
Aspect: Water						
EN8	Total water withdrawal by source.	C	7	1	1	24, (95)
(EN9)	Water sources significantly affected by withdrawal of water.	A	1	0	8	-
(EN10)	Percentage and total volume of water recycled and reused.	A	2	0	7	-
Aspect: Biodiversity						
EN11	Location and size of land owned, leased, managed in, or adjacent to, protected areas and areas of high biodiversity value	C	1	0	8	-
EN12	Description of significant impacts of activities, products, and services on biodiversity in protected areas and areas of high biodiversity value	C	2	0	7	-
(EN13)	Habitats protected or restored.	A	2	0	7	-
(EN14)	Strategies, current actions, and future plans for managing impacts on biodiversity.	A	3	0	6	-
(EN15)	Number of IUCN Red List species and national conservation list species with habitats in areas affected by operations, by level of extinction risk.	A	1	0	8	-
Aspect: Emissions, Effluents, and Waste						
EN16	Total direct and indirect greenhouse gas emissions by weight.	C	9	0	0	(28),131
EN17	Other relevant indirect greenhouse gas emissions by weight.	C	4	1	4	-
(EN18)	Initiatives to reduce greenhouse gas emissions and reductions achieved.	A	6	0	3	-
EN19	Emissions of ozone-depleting substances by weight.	A	7	0	2	-
EN20	NOx, SOx, and other significant air emissions by type and weight.	C	6	0	3	-
EN21	Total water discharge by quality and destination.	C	6	0	3	40
EN22	Total weight of waste by type and disposal method.	C	8	0	1	(51,95),132
EN23	Total number and volume of significant spills.	C	7	0	2	96
(EN24)	Weight of transported, imported, exported, or treated waste deemed hazardous under the terms of the Basel Convention Annex I, II, III, and VIII, and percentage of transported waste shipped internationally.	A	2	0	7	-
(EN25)	Identity, size, protected status, and biodiversity value of water bodies and related habitats significantly affected by the reporting organization's discharges of water and runoff.	A	1	0	8	-
Aspect: Products and Services						
EN26	Initiatives to mitigate environmental impacts of products and services, and extent of impact mitigation.	C	9	0	0	-
EN27	Percentage of products sold and their packaging materials that are reclaimed by category.	C	5	0	4	47, 96
Aspect: Compliance						
EN28	Monetary value of significant fines and total number of non-monetary sanctions for non-compliance with environmental laws and regulations.	C	8	0	1	97
Aspect: Transport						
(EN29)	Significant environmental impacts of transporting products and other goods and materials used for the organization's operations, and transporting members of the workforce.	A	6	0	3	-
Aspect: Overall						
(EN30)	Total environmental protection expenditures and investments by type.	A	3	0	6	-

* C = Core indicators, A = Additional indicators; reporting 'yes': full or not specified;

** in this note (page numbers in brackets: data modified by us for comparison)

Source WestLB Research, company reports

Energy consumption, greenhouse gases and initiatives to mitigate environmental impacts covered by all nine companies

All nine companies with G3 reports reported on the core indicators EN3 ('Direct energy consumption'), EN16 ('Total direct and indirect greenhouse gas emissions by weight'), and EN26 ('Initiatives to mitigate environmental impacts of products and services, and extent of impact mitigation'). Eight reported on EN8 ('Total water withdrawal by source'), EN22 ('Total weight of waste by type and disposal method'), and EN28 ('Monetary value of significant fines and total number of non-monetary sanctions for non-compliance with environmental laws and regulations').

No information at all has been given for the additional indicators EN9 ('Water sources significantly affected by withdrawal of water'), EN11 ('Location and size of land owned, leased, managed in, or adjacent to, protected areas and areas of high biodiversity value'), EN15 ('Number of IUCN Red List species and national conservation list species with habitats in areas affected by operations, by level of extinction risk'), and EN25 ('Identity, size, protected status, and biodiversity value of water bodies and related habitats significantly affected by the reporting organization's discharges of water and runoff') while IBM is the only company that reported on the core indicator EN2 ('Percentage of materials used that are recycled input materials').

Assessing the usability of reported environmental performance data

Benchmarking companies based on reported 'Key Performance Indicators' (KPIs)

Taking a detailed look at a selected set of performance indicators

Of course, much can be said about each individual extra-financial report, about its compliance with the GRI guidelines, the quality with which the company links ESG issues and its overall business strategies, the materiality of the reported information, and so forth. This, however, is clearly beyond the scope of our note. What we did instead was to try and use the data delivered by the companies on a set of environmental performance indicators we consider to be of key importance (except EN5 all are classified as 'core indicators' by the GRI). To collect the data points we started with the information given in the CIs. So where it was linked to websites, we took the information of the websites we were led to. In case it referred to pages within the printed report we used that information. The table below gives an overview and shows some of the gaps between what the companies claim to deliver in their CIs and what they actually deliver in their reports and on their websites.

Reporting status on selected GRI performance indicators

Company (reporting level)		*Aspect: Materials* Materials used by weight or volume. EN1	*Aspect: Energy* Direct energy consumption by primary energy source. EN3	Indirect energy consumption by primary energy source. EN4	Energy saved due to conservation and efficiency improvements. (EN5)	*Aspect: Water* Total water withdrawal by source. EN8	*Aspect: Emissions, Effluents, and Waste* Total direct and indirect greenhouse gas emissions by weight. EN16	Total water discharge by quality and destination. EN21	Total weight of waste by type and disposal method. EN22	Total number and volume of significant spills. EN23	*Aspect: Products and Services* Percentage of products sold and their packaging materials that are reclaimed by category. EN27	*Aspect: Compliance* Monetary value of significant fines and total number of non-monetary sanctions for non-compliance with environmental laws and regulations. EN28
Communications equipment												
Ericsson	CI	x	x	x	x	x	x	nr	x	x	na	x
(G3 - B+)	actually reported	x	x	x	x	x*	x	nr	x	x	na	x
Nokia	CI	na	x	x	x	x	x	x	x	x	na	x
(G3 Draft)	actually reported	na	x	x	(x)*	x	x	x	x	x	na	x
Cisco	CI	na	x	na	x	x	x	x	x	na	x	na
(G3 Draft)	actually reported	na	(x)	(x)	(x)	(x)	x	(x)	(x)	na	(x)	na
Computer Hardware												
IBM	CI	x	x	x	x	x	x	x	x	x	x	x
(G3 - A)	actually reported	na*	x	x	x	nr*	x*	na*	x*	x*	x*	x
Dell	CI	na	x	na	na	x	x	na	na	na	na	x
(G3 - C)	actually reported	na	na	(x)	na	(x)	(x)	na	na	na	na	na
HP	CI	x	x	x	x	x	x	nr	x	x	x	x
(G3 - B)	actually reported	x	x	x	na	x	x	nr	x	x	x	x
Toshiba	CI	x	x	x	x	x	x	x	x	x	x	x
(G3 Draft)	actually reported	x	x	x	(x)	x	x	x	x	(x)*	(x)	x
Semiconductors												
STMicro	CI	x	x	na	x	na	x	x	x	x	na	x
(G3 Draft)	actually reported	x	na	x	x	x	x	(x)	x	(x)*	na	x
Semiconductor equipment												
ASML	CI	na	x	x	na	x	x	x	x	x	x	x
(G3 - B)	actually reported	na	x*	x	na	x	x*	na*	x	x	na	x

nr = regarded as not relevant; na = not available; (x) reported but not well fitting to GRI definition; * = with comment;

Source WestLB Research, companies

Matching data points – by no means a trivial task

Taking the next step

In the next step, we have tried to match the data points actually reported by the companies taking into account the sometimes quite different company-specific definitions. To compare the available data, we transformed absolute numbers for the respective indicators (e.g. water use, CO_2 emissions) into 'per unit of revenues' numbers where possible. To do this, we used the net sales figures we found in the extra-financial reports themselves (or, if not available there, in the corresponding financial report) and rebased them, when necessary, to US$, using the average exchange rate of the respective year (see table in the appendix).

Most of the reported indicators do not appropriately match the GRI definitions

In our aforementioned 'GRI reporting' note, we had pointed out already that companies tend to use the indicators they have available anyway and link them to the GRI performance indicators even if the fit is far from being perfect. For ICT companies, too, it happens rather often that performance indicators do appropriately match the definitions in the GRI guidelines. While switching metrics (for example from Terra-Joule in GWh) is

rather easy (but annoying), different definitions make it almost impossible to benchmark companies.

Mix of EN3 ('Direct energy consumption) and EN4 ('Indirect energy consumption')

In some cases, for example, there was no clear separation between direct and indirect energy consumption (EN3 and EN4). While IBM reports its consumption very detailed for each source of energy, most of the companies split only between electricity use, heating and – maybe – gas and/or oil use. Dell and STM only show figures on their electricity usage and Cisco gives just one total figure on its global energy consumption. So, finally, we decided to compare just the specific total energy consumption in MWh/m US$ (see also p. 28. For the concrete figures, see appendix).

Specific energy consumption per unit of sales

Company	Specific energy consumption (MWh/m US$)	2007	2006	2005	2004	2003	2002
Ericsson	Total energy consumption / net sales (MWh/m US$)		25.8	22.2	31.0	49.7	61.6
Nokia	Total energy consumption / net sales (MWh/m US$)		16.7	18.3	22.2		
Cisco	Total energy consumption / net sales (MWh/m US$)	25.7	30.1	30.4			
IBM	Total energy consumption / revenues (MWh/m US$)		75.9	74.2	67.3		
Dell*	*Electricity usage / net revenues (MWh/m US$)*	*7.1*	*6.8*	*7.5*	*7.3*		
HP	Total energy use / net revenues (MWh/m US$)		34.1	37.0			
Toshiba	Total energy consumption / net sales (MWh/m US$)		239.4				
STM*	*Electricity consumption / net revenues (MWh/m US$)*		*250.6*	*263.6*	*245.2*		
ASML	Total energy consumption / net sales (MWh/m US$)	40.0	44.0	57.5			

* only electricity consumption

Source WestLB Research, companies' reports

Even on a 'per unit of revenues' basis the results differ extremely. For sure, the specific product range is a key element here, as manufacturing semiconductors needs much more energy than producing mobile phones, for example. However, we guess that not all of the differences can be explained with fundamental differences in the energy intensity of production.

Data on 'Energy saved…' (EN5) not comparable at all

The figures on EN5 ('Energy saved due to conservation and efficiency improvements') were completely useless for an intra-sectoral comparison. While IBM delivers the total amount on energy saved in Giga-Joules, STM measured its energy savings in US$ and Ericsson discloses its achievements in facility management, transport and business air travel, but except for the latter one the base date is not clear. The other six companies delivered some examples, but no overall figures or nothing at all.

EN5 'Energy saved due to conservation and efficiency improvements'

Company	Definition in respective company report	2007	2006	2005	2004	2003	2002
Ericsson	1) facility management: Reduced space by approximately 7% per employee.						
	2) transport: reduced air transport from 70% to 63% in 2006. Increase surface transport to 37% in 2006						
	3) business air travel: 20% less than 5 years ago.						
Nokia	*only examples, no overall figures*						
Cisco	*Website with text only, no clear figures*						
IBM	Total energy saved (in Gigajoules)		1,000,793.0	845,426.0	1,596,480.0		
Dell	*NA*						
HP	*'The page you are looking for is no longer available or has been moved' (21/04/08)*						
Toshiba	*only examples, no overall figures*						
STM	**Energy savings (US$ m)**		**129.0**	**107.0**	**91.0**	**69.0**	**48.0**
	Water savings (US$ m)		26.0	22.0	19.0	15.0	11.0
	Chemical savings (US$ m)		82.0	74.0	64.0	48.0	35.0
	Total savings (US$ m)		237.0	203.0	174.0	132.0	94.0
	Total costs (US$ m)		35.0	34.0	35.0	35.0	32.0
	Balance (cost savings) (US$ m)		202.0	169.0	139.0	97.0	62.0
	Electricity produced by ST wind farm (GWh)		23.7	33.1	30.5	18.6	
ASML	*NA*						

Source WestLB Research, companies' reports

Disclosure of 'Greenhouse gas emissions' (EN16) appears to be of higher quality

A bit easier to compare is the data on 'Greenhouse gas emissions' (EN16). Here, the increasing awareness of the topic during the recent years as well as initiatives like the Carbon Disclosure Project obviously have had a positive impact on the reporting: All companies we looked at – except Dell - delivered data on their total CO_2 emissions. Here, again, the bigger differences should be explainable by the respective product ranges (see also p. 28. For more detailed data see appendix.)

Specific GHG emissions per unit of sales

Company	Specific GHG emissions (t CO_2/m US$)	2007	2006	2005	2004	2003	2002
Ericsson	Total CO_2 emissions / net sales (t CO_2e/m US$)		6.4	5.9	8.1	13.0	16.6
Nokia	Total CO_2 emissions / net sales (t CO_2e/m US$)		6.5	6.7	5.9		
Cisco	GHG emissions / net sales (t CO_2e/m US$)	8.9	12.3	12.6			
IBM	Total GHG emissions /revenues (t CO_2e/m US$)		29.3	29.8	24.7	28.6	
Dell*	*CO_2 from electricity use / net revenues (t CO_2e/m US$)*	6.6					
HP	GHG emissions / net revenues (t CO_2e/m US$)	14.5	17.4	17.9			
Toshiba	GHG / net sales (t CO_2e/m US$)		55.0				
STM	CO_2 emissions / net revenues (t CO_2e/m US$)		57.2	70.5	59.7		
ASML	Total emissions of GHG / net sales (t CO_2e/m US$)	12.9	14.2	18.3			

Source WestLB Research, companies' reports

Reported data on 'Materials used…' (EN1) differ completely in scope

The reporting on EN1 ('Materials used by weight or volume'), on the other hand, is not useful at all for comparison. The companies either do not report at all on this performance indicator or they deliver just parts of the data required by the GRI. Ericsson, for example, distinguishes only between products and packaging, while HP concentrates on packaging, splitting it up in plastics and paper. Toshiba, on the other hand, delivers only data on materials used and distinguishes between iron, plastics, chemicals and others but doesn't say if packaging material is included or not. And STM, finally, discloses just the chemicals consumed (see p. 22).

Data on 'Water consumption' (EN8) seems to be comparable at first glance ….

…but is not

Regarding 'Water consumption' (EN8), six out of the nine companies delivered figures that seemed to be useful for comparison – at least at first glance (see p. 24). However, when calculating the specific figures we found extreme variations that could not only be explained by the different product ranges. For sure, the production of semiconductors needs much more water than the manufacturing of mobile phones. But that can not explain completely the huge differences we found for example between STM, Toshiba and HP in our view.

Specific water consumption per unit of sales

Company	Definition in respective company report	2007	2006	2005	2004	2003	2002
Ericsson	Water consumption / net sales ('000 l/US$)		46.3	NA	58.5	NA	176.1
Nokia	Water consumption / net sales ('000 l/US$)		26.6	27.0	36.9		
Cisco	*no useful indicator*						
IBM	*no useful indicator*						
Dell	*no useful indicator*						
HP	Water consumption / net revenues ('000 l/US$)	70.6	91.2	93.8			
Toshiba	Water / net sales ('000 l/US$)		915.8				
STM	Water consumption / net revenues ('000 l/US$)		2,254.4	2,458.2	2,345.9		
ASML	Tap water consumption / net sales ('000 l/US$)	86.7	84.9	103.3			

Source WestLB Research, companies' reports

'Total water discharge …' (EN21) not comparable either

Big differences, again, show up in the definitions of EN21 ('Total water discharge by quality and destination'). Most of the companies did not deliver any data. Only Nokia, Toshiba and STM had figures in place. However, the definitions of the indicators actually reported differed strongly across these companies (see p. 40) so that a comparison didn't make any sense to us.

Hazardous waste most interesting component of EN22 ('Total waste…')

Regarding 'Total waste …' (EN22), the companies – particularly IBM, HP and Toshiba – delivered a huge amount of detailed data (see appendix). However, for the comparison we concentrated on 'Hazardous waste' as we regard this component as the most interesting one. Here, only four companies delivered useful indicators: Ericsson, IBM, HP and ASML.

Specific hazardous waste

Company	Specific hazardous waste (kg/m US$)	2007	2006	2005	2004	2003	2002
Ericsson	Special treatment (hazardous) (kg/m US$)		22.4	13.0	20.5	30.8	31.0
Nokia	*no useful indicator*						
Cisco	*no useful indicator*						
IBM	Total waste generated - hazardous (kg/m US$)		126.3	137.1	136.0	130.8	
Dell	*no useful indicator*						
HP	Hazardous waste (kg/m US$)	85.7	94.2	80.8			
Toshiba	*no useful indicator*						
STM	*no useful indicator*						
ASML	Hazardous waste materials (kg/m US$)	24.6	16.4	14.6			

Source WestLB Research, companies' reports

KPIs on waste (EN22) and reclaiming (EN27) often mixed up and not defined identically – which hampers comparability

Often, the indicator for waste is mixed with data on recycling and reclaiming. So, in some cases it was not easy to separate the two GRI indicators EN22 ('Total weight of waste by type and disposal method') and EN27 ('Percentage of products sold and their packaging materials that are reclaimed by category'). Especially the latter one was not easy to identify, as the companies used a variety of issues they reported on, so that comparability is hampered once again here (see also p. 47).

EN 27 'Percentage of products sold and their packaging materials that are reclaimed by category'

Company	Definition in respective company report	2007	2006	2005	2004	2003	2002
Ericsson	*NA*						
Nokia	*NA*						
Cisco	*Website with text but no clear figures*						
IBM	% of reclaimed products and their packaging materials (Category of product sold: IT products)		49.2	43.6	27.1		
Dell	*NA*						
HP	*(no clear link to tables)*						
	HP LaserJet print cartridge recycling (total in t)	15,000.0	13,600.0	11,100.0			
	- % of LaserJet market covered by program	88%	88%	87%			
	- Materials recycled into new products	59%	63%	60%			
	- Energy recovery	41%	37%	40%			
	HP Inkjet print cartridge recycling (t)	2,000.0	700.0	440.0			
	- % of LaserJet market covered by program	89%	88%	80%			
	- Materials recycled into new products	53.0%	60.1%	56.5%			
	- Energy recovery	21.0%	23.2%	24.0%			
Toshiba	Weight recycled (t)		67,351.0				
	Weight of end-of-use products recovered (t)		87,827.0				
	Amount of materials recycled from end-of-use products		67,351.0				
	- TVs		14,277.0	10,000.0	9,100.0	8,600.0	
	- Refrigerators		16,827.0	16,600.0	16,000.0	15,300.0	
	- Washing machine		14,746.0	13,900.0	11,600.0	10,900.0	
	- Air conditioners		7,313.0	8,100.0	7,400.0	6,600.0	
	- PCs		508.0	200.0	100.0	100.0	
	- Medical equipment		5,000.0	4,300.0	3,600.0	3,600.0	
	- Commercial equipment		8,700.0	12,000.0	13,100.0	10,500.0	
STM	*'These indicators are not reported because we do not yet have reliable enough systems in place to provide the data.'*						
ASML	*only text*						

Source WestLB Research, companies' reports

Data on significant spills (EN23) more easy to compare, but often no history disclosed

More easy is the comparison of data regarding significant spills (EN23). Except Cisco and Dell, all companies disclosed at least the latest numbers. However, Toshiba and STM didn't give concrete numbers, but listed respectively mentioned a couple of incidents. But it is not clear if the spills mentioned comprise all significant spills during the respective period. Besides, we miss historic data for Ericsson, Nokia, HP, Toshiba and STM.

EN23 'Total number and volume of significant spills'

Company	Definition in respective company report	2007	2006	2005	2004	2003	2002
Ericsson	*'There were no spills reported during 2006'*		0				
Nokia	*'There were no significant chemical, oil or fuel spills from Nokia operations in 2006.'*						
Cisco	NA						
IBM	Recorded significant spills (number / volume)		0	0	0		
Dell	NA						
HP		0					
Toshiba	*Table with location, progress, purification and amount recovered for 15 sites for 2006*						
STM	*Two spills mentioned for 2006*						
ASML	Total environmental incidents	0	0	1			

Source WestLB Research, companies' reports

The same holds for data on fines (EN28)

For EN28 ('Monetary value of significant fines…'), too, in most cases there is no historic data to find within the most recent report or on the website. Only IBM and HP disclosed the data for the last three years. Cisco and Dell, again, did not disclose any data here.

EN28 'Monetary value of significant fines and total number of non-monetary sanctions for non-compliance with environmental laws and regulations'

Company	Definition in respective company report	2007	2006	2005	2004	2003	2002
Ericsson	*'No fines or sanctions reported for 2006'*		0				
Nokia	*'There have been no environmental sanctions in 2006.'*		0				
Cisco	NA						
IBM	Total monetary value of significant fines (US$)		0	0	0		
Dell	*nothing to find*						
HP	Environmental violations resulting in fines (US$)	1,360.0	1,160.0	8,054.0			
Toshiba	*'Not in breach of any law, subject to any fine or other penalty concerning the environment.'*						
STM	*'In 2006, for all our locations / sites at worldwide level we had no fines or penalties.'*						
ASML		0					

Source WestLB Research, companies' reports

Conclusion: Benchmarking the companies based on reported performance indicators appear to be a 'mission impossible'

The conclusions that we are able to draw from what we found resemble those of our general note on 'GRI reporting'. The overall picture on the scope and the quality of performance indicators reported is disenchanting. In particular, a direct comparison of the companies is still very difficult (not to say almost impossible). The most aggravating factor is that the companies use other definitions of the performance indicators than recommended by the GRI guidelines. This explains to some degree the need for a more complex rating process, which takes into account both the qualitative and quantitative information provided by the companies themselves as well as external sources of information.

‘Green ICT’ and the integration of financial decision-making variables

To assess the ICT companies in our global coverage list (which is based on the DJ STOXX Global 1800) we have developed an overall ‘Green ICT’ indicator and additional sub-indicators, all of them based on our Extra-Financial Risk Navigator. The ‘Green ICT’ indicator aims to give a picture of ICT companies’ environmental behaviour overall, whereas the sub-indicators relate to particular phases of the entire life cycle of ICT products. Based on these ratings we have created additional theme indicators on supply chain management, energy consumption (CO_2 emissions) and waste. Finally we integrate our ‘Green ICT’ scores with traditional financial information and provide investment ideas for ‘Growth-’, ‘Value-’, and ‘G.A.R.P.’ (Growth At Reasonable Price) investors.

‘Green ICT’ - Rating companies on a global basis

57 companies in the worldwide ICT sector assessed

To assess the ICT companies on our global coverage list (which is based on the DJ STOXX Global 1800) we have focused on the seven GICS sectors (level 4) that represent the core ICT segments: Communications Equipment, Computer Hardware, Computer Storage & Peripherals, Office Electronics, Semiconductor Equipment, and Semiconductors. All in all we have identified 57 ICT companies within these sectors.

‘Green ICT’ indicator – companies assessed

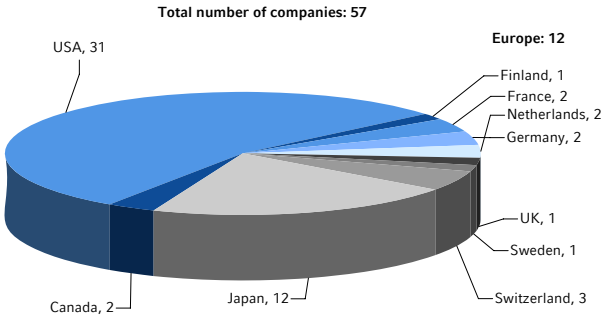
GICS sector level 2	GICS sector level 4	Company	total
Technology Hardware & Equipment	Communications Equipment	Alcatel-Lucent (Ordinary), Cisco Systems Inc, Corning Inc, Ericsson (Class B), Juniper Networks, Motorola Inc, Nokia, Nortel Networks (CA Listing), Qualcomm, Research in Motion Ltd. (CA Listing), Tom Tom	11
	Computer Hardware	Apple Inc., Dell Inc, Fujitsu (JP Listing), Hewlett Packard Co, IBM, NEC Corp. (Ordinary), Sun Microsystems Inc, Toshiba Corp., Wincor Nixdorf AG	9
	Computer Storage & Peripherals	EMC Corp., Logitech International SA (Ordinary), Mitsumi Electric, SanDisk Corp., Seagate Technology Inc, Seiko Epson Corp.	6
	Office Electronics	Brother Industries Ltd (JP Listing), Canon (JP Listing), Konica Minolta Holdings, Neopost SA (FR Listing), Ricoh Co Ltd (Ordinary), Xerox Corp.	6
Semiconductors & Semiconductor Equipment	Semiconductor Equipment	Advantest (JP Listing), Applied Materials Inc., ASML Holding (Ordinary), KLA Tencor Corp, Lam Research Corp., OC Oerlikon Corporation AG, Tokyo Electron	7
	Semiconductors	Advanced Micro Devices, Altera Corp., Analog Devices, ARM Holdings (Ordinary), Broadcom, Infineon Technologies AG (DE Listing), Intel Corp., Linear Technology Corp., LSI Corp., Marvell Technology Group, Microchip Technology, Micron Technology Inc, National Semiconductor, NVIDIA Corporation, Rohm Co Ltd, STMicroelectronics (IT Listing), Texas Instruments Inc, Xilinx	18

Source WestLB Research, SiRi

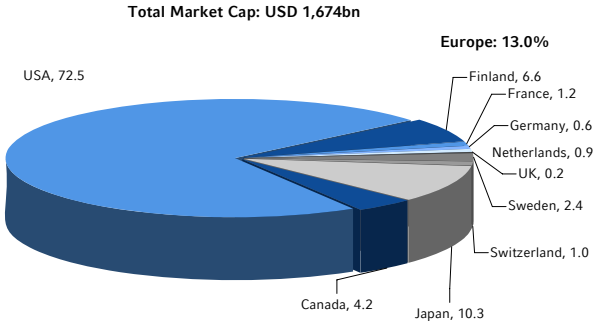
The majority (31) of these 57 companies are based in the USA, while Japan is home to the second-largest share (12). Twelve companies are located in Europe (including Sweden, Switzerland and the UK). The US companies also represent the biggest share of combined market capitalisation (72.5%, as of 15 May 2008), while European companies account for 13.0% and Japanese companies for 10.3%.

Regional provenance of companies under assessment

Number of companies



Market cap
% of total, as of 15/05/2008

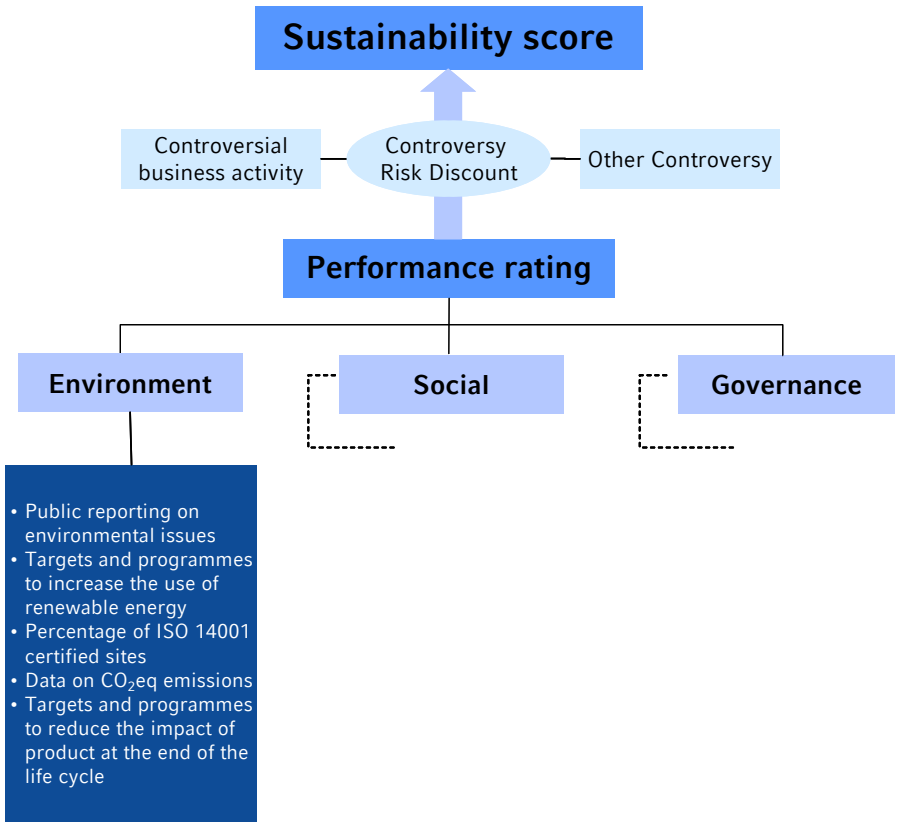


Source WestLB Research, JCF

Our extra-financial ratings

The basic data for the system are provided by our research partner SiRi Company. The ratings are made up of two main components: (1) the Performance Score (PSC) and (2) the so-called Controversy Risk Discount (CRD). The PCS's fundamental structure and philosophy correspond to those of many other sustainability rating systems. Its structure is based on three basic pillars – Environment, Social and Governance (ESG) – which in turn comprise seven thematic components in all.

WestLB Extra-Financial Risk Navigator



Source WestLB Research, SiRi

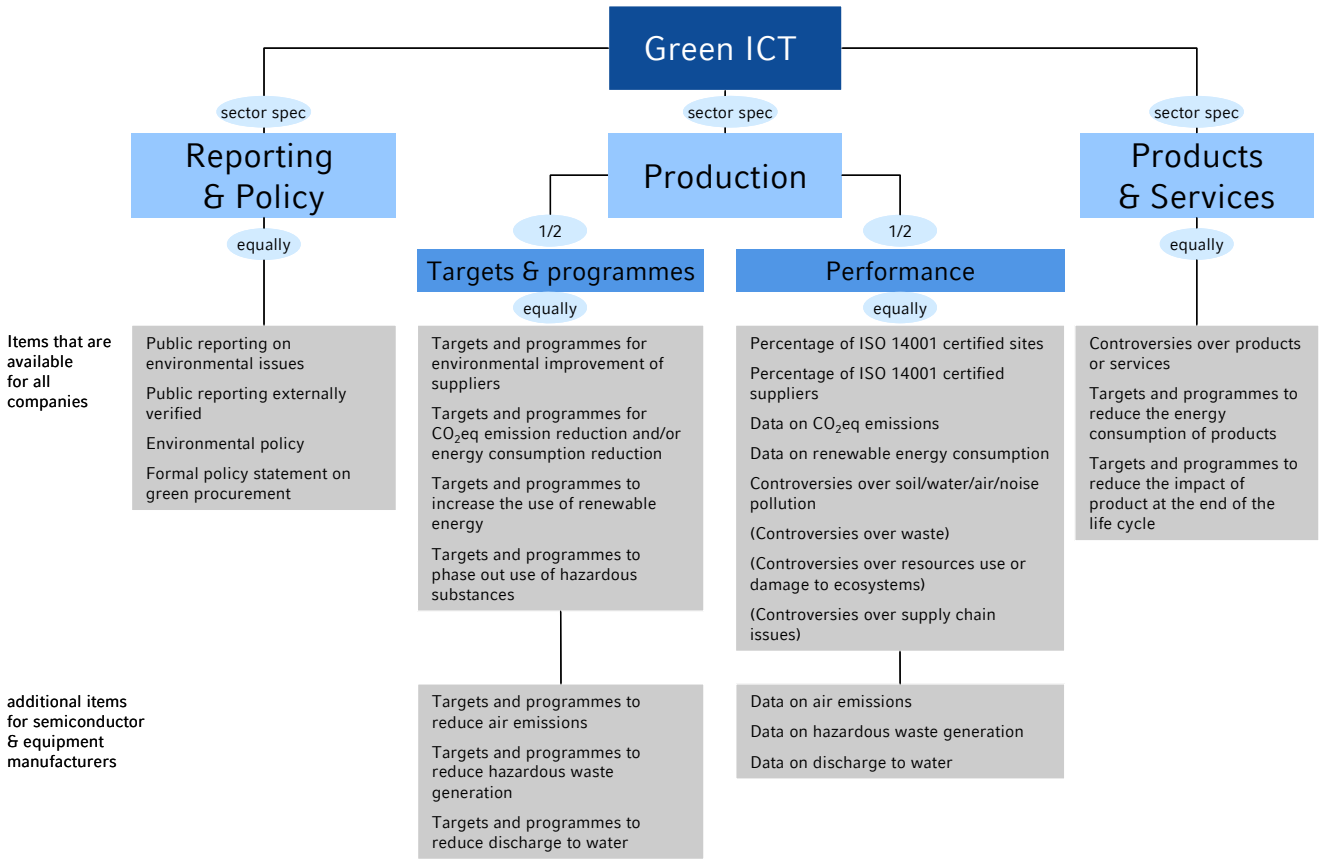
Selection of the items

The Environment component covers a number of items from which we have selected the ones we consider to be material and of particular relevance to our topic 'Green ICT'. These have been combined to form our 'Green ICT' indicator, with Reporting & Policy,

Production, and Products & Services as sub-components and a set of theme indicators that each relate to part of the life cycle of ICT products: Supply Chain, Energy Consumption (CO_2 Emissions), Products and Waste.

Some items (targets and programmes and data on air emissions, hazardous waste generation and discharge to water) are applicable only to Semiconductors and Semiconductor Equipment companies, but not for the other companies.

WestLB 'Green ICT' indicator



Source WestLB Research, SiRi

Equal weights for all sub-components

All items within each sub-component are weighted equally. However, for three items (controversies over waste, use of resources or damage to ecosystems, and supply chain issues), all companies assessed showed the same score. Thus these three items do not deliver additional, distinguishing information. We have therefore assigned to the three items a weighting of zero within our 'Green ICT' rating, to prevent other items under the heading Production – Performance from unjustifiably losing relative significance.

Sector-specific weightings

The weightings for the sub-components are set on a sector-by-sector basis. In each case we have attached the highest weighting to the Production sub-component. Since ICT hardware products themselves contribute significantly to the total environmental life-cycle footprint, the Products & Services sub-component also receives a relatively high weighting for all companies. The findings for the individual sub-components (best and worst within each sector) can be found in the appendix to this note.

Green ICT' indicator: components, items and weightings

Green ICT indicator - components & items	weights within resp. component	
	semicond.&equip.	others
Reporting & policy	***0.15***	***0.20***
Public reporting on environmental issues	0.25	0.25
Public reporting externally verified	0.25	0.25
Environmental policy	0.25	0.25
Formal policy statement on green procurement	0.25	0.25
Production	***0.60***	***0.50***
Targets & programmes	*0.50*	*0.50*
Targets and programmes for environmental improvement of suppliers	0.14	0.25
Targets and programmes for CO_2eq emission reduction and/or energy consumption reduction	0.14	0.25
Targets and programmes to increase the use of renewable energy	0.14	0.25
Targets and programmes to reduce air emissions*	0.14	0.00
Targets and programmes to reduce hazardous waste generation*	0.14	0.00
Targets and programmes to reduce discharge to water*	0.14	0.00
Targets and programmes to phase out use of hazardous substances	0.14	0.25
Performance	*0.50*	*0.50*
Percentage of ISO 14001 certified sites	0.13	0.20
Percentage of ISO 14001 certified suppliers	0.13	0.20
Data on CO2eq emissions	0.13	0.20
Data on renewable energy consumption	0.13	0.20
Data on air emissions*	0.13	0.00
Data on hazardous waste generation*	0.13	0.00
Data on discharge to water*	0.13	0.00
Controversies over soil/water/air/noise pollution	0.13	0.20
Controversies over waste	0.00	0.00
Controversies over resources use or damage to ecosystems	0.00	0.00
Controversies over supply chain issues	0.00	0.00
Products	***0.25***	***0.30***
Controversies over products or services	0.33	0.33
Targets and programmes to reduce the energy consumption of products	0.33	0.33
Targets and programmes to reduce the impact of product at the end of the life cycle	0.33	0.33

* only for semiconductor and equipment manufacturers

Source WestLB Research, SiRi

Z scores for the sake of better interpretability and comparability

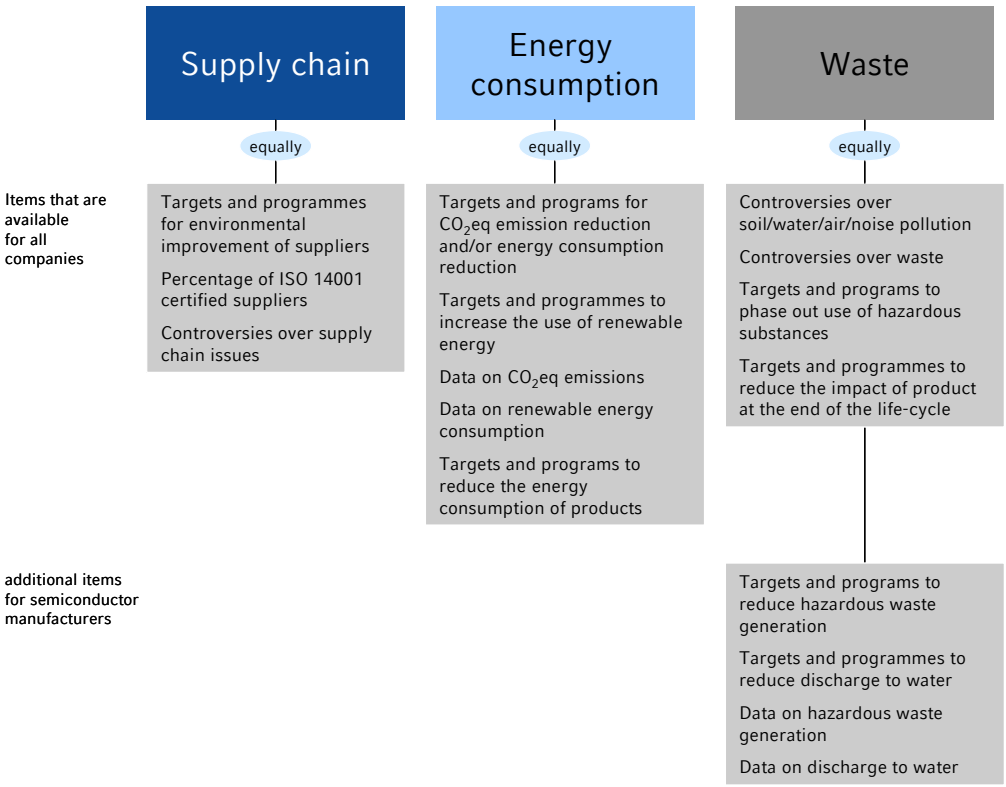
We have aggregated the selected items for each of the 57 ICT companies in our global coverage list. The results obtained are then converted into so-called Z scores for the sake of better interpretability and comparability. In other words, the score is adjusted by the mean and the standard deviation of the total universe. A Z score of 0 thus means that a company's score is average compared with the overall universe. A Z score of +1 (or -1) implies that a company performs better (or worse) than the average company by one standard deviation.

Additional theme-specific indicators

'Supply Chain', 'Energy' 'Consumption' and 'Waste'

The theme-specific sub-indicators 'Supply Chain', 'Energy Consumption' and 'Waste' (see chart below) are built up in a similar manner as the components of the 'Green ICT' indicator. Here, too, all available items are weighted equally. Thus the final weighting of each single item depends on the number of items available for each sector.

WestLB 'Green ICT' theme indicators



Source WestLB Research, SiRi

Selected items weighted equally

With regard to supply chain issues the number of items is the same for all companies, and therefore the weightings are the same for all items within the theme indicator 'Supply Chain'. However, they differ markedly from sector to sector within the indicator 'Waste'. Here, the number of available items for Semiconductors and Semiconductor Equipment is much higher than for the other sectors. The aggregated scores are then again converted into Z scores. The findings for the theme indicators (best and worst within each sector) can be found on p. 19 ('Supply chain'), on p. 39 ('Energy consumption'), and on p. 52 ('Waste').

'Green ICT' theme indicators: items and weightings

Green ICT theme indicators - components & items	weights within resp. indicator	
	semicond.&equip.	others
Supply chain		
Targets and programmes for environmental improvement of suppliers	0.33	0.33
Percentage of ISO 14001 certified suppliers	0.33	0.33
Controversies over supply chain issues	0.33	0.33
Energy		
Targets and programmes for CO_2eq emission reduction and/or energy consumption reduction	0.20	0.20
Targets and programmes to increase the use of renewable energy	0.20	0.20
Data on CO_2eq emissions	0.20	0.20
Data on renewable energy consumption	0.20	0.20
Targets and programmes to reduce the energy consumption of products	0.20	0.20
Waste		
Targets and programmes to reduce hazardous waste generation*	0.13	0.00
Targets and programmes to reduce discharge to water*	0.13	0.00
Targets and programmes to phase out use of hazardous substances	0.13	0.25
Targets and programmes to reduce the impact of product at the end of the life cycle	0.13	0.25
Data on hazardous waste generation*	0.13	0.00
Data on discharge to water*	0.13	0.00
Controversies over soil/water/air/noise pollution	0.13	0.25
Controversies over waste	0.13	0.25

* only available for semiconductor and semiconductor equipment manufacturers

Source WestLB Research, SiRi

'Green ICT' rankings – the findings

Japanese companies lead our ranking list

Looking first at the best- and worst-ranked companies within our universe, we find one thing particularly striking. While 6 of the top 10 companies are Japanese, only 2 are based in the USA and Europe. The lower end of our rankings list looks quite the reverse: 8 of the bottom 10 companies have their headquarters in the USA, 1 is from the Canada and 1 is from the UK.

'Green ICT' ratings – complete list of companies*

GICS sector level 2	GICS sector level 4	Company	Country	Price 15/05/08	Market Cap USD m	Green ICT Z score	Rank overall	Rank sector
Technology Hardware & Equipment	Communications Equipment	Alcatel-Lucent	France	7.4	17,230.5	0.74	18	3
		Cisco Systems Inc	USA	26.5	157,966.4	0.24	25	5
		Corning Inc	USA	27.0	42,314.2	-0.27	37	7
		Ericsson	Sweden	2.7	40,042.7	1.29	9	1
		Juniper Networks	USA	28.2	14,693.5	-1.43	54	10
		Motorola Inc	USA	10.1	22,841.0	1.15	11	2
		Nokia	Finland	28.2	110,897.1	0.65	19	4
		Nortel Networks	Canada	8.2	3,569.1	-0.67	44	8
		Qualcomm	USA	45.0	72,732.8	-0.86	46	9
		Research in Motion Ltd.	Canada	140.9	67,244.0	-1.43	54	10
		Tom Tom	Netherlands	39.9	2,289.9	-0.07	33	6
	Computer Hardware	Apple Inc.	USA	189.7	166,115.4	0.27	23	8
		Dell Inc	USA	20.6	40,644.8	1.34	6	4
		Fujitsu	Japan	7.4	15,390.3	1.37	5	3
		Hewlett Packard Co	USA	46.7	120,472.6	1.00	13	6
		IBM	USA	128.5	175,479.8	0.58	20	7
		NEC Corporation	Japan	5.3	10,655.1	1.88	1	1
		Sun Microsystems Inc	USA	13.5	10,694.4	1.19	10	5
		TOSHIBA CORP	Japan	8.4	27,061.5	1.80	2	2
		Wincor Nixdorf AG	Germany	76.1	2,516.3	-0.23	34	9
	Computer Storage & Peripherals	EMC Corp.	USA	17.8	37,362.9	0.06	28	3
		Logitech International SA	Switzerland	31.2	5,324.7	-0.04	32	5
		Mitsumi Electric	Japan	34.9	3,010.2	0.04	29	4
		SanDisk Corp.	USA	33.1	7,423.0	-0.52	43	6
		Seagate Technology Inc	USA	21.3	11,393.3	0.18	26	2
		Seiko Epson Corp.	Japan	24.7	3,995.9	1.70	3	1
	Office Electronics	Brother Industries Ltd	Japan	13.9	3,836.5	0.85	16	4
		Canon	Japan	53.3	63,925.5	1.32	7	1
		Konica Minolta Holdings	Japan	17.7	9,408.1	0.95	14	3
		Neopost SA	France	114.5	3,631.8	-0.28	38	6
		Ricoh Co Ltd	Japan	17.6	12,950.0	1.30	8	2
		Xerox Corp.	USA	14.5	13,422.7	0.85	16	4
Semiconductors & Semiconductor Equipment	Semiconductor Equipment	Advantest	Japan	27.2	4,533.5	0.11	27	3
		Applied Materials Inc.	USA	19.6	26,630.4	-0.23	35	4
		ASML Holding	Netherlands	29.9	13,304.8	1.47	4	1
		KLA Tencor Corp	USA	46.3	8,330.9	-1.45	56	7
		Lam Research Corp.	USA	41.9	5,172.4	-1.28	52	6
		OC Oerlikon Corporation AG	Switzerland	359.9	2,416.8	-0.48	41	5
		Tokyo Electron	Japan	65.1	10,742.9	0.88	15	2
	Semiconductors	Advanced Micro Devices	USA	7.4	4,109.8	0.34	22	3
		Altera Corp.	USA	23.0	7,052.7	-0.51	42	10
		Analog Devices	USA	35.4	10,405.3	-0.31	39	8
		ARM Holdings	UK	2.1	2,795.8	-1.13	49	14
		Broadcom	USA	27.6	12,910.2	-1.36	53	17
		Infineon Technologies AG	Germany	10.5	7,902.3	0.26	24	4
		Intel Corp.	USA	25.0	145,236.4	0.57	21	2
		Linear Technology Corp.	USA	37.0	7,636.5	-1.01	47	12
		LSI Corp.	USA	7.0	4,948.5	-0.25	36	7
		Marvell Technology Group	USA	14.8	6,902.0	-1.68	57	18
		Microchip Technology	USA	37.9	7,151.9	-1.27	51	16
		Micron Technology Inc	USA	8.8	6,668.7	-1.01	47	12
		National Semiconductor	USA	20.8	5,291.5	-0.45	40	9
		Nvidia Corporation	USA	23.8	13,211.5	-1.23	50	15
		Rohm Co Ltd	Japan	65.1	6,910.2	0.02	30	5
		STMicroelectronics	Switzerland	12.9	8,519.4	1.05	12	1
		Texas Instruments Inc	USA	31.4	41,593.4	-0.02	31	6
		Xilinx	USA	27.0	7,719.1	-0.83	45	11

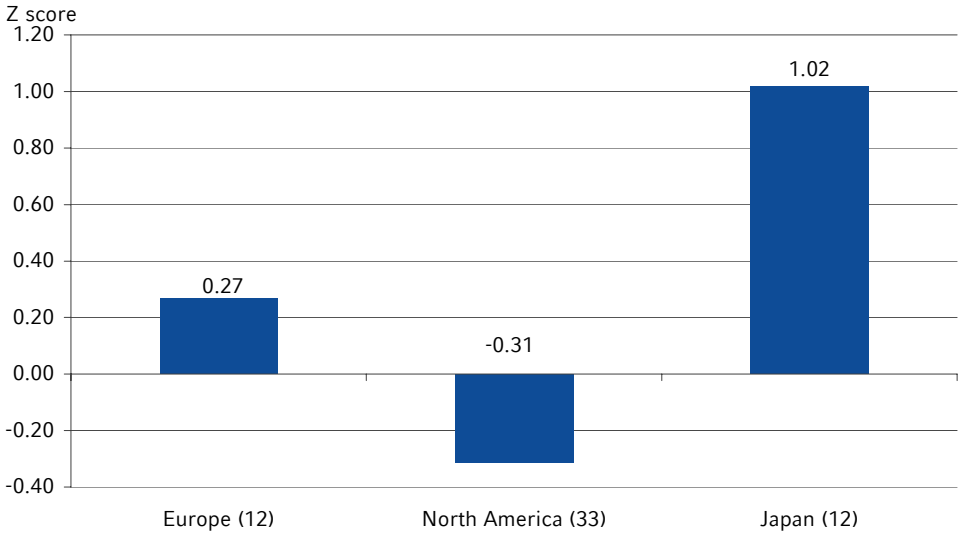
* sector leaders marked in blue

Source WestLB Research, SiRi

Breakdown by region

The Japanese companies within our universe generally perform quite well with respect to the indicators that make up our 'Green ICT' rating; their average Z score of 1.02 is the highest observed for any country or region. Europe attains an average Z score of 0.27 while the USA lags behind on -0.27 (when Canada is added, the average actually decreases to -0.31).

'Green ICT' ratings – breakdown by region
Average Z score for each region*



* number of companies in brackets

Source WestLB Research, SiRi

Findings might be linked to general trends in CSR reporting …

This finding fits in with the picture we have received from other analyses in the past: US companies have often been shown up as laggards in terms of environmental performance and CSR reporting, while many European and Japanese companies have been among the leaders. We observed this in looking at our Extra-Financial Risk ratings and in our 2007 report on GRI reporting, for example. It should also be noted that CSR ratings currently reflect the status of reports rather than giving an objective, holistic picture of companies' environmental performance. (For more details on this topic see our report 'GRI reporting – aiming to uncover true performance', September 2007.) So it may simply be the case that US companies are less transparent with respect to their 'true' performance in the ESG space.

… as well as to sector affiliation

It may be that many Japanese ICT companies perform particularly well (i.e. better than their European peers) with respect to 'Green ICT' because they occupy a leading position in many respects – not just with regard to environmental issues. However, it might also be a question of which sector a company operates in. Within the Computer Hardware and Office Electronics sectors, which both score comparatively highly on the issue under consideration (see below), the number of Japanese companies is much higher than European ones. Hence it is not clear whether this is due to a country or sector effect here.

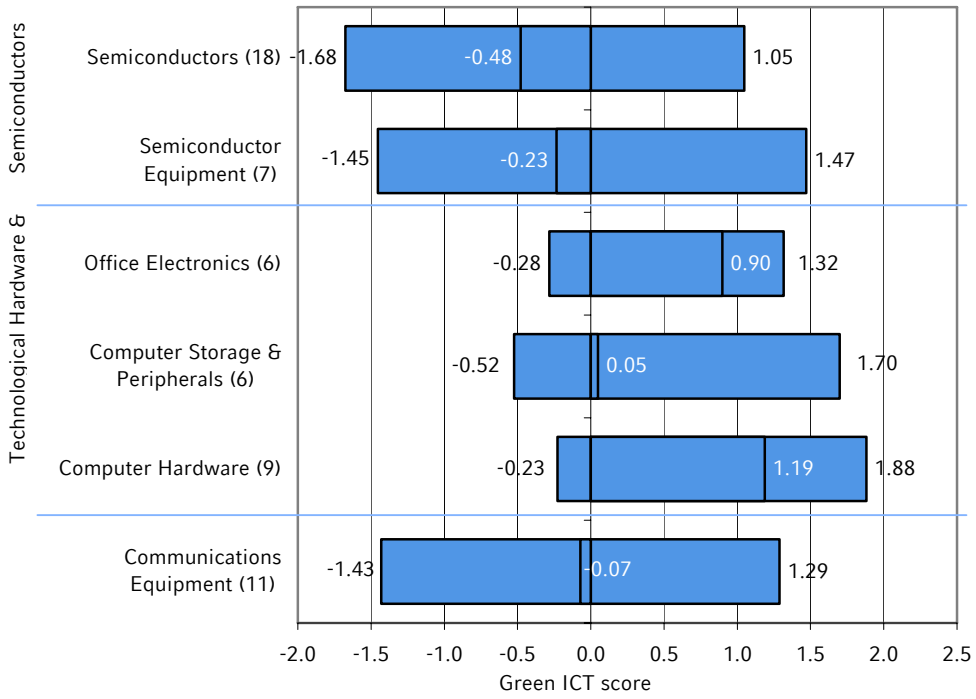
Breakdown by sector

Sector affiliation and 'Green ICT' rankings are in general not independent of each other: 5 of the top 10 ranked companies are in Computer Hardware, and 2 others are in Office Electronics. The sectors Computer Storage & Peripherals, Semiconductor Equipment, and Communications Equipment are each represented by one company. Of the 11 worst-ranked companies (tenth place is shared by 2 companies), on the other hand, 9 are in Semiconductors or Semiconductor Equipment while 2 are in Communications Equipment and none are from Computer Storage & Peripherals.

Computer Hardware and Office Electronics perform well

When we look at rankings on a sector-by-sector basis, the above impressions are confirmed: Computer Hardware includes the company with the highest overall score (NEC on 1.88), and the median sector score (1.19) by far exceeds those of other sectors. Finally, the company with the lowest rating within Computer Hardware (Wincor Nixdorf) outperforms the bottom-ranked companies in all other sectors. A fairly positive picture also emerges for Office Electronics, which shows the second-highest median score (0.90) and the second-highest minimum score (-0.28 for Neopost).

'Green ICT' scores at sector level
Minimum, median and maximum; number of companies in brackets



Source WestLB Research, SiRi

Semiconductors score rather poorly

According to our 'Green ICT' rankings, Semiconductors perform worst. The median score of this sector too lies below zero (-0.48), and this is particularly significant because of the comparatively large number of companies included (18). The best-in-class company is STMicroelectronics; its score of just +1.05 is the lowest of all sector leaders. With Marvell Electronics, the sector also contains the company with the lowest overall score (-1.68). The min/max range within the sector is wide (2.73); this is also true of Computer Storage & Peripherals (2.22), Communications Equipment (2.72) and Semiconductor Equipment (2.92).

Reputational risk and other possible factors

A possible explanation of these observations is that Computer Hardware and Office Electronics companies have a relatively high reputational risk, with customers focusing increasingly on energy efficiency – and probably not just because of ecological considerations. Often energy use is linked to the size and weight of a company's products; for example, fans for the cooling of laptops, PCs, servers etc. need extra space. For portable products energy use also plays an important role with regard to potential operating times when working off-line. So companies use their efforts in these fields for 'green' marketing. Internet companies, on the other hand, have only recently come under the spotlight of energy considerations.

Focus on intra-sectoral assessments

Another factor behind sector-specific results may be the structure of our rating system. The number of items for the Semiconductors and Semiconductor Equipment sectors face a far larger number of issues than other ICT hard companies. We would thus recommend focusing on intra-sector assessments.

Overview of the top-performing companies

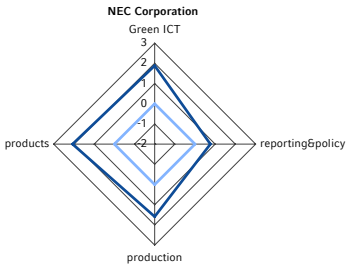
As already mentioned, there are many Japanese companies among the top performers, with Computer Hardware and Office Electronics manufacturers particularly strongly represented. We now take a closer look at their environmental policies in general and at some outstanding features. These spotlights, however, are not exhaustive, and we do not claim that they give a complete, holistic picture of companies' environmental behaviour.

'Green ICT' – the 10 top-ranked companies

Company	GICS sector (level 4)	Country	Market Cap* 15/05/08	Green ICT Z score	Components r&p**	production	products
NEC Corporation	Computer Hardware	Japan	10,655.1	1.88	0.76	1.59	2.06
TOSHIBA CORP	Computer Hardware	Japan	27,061.5	1.80	0.76	2.40	0.61
Seiko Epson Corp.	Computer Storage & Peripherals	Japan	3,995.9	1.70	0.76	1.46	1.74
ASML Holding	Semiconductor Equipment	Netherlands	13,304.8	1.47	0.76	1.31	1.74
Fujitsu	Computer Hardware	Japan	15,390.3	1.37	0.76	1.05	1.42
Dell Inc	Computer Hardware	USA	40,644.8	1.34	0.11	1.86	0.61
Canon	Office Electronics	Japan	63,925.5	1.32	1.63	0.51	1.42
Ricoh Co Ltd	Office Electronics	Japan	12,950.0	1.30	0.76	0.92	1.42
Ericsson	Communications Equipment	Sweden	40,042.7	1.29	0.76	1.32	0.77
Sun Microsystems Inc	Computer Hardware	USA	10,694.4	1.19	0.97	1.46	0.12

* in US$m; ** r&p = reporting & policy

Source WestLB Research, SiRi



NEC: Pro-active in management of sustainability issues

The company with the highest overall rating is the Japanese network and semiconductor solutions provider NEC. NEC operates through three principal segments: integrated IT and networks solutions, mobile/personal solutions, and semiconductor solutions.

NEC is a pro-active company with a strong management of key sustainability issues, and is well advanced in designing new environmentally-friendly technologies. The company has extensive environmental policies and programmes. Its environmental management system (EMS) strategy covers reductions in environmental impact, compliance with applicable laws and regulations, and risk management strategies at all of its plants and manufacturing subsidiaries. All manufacturing and all design and sales subsidiaries worldwide are certified ISO 14001, which makes the company a leader in its sector.

Strength in environmentally-friendly product design

NEC is well advanced with regard to designing eco-friendly products, and has thus achieved by far the highest score within our Products component. Its design of so-called 'eco-products' is one of the three pillars of NEC's environmental strategy (the other two are 'eco-factories' and 'eco-communication'). The company has introduced guidelines to

produce 'eco-products' that incorporate environmental considerations and management of hazardous substances into the entire product life cycle, starting at the design and development stage, and it has developed an internal eco symbol. By 2006 100% of new products fulfilled the criteria of these guidelines, and this confirms its shift from being a conventional to an environmentally responsive manufacturer. (NEC has since then tightened its guidelines still further in order to proceed on this course.) One example of the efforts it has made is recyclable bioplastics that hold their shape. Another big target the company has set itself is to reduce the CO_2 emissions of its products by 50% by 2010. Solar-powered products are one striking example of what the company is working on to achieve this target; another is its use of advanced process technologies that integrate multiple functions on a single chip to produce end-products that use less energy. NEC's widespread waste management concept includes the phasing out of hazardous substances; a commitment to disclosing information on chemical substances contained in products; and take-back, re-use and recycling programmes.

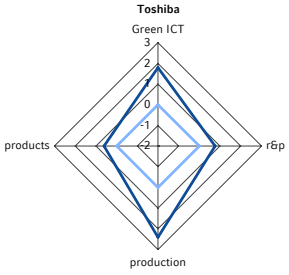
'Eco-factories' focuses on production processes

The second pillar, 'eco-factories', focuses on reducing the impact of production processes on the environment through efficient use of energy, reducing greenhouse gas emissions and phasing out hazardous substances used in manufacturing. Where greenhouse gases are concerned, NEC focuses on reducing perfluorocarbons (PFCs) – extremely potent greenhouse gases that are emitted mainly in the semiconductor industry (and in aluminium smelting). NEC aims to reduce its PFC emissions by at least 10% of their 1995 level by 2010 – which means meeting the reduction goals set by the PFC Reduction/ Climate Partnership for the Semiconductor Industry (of which NEC is a member). Extensive efforts with regard to waste management resulted in 2002 in zero waste at all NEC headquarters, plants, laboratories and manufacturing subsidiaries.

'Eco-communication' as the third pillar of NEC's environmental strategy

The third pillar, 'eco-communication', aims at educating employees and raising their awareness of environmental issues, and at informing the public of its eco activities. The company runs a comprehensive internal audit programme and issues detailed environmental reporting, with goals and constant monitoring. However, the reporting is not externally certified, and although NEC takes part in the GRI initiative, its 2007 CSR report does not use the G3 guidelines of the Global Reporting Initiative (GRI) and is not in full accordance with the 2002 guidelines (the precursor to G3). The company uses the 2002 guidelines only as a reference. The report also contains no table of key performance indicators for easy comparisons with the company's peers.

Toshiba



The Japanese electronics manufacturer Toshiba holds the second-best rating in our universe. Toshiba is one of the largest comprehensive electronics manufacturing and service conglomerates in Japan. Its areas of operation cover Digital Products, Electronic Devices & Components, Infrastructure Systems, and Network Services.

According to its Environmental Vision 2050, Toshiba 'aims to improve the value and eco-efficiency of its products and business processes and to reduce emissions of carbon dioxide by the equivalent of 57.6 million tons per year in FY2025 compared with FY2000, while concurrently working to enhance its environmental efficiency and raise overall eco-efficiency to a factor of 10 by FY2050.' To meet specific goals and to address environmental issues the company has established two approaches: 'Energy Vision' and 'Eco Products' Vision. The environmental strategy is integrated into group operations via the Corporate Environment Management division, which is chaired by the president and CEO and by the corporate environmental officer. To achieve its aims Toshiba has implemented a 'Plan-Do-Check-Aim' (PDCA) cycle, and has an environmental audit

scheme in place. By 1997 all 16 of Toshiba Corp sites had gained ISO 14001 certification. Of the 101 sites of Toshiba Group companies in Japan and overseas, 97 have gained ISO 14001 certification and the remainder are working to gain certification. Toshiba published a CSR report in 2007 in accordance with the GRI G3 reporting standards (however, it is not externally verified), and offers much information on its website on its environmental policy and achievements.

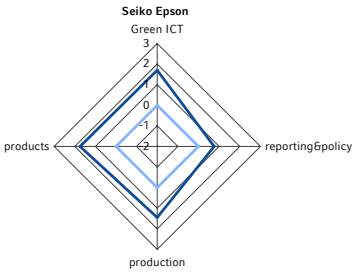
Strength in production

Within our 'Green ICT' rating structure, Toshiba achieves a particularly high rating for the Production component. The company has a programme to facilitate the use of renewable energy, by buying electricity via a system of green power certificates. Currently, more than 4% of demand at its headquarters building is covered by biomass power generation.

'T factor' to assess eco-efficiency of products

To monitor and expand the eco-efficiency of its products, Toshiba has developed a special factor (the so-called 'T-factor') that compares the eco-efficiency of a product produced in the year of assessment with the eco-efficiency of the equivalent product in a benchmark year. Based on this factor, the company aims to achieve by 2010 a product eco-efficiency of 2.2 times against 2000; it says it is currently close to a factor of 2. Toshiba has also set a target for products categorised as 'eco-products' of 60% of total sales by 2010.

Seiko Epson



The leader among Computer Storage & Peripherals companies is Seiko Epson, the third-best company within our overall ratings. Seiko Epson is a comprehensive IT-related product-manufacturing company specialising in information-related equipment (computers and peripherals, including PCs, printers, scanners and projectors), electronic devices (semiconductors, displays and quartz devices) and precision products (watches, plastic corrective lenses and factory automation equipment). Aside from its Japanese heritage, Epson holds a leading position in its sector in environmental management. 'Action 2010', which lays out the company's environmental action plans from fiscal 2006 to fiscal 2010, gives detailed objectives for three areas of action: 'global warming prevention', 'resource recycling & prevention', and 'substance management'.

Balanced environmental strategy with focus on production and products, based on a broad LCA

The company capitalises on eco-friendly technology and is well under way to designing new environmentally-friendly products. In product development, for example, Epson aims to develop environmentally-conscious products based on its policies of energy-saving design, lowering resource consumption and eliminating hazardous substances. The company is now introducing life-cycle assessment (LCA) to analyse the impact a product has on the environment at every stage of its life cycle, with the findings of this analysis to be quantified and made available to the public. Besides this, Epson has introduced its own label, Epson Ecology, and the company aims to achieve classification of 20% of its products with this label every year.

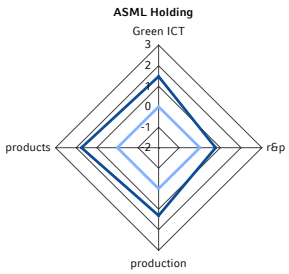
The company has imposed a ceiling on CO_2 emissions

Epson aims to minimise its environmental burden by reducing energy consumption, waste and harmful materials in all business and production processes. The company has imposed a ceiling on emissions of CO_2 and other exhaust gases responsible for global warming, and has taken steps to recycle or eliminate all emissions. According to its website, Epson is now focused on reducing the use of materials that generate emissions in the first place, to enhance its resource management.

In December 2006 Epson received the LCA Japan Forum Chairman's Award for its LCA-based environmental product development programme. Epson earned high marks for

initiatives to bring LCA methods into product development, for its pro-active stance in publishing environmental data, and for implementing a system for sharing environmental information about parts and materials, including those of suppliers.

ASML Holding



Number four within our 'Green ICT' ratings, and the top-performing company within the Semiconductor Equipment sector, is ASML Holding, one of the world's leading providers of lithography systems for the semiconductor industry. The company has a strong and detailed environmental policy aimed at continuously improving its environmental performance, developing and implementing environment, health & safety (EHS) procedures, reviewing them periodically to ensure their effectiveness, informing and educating its employees, and communicating EHS issues and performance. ASML's most recent EHS report was published in March 2007 in accordance with the GRI G3 guidelines (level B3, self-declared). It gives short, clear statements about the company's EHS policy & progress.

Supplier assessment through QLTC

ASML's environmental management system received ISO 14001 certification for all its activities. In addition, 35% of all ASML's suppliers in 2005 were certified in accordance with ISO 14001. However, the company has not disclosed any figures on certified suppliers for 2006. ASML states that it has its own quality, logistics, technology and cost (QLTC) system for its suppliers. Questions regarding suppliers' environmental, safety and health performance have been included in the 'quality' category since 2005. The QLTC review is conducted every quarter or half-year for the larger suppliers,and annually for other suppliers.

Regarding energy consumption, ASML pursues opportunities 'to use energy in the most efficient way possible, minimizing and reducing energy consumption'. This is done by developing energy-efficient products and reducing its overall use of energy. However, while the company claims that it ensures that the amount of energy consumed to manufacture its products remains as low as possible, it also states that 'it is inevitable that as the performance of ASML semiconductor lithography systems continues to increase, they need more energy to operate due to the more advanced lasers and cooling systems required.'

Its own co-generation plant

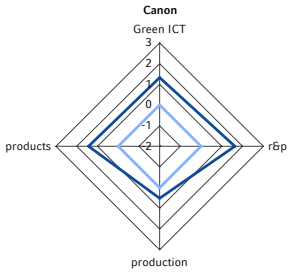
Within its own production processes, total energy use (excluding own produced electricity) decreased from 0.27% of net sales in 2005 to 0.19% in 2006. ASML also generates its own electricity in Veldhoven, using natural gas in a co-generation plant that is also used as an emergency power plant and for cooling purposes. The heat that is released during these processes is re-used for production purposes.

Intensive waste separation and recycling programmes

Hazardous waste materials decreased by 9% in 2005 compared to 2004 due to intensive waste separation and recycling programmes. However, hazardous waste materials increased by 52% in 2006 from 2005. For this the company provides two explanations. Firstly, in 2006 in both Veldhoven and Wilton, chemical secondary containment tanks were emptied and disposed of as hazardous waste, which occurs approximately every three years. Secondly, according to ASML, better separation of solvent waste materials causes a higher fraction of hazardous waste in the total waste stream. The company states that it is continuously screening new materials for any chemical, physical or toxicological properties or hazards in order to protect both the environment and people's safety.

From the specialty gases used in ASML's lithographic systems, the fluorine is captured and the inert gases are emitted into the atmosphere. The fluorine traps are subsequently returned to the manufacturer for recycling. No ozone-depleting substances are used anywhere in the production process.

Canon



The best company in the Office Electronics sector is Canon, with an overall ranking of 7. Canon develops, produces and markets office imaging products, computer peripherals, business information products, cameras and related optical products. Its product range includes copying machines, laser/inkjet printers, cameras, digital cameras, video cameras and semiconductor products.

Canon has one of the most outstanding reporting procedures and initiatives in its sector regarding sustainability issues, and thus achieves the highest score in our reporting and policy ratings. Its environmental initiatives are based on the concept of maximising resource efficiency. The company aims to reduce the environmental burden of product life cycles, and has incorporated this concept into its environmental targets. These include the promotion of product recycling systems, the elimination of certain chemicals from its products, the reduction of CO_2 emissions per sale, and a decrease in waste generation and in the use and releases of chemicals. For example, in its 'Vision for 2010' plan, adopted in 2003, Canon mapped out its long-term environmental management objective of doubling by 2010 net sales per unit of CO_2 emission during products' life cycles, relative to 2000 levels.

Strong environmental management system since long time in place

Strong environmental management systems seem to be mitigating Canon's environmental risk. For example, the company eliminated chlorinated solvents (trichloroethylene, tetrachloroethylene and dichloromethane) from its production process in 2003. In 2004 the company completed the elimination of six chemicals and metals regulated by the EU's Restriction of Certain Hazardous Substances (RoHS) Directive (see p. 68). Thus Canon was one of the first companies in its sector to comply with the directive, and is now preparing for Registration, Evaluation and Authorisation of Chemicals (REACH – see also p. 68). In 2005 Canon began a three-year plan to gain ISO 14001 certification for itself and 103 affiliated companies (15 Canon sites and 66 affiliated companies were covered by end-2006). Canon also has some of the most comprehensive supplier screening criteria in its sector.

Environmental impact assessment software covers all life cycle states

With regard to environmentally-conscious products, Canon has built a product environmental information system from product-related data spanning all stages of development: product planning, development and design, prototype creation, quality assurance, and manufacturing; this is available on the company's intranet. The company states that, along with 3D CAD systems, support tools and digital mock-up reviews (DRMs) that help to reduce the number of prototypes needed, it has developed environmental impact assessment software that can be applied from the early development and planning stages to evaluate compliance with regulations like the Waste Electrical and Electronic Equipment (WEEE – see p. 67) and RoHS Directives, application of various eco-labels, LCA, life-cycle cost (LCC) assessment, and product assessment.

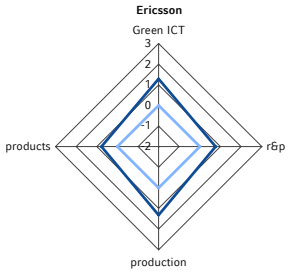
Energy-efficiency goals for all new products

To achieve top-level energy efficiency in all product groups, Canon has set goals to reduce energy consumption of products in operation and standby modes by more than 30% over previous models, and by more than 50% from 2000 levels. According to its

environmental report, the company achieved these goals for major products sold in 2006: cameras, copying machines, multi-functional peripheral devices (MFPs), laser beam printers, inkjet printers, optical products, large-format printers and medical equipment, among others.

From the development and design stages onwards, Canon strives to make products 75% recyclable by mass (for re-use and recycling of materials) and 85% recoverable by mass (including thermal recycling). In implementing the EU WEEE Directive, Canon has developed its own cartridge recycling system on a global scale and employs a thorough recyclability evaluation from the product design stage.

Ericsson



Swedish mobile phone manufacturer Ericsson holds the best 'Green ICT' rating within the Communications Equipment sector. Its overall ranking is 9th; the company is thus one of the top 10 companies in our ratings. Ericsson is a leading provider of telecommunications equipment and related services to mobile and fixed network operators globally. Its sustainability strategy covers a full range of environmental issues and is based on a life-cycle approach that aims to provide guidance on necessary improvements. The company has established a sector-leading environmental management system to enable it to mitigate environmental risk, while at the same time providing added financial value through cost savings and new market opportunities. Its EMS has been certified to ISO 14001 standards since 2001 and covers all manufacturing and non-manufacturing operations. Ericsson was one of the first companies to receive global ISO 14001 certification. The formal EMS is supported by an audit programme, employee environmental issues awareness training, and strong support from upper management.

Comprehensive LCA finds that product use consumes most energy

According to Ericsson's LCA, the GSM and 3G mobile network cause more than 50% of CO_2 emissions during operation, operator activities account for 15%, and 34% of the total impact relates to the production phase, including raw materials production, supply-chain production and all Ericsson activities (including production, transportation and office activities) – with the latter accounting for 3% of direct CO_2 emissions. As a result of these findings the company has decided to focus on the energy consumption of its products in operation. Its 'Design for the Environment' programme has been developed to control material and energy flows relating to Ericsson's products and services. It focuses on improving the energy efficiency of products, avoiding hazardous substances, reducing mass and volume, and simplifying end-of-life use, recycling and disposal.

'Green site' solutions with renewable energy sources and reduced energy consumption

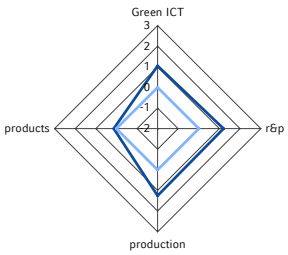
Ericsson addresses energy efficiency and consumption by optimising individual products, the total product portfolio, and network design, and through the use of renewable energy. For example, it sees increasing customer interest and demand for 'green sites' and is responding to the market with innovative solutions that are mostly suitable for areas that are not part of the electricity grid, or that have unreliable energy sources. The company focuses on a two-fold strategy: (1) to design optimal site solutions that combine renewable sources based on locally available sources; and (2) to introduce products that reduce energy consumption and to improve the energy efficiency of the total product mix. According to its 2007 CSR report, approximately 100 solar-powered sites were in operation, primarily in Morocco, Algeria, Ethiopia and Mexico. Pilot projects using biofuels were underway during 2006.

Collection and recycling systems

By following a rigorous process to ensure that its entire product portfolio met RoHS restrictions, Ericsson was able to meet the 1 July 2006 deadline for compliance with the EU's RoHS Directive, and aims to phase out all RoHS substances globally by 2008. Besides, Sony Ericsson complies with national legislation resulting from the WEEE Directive by joining collection and recycling systems for discarded electrical and electronic products, and participates in existing voluntary and required collection and recycling schemes in many countries around the world. It also works with international organisations such as the UN Environment Programme to set up guidelines for proper management of products for recycling and re-use.

Company data show a steady reduction in total energy use. Besides, Ericsson reports sustained reductions in its waste output, while simultaneously increasing re-use of waste, recognising the financial benefits of doing so.

STMicroelectronics



The best-performing company in the Semiconductors sector, one of the two 'laggard' sectors, is STMicroelectronics (STM). However, with an overall rating of 1.07 the company is still well above average overall, with only 11 ICT companies performing better and leaving sector peers far behind (the second-best-performing company in the sector is Intel, with an overall rating of 0.60 and ranked 21 in our overall list).

STM is one of the world's largest semiconductor companies, operating in five major fields: Communications, Consumer, Computer, Automotive and Industrials. Its product range varies from semiconductors for Industrials and set-top box applications, to multimedia convergence applications and power solutions. The company is a sector leader in progressive environmental management. Its environmental policy (called 'EHS Decalogue' and set out in 1999) consists of concrete statements and aggressive, time-defined and measurable goals that make STM a leader in this field. It, says for example: 'meet the most stringent environment, health and safety (EHS) regulations of any country in which we operate, at all of our locations,' 'comply with all relevant international protocols at least one year ahead of official deadlines at all our locations' and 'reduce total energy consumption (kWh per production unit) by at least 5% per year, through process and facilities optimization, conservation and building design.' It comprises the fields of resource conservation (focusing on energy, water and chemicals), CO_2 neutrality, pollution, risk management, waste, products and processes, pro-activity, health and safety, and measurement and validation, thus addressing a broad variety of environmental issues.

A leader in progressive environmental management systems

STM uses LCAs and has defined its own 'eco-footprint indicator' consisting of 10 parameters representing key aspects such as global warming, VOC emissions, material intensity, energy, water and chemicals consumption waste, water discharge and eutrophication. Its environmental management system is ISO 14001 certified for all sites and 100% EMAS validated for at least 10 years, while 68.6% of its main suppliers were ISO/EMAS certified in 2005 and 11.8% were in the process of being certified.

Commitment to carbon neutrality by 2010

With regard to climate change, STM is committed to becoming carbon neutral by 2010 by reducing energy consumption, increasing the use of renewable and alternative sources of energy, and offsetting remaining emissions through carbon sequestration (reforestation). In 2005 about 10% of STM's energy consumption came from renewable energy. The company aims to increase this to 15% of total energy supplies by the end of

2010. As of 2006, STM had achieved a 46% reduction in electricity consumption per unit of production from its 1994 level, while unit consumption of water had decreased to 30% of its 1994 level. As a result, STM reported cost savings in energy, water and chemicals of US$202m in 2006 alone. According to the company, savings mounted to a total of US$700m over six years and over US$1bn since the launch of its environmental initiative. STM's self-defined 'eco-footprint indicator' came down from 1.23 in 2004 to 1.14 in 2006.

Efforts to comply with US ENERGY STAR standards

On the product side, STM is also pro-active with regard to environmental issues: many of STM's chips are used in applications and products that improve energy efficiency (e.g. electronic fuel injection, reduced power consumption). Where possible, STM designs comply with the US ENERGY STAR standards for electronic products (see p. 72 for details). Renewable energy is also an essential part of research for STM. The company designs chips and materials for application in photovoltaic and fuel cells. An example of this is the company's development of tiny yet extremely efficient fuel cells that could power a mobile phone for 20 days.

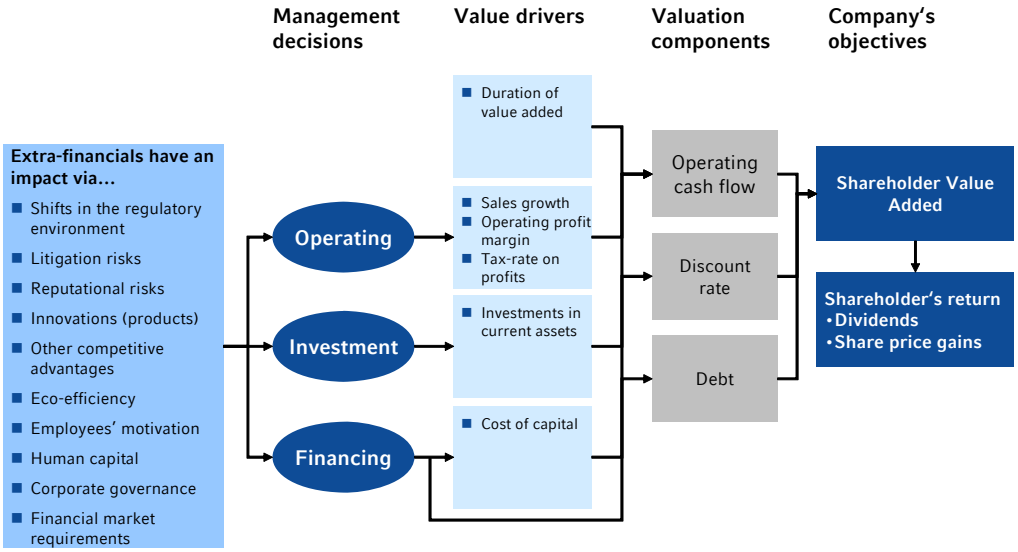
Integrating extra-financial ('Green ICT') information with traditional financial information

Extra-financial information and shareholder value

Incorporating all material information

We have discussed our stance vis-à-vis the incorporation of extra-financial information into investment decision making many times (e.g. see 'What really counts - The materiality of extra-financial factors', February 2007). Hence, we want to limit ourselves here to just a few general remarks. First of all we would like to stress that our perspective on the integration matter is a completely neutral, non-ideological one. We consider all information enabling us to better assess a company's ability to create value as material. In that sense factoring in ESG is by no means a subversive act but is entirely compatible with the traditional shareholder value model.

Extra-financial information and shareholder value – several transmission channels



Source WestLB Research

Using an enriched information set in order to maximise the information coefficient of the portfolio

In our view extra-financial factors are an expansion, as well as a qualitative improvement, of the volume of information that is suitable for maximising long-term investment success in terms of financial risk and return. Hence, in principle we retain the philosophy of the investor as a two-dimensional decision maker driven purely by trade-off between financial risk and return. The only difference is that the 'new investor' we envisage uses a different and enriched set of information in order to maximise the so-called information coefficient in investment decision making.

Still much convincing remains to be done

We are well aware of the fact that the mainstream (>90% of the market) is still in the camp of non-believers and that there are still many obstacles on the road to general acceptance (for a discussion of these, see our note 'GRI reporting – Aiming to uncover true performance', September 2007). The debate definitely has to continue and much convincing remains to be done, but this is certainly the aim of this note. Hence, we continue here by briefly looking at an important distinction that has to be made when talking about integration and then move over to the integration exercise that we have undertaken with respect to the 'Green ICT' topic.

Integration of ESG factors - company valuation vs. portfolio construction

An important but still often neglected distinction has to be made with respect to the type of integration approach. The two major ones are:

- Integration of ESG factors into company valuation
- Integration of ESG factors into portfolio construction & screening processes

Both have the same roots, i.e. the shareholder value/risk-return optimization doctrine, but have very different practical implications and challenges.

Valuation models

Valuation of equities is both an art and a science

The valuation of equities is both an art and a science. It is an art, because we talk about the individual quality with which an analyst is able to incorporate information in estimating future cash flows and risks. As previously stated, ESG is just an extension of the information set that is used by the analyst to enhance the quality of predictions. There is no formal model, no equation that could be set up to help an analyst do this. What differentiates good analysts is the superior understanding of how ESG are correlated with the value drivers of firms in a given sector.

Tools need to be developed that translate ESG information into the language of risk and return

It is a science as well, since expected cash flows and systematic risk can be modelled as a function of ESG factors. The formulas of financial theory do not have to be rewritten though. They can remain in place as they are. As stated above, integrating ESG should not be considered a subversive doctrine. What changes is how future cash flows and risks are estimated. First of all, as said above, the information set used to perform this task is extended compared to traditional approaches (well justified by empirical results, see UNEP FI/Mercer note 'Demystifying performance', October 2007). Secondly, tools need to be developed that are able to translate ESG information into the language of risk and return.

Looking for imperfect, heuristic models of firm value

This translation is not a trivial task and it is simply wrong to assume that there is a single formula that just needs to be discovered. We are not talking financial alchemy here. Rather we are looking for imperfect, heuristic models which allow us to get better proxies of firm value as compared to the traditional, imperfect models that neglect ESG information. First examples do already exist. Most of them focus on adjusting the risk component in 'Discounted Cash Flow' models (see our note 'Inside SRI - We have a dream', June 2004, in which we analysed the impact of a beta risk adjustment on the appraisal value of European insurance companies). However, much remains to be done in this area before one could talk about a truly integrated, systematic valuation approach. The much lower hanging fruit is the integration of ESG factors into portfolio construction and screening processes.

Portfolio construction and screening processes

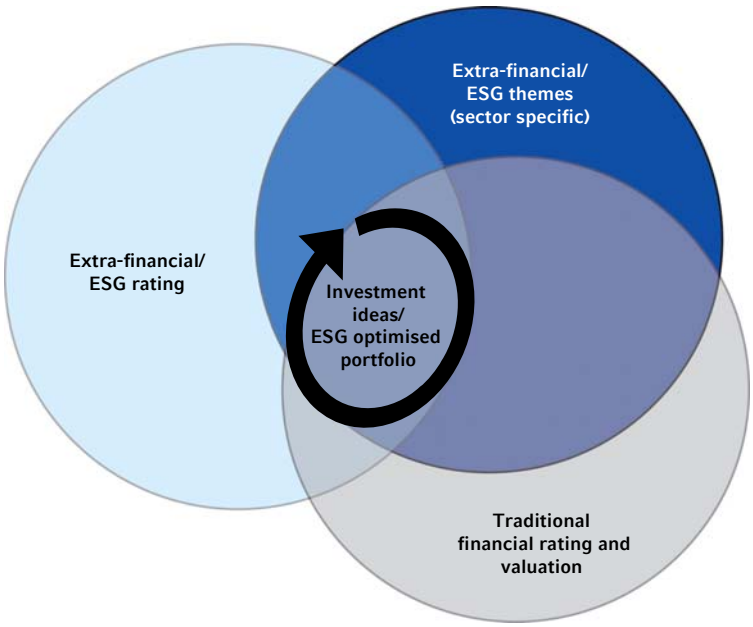
Combining the two information sets

What integration actually means here is the combination of extra-financial information with traditional financial information in a standardised (i.e. disciplined) manner in order to enhance the information coefficient in investment decision making. The following chart the basic idea behind this approach. Integration here does not mean that ESG factors are not modelled as causal drivers of company value, as is the case in the type 1 approach. Rather, the universe of listed companies is screened for investment opportunities that outperform their benchmark with respect to both dimensions – the one that is based on traditional financial selection criteria and the extra-financial one.

True integration vs. simple screening models

Type 2 approaches are less ambitious, but more pragmatic and easier to implement. This, however, does not necessarily mean that their potential to outperform is smaller than that of type 1 approaches. The long history of empirical results showing the superiority of simple screening approaches (e.g. based on value or company size measures) delivers sufficient evidence to support this claim in our view. The question whether a simple screening process works, i.e. leads to an enhanced risk/return profile of the investment portfolio, is a purely empirical one.

Combining extra-financial with traditional financial information



Source WestLB Research

Investment ideas from three different style perspectives

In this note we integrate 'Green ICT' ratings of companies with traditional financial selection criteria based on growth and value measures. Hence, our approach also has a thematic component or overlay within the ESG rating space as it is also indicated in the above chart. We aim to provide investment ideas from the perspective of three investor types: the 'Growth-', the 'Value-', and the 'G.A.R.P.' (Growth At Reasonable Price) investor. We do not claim to deliver a recommended portfolio here, because the number of stocks in our ICT universe (57) is simply too small to arrive at a reasonable degree of diversification. At this point, however, we would like to point out that we are going to apply the G.A.R.P. stock selection process described below to our ESG stock universe to generate a portfolio that will be measured against a generally accepted benchmark (DJ STOXX Global 1800).

'Green ICT' stock ideas for growth investors

When determining the growth characteristic of companies we resort solely to growth ratios independent of the stock price. These include:

- Earnings growth
- Cash flow growth
- Sales growth
- EBITDA growth
- Dividend growth

A broad range of indicators offers protection against biases

Our calculations are based on historical (i.e. realised) data and analyst consensus forecasts. Additionally we differentiate between long-term and short-term growth, so we calculate a total of 18 growth measures, of which one has to be able to calculate at least 11 for a stock to 'survive' the screening process. The use of consensus numbers (JCF) offers some protection against unsystematic biases (diversification effect!). The potential for error is also minimised by using not only one (as is often the case) but a broad range of indicators to assess the growth characteristic of a stock. Furthermore, this has the advantage that stock classification is based on the widest possible information base.

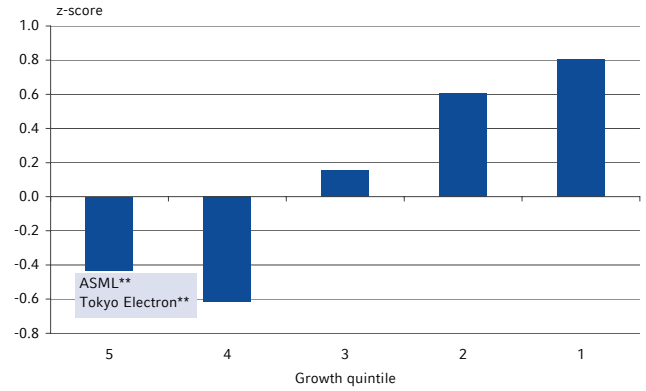
Construction of quintile groups

For each single indicator we establish a ranking list and divide these lists into quintiles (five equally sized groups). We then attach a corresponding quintile score to each of the stocks we consider, i.e. the stocks within the highest growth bracket receive a score of 5, the ones in the lowest quintile receive a score of 1. The quintile scores for the individual indicators are then aggregated on an equally weighted basis to arrive at an overall 'Growth Score' for each stock in our sample. The same methodology is used to arrive at an aggregate 'Value Score' (see below).

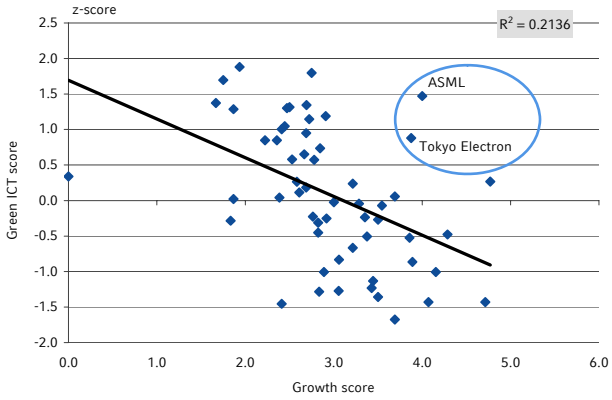
Negative association between 'Growth-' and 'Green ICT' characteristic

First of all, we take a look at the general association between the 'Growth-' and the 'Green ICT' characteristic of the firms in our sample. As the two charts below indicate the correlation between the two is negative, i.e. companies with above (below) average growth rates tend to display comparatively low (high) 'Green ICT' scores. This relationship is statistically highly significant (R^2 of 21%).

Analysis of 'Growth' quintiles - Average 'Green ICT' scores*



Significantly negative association between 'Growth-' and 'Green ICT' scores



* For this analysis we used a secondary quintile ranking to assure that quintiles are equally populated. Secondary ranking in this case means that we've set up a ranking list based on the aggregated growth scores and then divided this list into five equally sized groups again. It is for these five groups we show the average 'Green ICT' scores.

Source WestLB Research, JCF

In the three top growth quintiles the average 'Green ICT' scores are below zero, whereas the companies in the two bottom quintiles display positive values on average. The implication of this is of course, that growth investors find it difficult to invest in 'Green ICT' companies. The group from which they can select from is very small.

ASML and Tokyo Electron lead the list of 'Growth' companies

Looking at the two top growth quintiles, for example, delivers just 5 companies with scores of above zero (above average 'Green ICT' assessment). And among these only two really stand out, i.e. ASML (provider of lithography systems for the semiconductor industry) and Tokyo Electron (vendor of semiconductor production equipment and flat panel displays). With z-scores of 1.47 and 0.88 respectively we attach a sufficiently high degree of confidence in the result of our 'Green ICT' rating. For the three other candidates the z-score is too close to zero to take up a clear stance. On the other hand, short ideas for growth investors based on the 'Green ICT' issue are much more numerous. Taking a z-score of -1.00 as a threshold, we have been able to identify seven companies within this bracket.

Top growth quintiles (4 & 5) – long & short ideas

Company	Growth score	Value score	Green ICT z score	Market Cap in US$	Price 15/05/08
ASML Holding	4.00	3.54	1.47	13,304.8	29.93
Tokyo Electron	3.88	2.31	0.88	10,742.9	65.08
Apple Inc.	4.77	2.00	0.27	166,115.4	189.73
Cisco Systems Inc	3.21	3.50	0.24	157,966.4	26.50
EMC Corp.	3.69	4.00	0.06	37,362.9	17.80
Logitech International SA	3.29	2.25	-0.04	5,324.7	31.24
Tom Tom	3.55	3.58	-0.07	2,289.9	39.85
Applied Materials Inc.	3.35	3.46	-0.23	26,630.4	19.64
Corning Inc	3.50	3.38	-0.27	42,314.2	27.05
OC Oerlikon Corporation AG	4.29	3.42	-0.48	2,416.8	359.92
Altera Corp.	3.38	1.85	-0.51	7,052.7	22.95
SanDisk Corp.	3.86	2.67	-0.52	7,423.0	33.10
Nortel Networks	3.21	3.92	-0.67	3,569.1	8.23
Xilinx	3.06	2.85	-0.83	7,719.1	26.96
Qualcomm	3.89	2.62	-0.86	72,732.8	45.00
Micron Technology Inc	4.15	4.30	-1.01	6,668.7	8.84
ARM Holdings	3.44	2.15	-1.13	2,795.8	2.08
Nvidia Corporation	3.43	3.50	-1.23	13,211.5	23.78
Broadcom	3.50	1.92	-1.36	12,910.2	27.58
Research in Motion Ltd.	4.71	1.75	-1.43	67,244.0	140.88
Juniper Networks	4.07	2.50	-1.43	14,693.5	28.17
Marvell Technology Group	3.69	2.58	-1.68	6,902.0	14.83

Source WestLB Research, JCF

'Green ICT' stock ideas for value investors

13 value indicators are computed for each stock

When determining the value characteristic of companies we used the following indicators:

- The price to earnings per share ratio (P/EPS)
- The price to cash flow per share ratio (P/CPS)
- The price to EBIT and EBITDA per share ratio (P/EBITPS, P/EBITDAPS)
- The price to book per share ratio (P/BPS)
- The price to dividend per share ratio, i.e. the reciprocal of the dividend yield (P/DPS)

For each of these ratios, the denominator is historical values (i.e. realised in the past) but also consensus forecasts for the near future. In this way we receive 13 value indicators, at least 7 of which have to be calculated for a stock to be considered for the screening process.

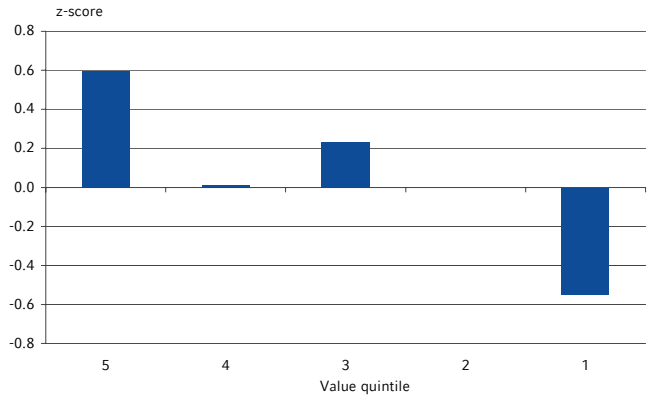
Results: mirror image of our 'Growth' analysis – positive association between 'Value' and 'Green ICT'

Looking at the results of our value analysis one can say that they basically appear to be the mirror image of our 'Growth' analysis. There is a clear and statistically significant positive link between the 'Value-' and the 'Green ICT' characteristic of a firm. Companies that offer above (below) average 'Value' tend to provide above (below) average 'Green ICT' scores. To be clear: this result is not produced by any 'technical', artificially induced correlation between our 'Value-' and 'Growth' measures. As stated above, we do not use valuation ratios as B/M, for example, to classify stocks with respect to their growth potential. All 'Growth' measures we use are independent of stock price.

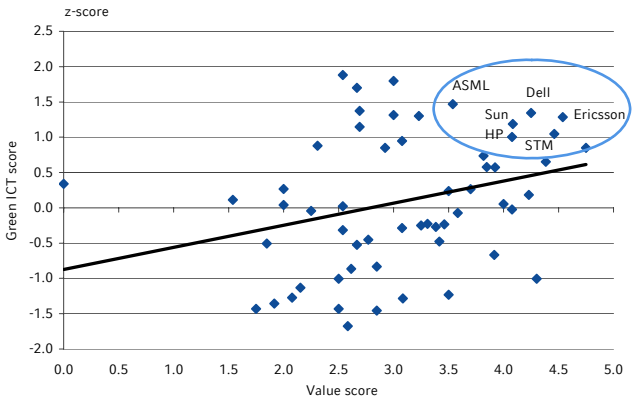
Company size may have had an effect on the results

The conclusion is that there seems to be a fundamental difference between 'Value-' and 'Growth' companies in terms of their relationship vis-à-vis 'Green ICT' issues. Obviously, company size plays a role here as well, since naturally smaller firms tend to display higher growth rates than more mature larger firms. This, however, is directly related to disclosure and reporting propensities: smaller firms tend to not report on ESG issues, which automatically leads to discounts in ESG type ratings. Of course, one could also put forward the hypothesis that environmental issue are simply compromised in strongly growing firms. We cannot reject this, but do not have further evidence that would fundamentally support this hypothesis.

Analysis of 'Value' quintiles - Average 'Green ICT' scores*



Significantly positive association between 'Value-' and 'Green ICT' scores



* For this analysis we used a secondary quintile ranking to assure that quintiles are equally populated. Secondary ranking in this case means that we've set up a ranking list based on the aggregated value scores and then divided this list into five equally sized groups again. It is for these five groups we show the average 'Green ICT' scores.

Source WestLB Research, JCF

63.6% of companies within the top 'Value' quintile have an above average 'Green ICT' score

Coming back to the 'Value' investor, the favourable practical effect of the positive link between 'Value' and 'Green ICT' is that there simply is a sufficient number of companies from which the 'Value' investor can choose from. In the two top quintiles there are 14 out of 22 companies with an above-average 'Green ICT' score (63.6%), six of which with a score of above 1.00 (more than one standard deviation above average). The latter ones include once again ASML (to be found on top of the 'Growth' list as well), Dell, Ericsson, Sun Microsystems, STMicroelectronics and HP. On the other hand, the number of short ideas for 'Value' investors is very limited. Of the seven companies with negative 'Green ICT' scores, only Micron Technology and Nvidia Corporation display z-scores of below minus one, which is the threshold we would recommend here (given the quite large gap that exists between the next company on the list, which is Nortel Networks).

Top value quintiles (5 & 4) – long & short ideas

Company	Growth score	Value score	Green ICT z score	Market Cap in US$	Price 15/05/08
ASML Holding	4.00	3.54	1.47	13,304.8	29.93
Dell Inc	2.69	4.25	1.34	40,644.8	20.63
Ericsson	1.87	4.54	1.29	40,042.7	2.70
Sun Microsystems Inc	2.91	4.08	1.19	10,694.4	13.49
STMicroelectronics	2.44	4.46	1.05	8,519.4	12.92
Hewlett Packard Co	2.41	4.08	1.00	120,472.6	46.73
Xerox Corp.	2.36	4.75	0.85	13,422.7	14.52
Alcatel-Lucent	2.85	3.82	0.74	17,230.5	7.44
Nokia	2.67	4.38	0.65	110,897.1	28.20
IBM	2.53	3.85	0.58	175,479.8	128.46
Intel Corp.	2.78	3.92	0.57	145,236.4	24.97
Infineon Technologies AG	2.58	3.70	0.26	7,902.3	10.54
Cisco Systems Inc	3.21	3.50	0.24	157,966.4	26.50
Seagate Technology Inc	2.69	4.23	0.18	11,393.3	21.33
EMC Corp.	3.69	4.00	0.06	37,362.9	17.80
Texas Instruments Inc	3.00	4.08	-0.02	41,593.4	31.36
Tom Tom	3.55	3.58	-0.07	2,289.9	39.85
Applied Materials Inc.	3.35	3.46	-0.23	26,630.4	19.64
OC Oerlikon Corporation AG	4.29	3.42	-0.48	2,416.8	359.92
Nortel Networks	3.21	3.92	-0.67	3,569.1	8.23
Micron Technology Inc	4.15	4.30	-1.01	6,668.7	8.84
Nvidia Corporation	3.43	3.50	-1.23	13,211.5	23.78

Source WestLB Research, JCF

'Green ICT' stock ideas for G.A.R.P. investors

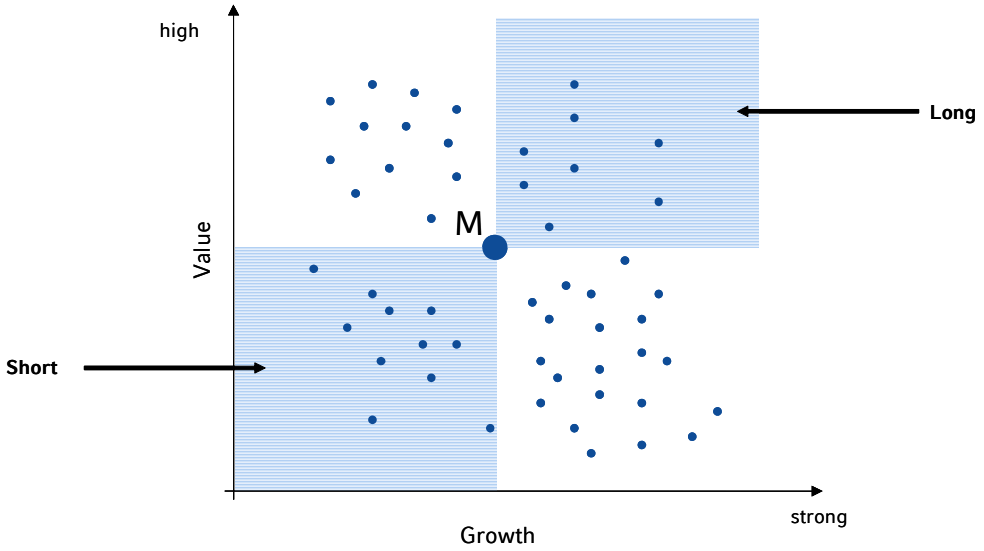
Synthesis between two puristic investment styles

The third investment style we are looking at here can be considered as a synthesis between the two puristic styles we looked at above. The G.A.R.P. (Growth At Reasonable Price) investment style combines the advantages and the return on the factors 'Growth' and 'Value' in investment decision making and portfolio construction processes. The aim is to identify stocks which show above-average growth and are – simultaneously – available at a reasonable price (at least with an average value characteristic).

Growth and value – not just two sides of the same coin

Classical approaches of identifying value and growth stocks are not suitable for assembling a G.A.R.P. portfolio. Methods that see growth and value as two sides of the same coin and accordingly classify stocks based on only one indicator (in most cases the book/market ratio), do not go far enough since they derive growth potential only indirectly from valuation ratios and thereby assume implicitly that the market values these potentials rationally. So while on the one hand it is assumed that the market finds the correct valuation, the value investment style is at the same time based implicitly on the idea that there are over and under-valuations, i.e. that the market does not price stocks correctly (valuation anomalies). To avoid this contradiction we consider whether a stock is a growth stock completely independent of valuation yardsticks such as the P/E ratio or the book/market (B/M) ratio. By doing this we take account of the fact that a company with a particularly low B/M ratio is not necessarily a growth company.

Combining 'Value' and 'Growth' – the G.A.R.P. stock selection philosophy



Source WestLB Research

G.A.R.P. – Generating long & short ideas based on the 'Green ICT' topic

We start by looking at growth and then identify those stocks that offer superior value

Portfolio construction is as follows: since 'Growth' is our primary criterion, we first look at the fifth growth quintile for stocks with an at least average valuation (value quintile ≥ 3). We first look at the stocks in the fifth value quintile, then in the fourth value quintile then the third. If this does not produce a sufficient number of stocks to choose from based on extra-financial scores, which can normally be assumed because of the negative correlation between value and growth, the same procedure starts in the fourth growth quintile until our G.A.R.P. target list is sufficiently populated.

G.A.R.P. selection process delivers only a small number of ideas: ASML (long), and KLA Tencor (short)

For the G.A.R.P. investor the number of 'Green ICT' stock ideas is very limited. Only three companies among the long candidates have 'Green ICT' scores of above zero, indicating an above average performance. And only one of them has a 'Green ICT' score that is truly significantly positive, and that is ASML. The company did already show up in the two other recommended lists, i.e. in the 'Growth-' and the 'Value' list. So ASML seems to be the only clear pick from style perspectives focusing on the 'Green ICT' topic. Among the short candidates there are also only two that would fulfil our additional extra-financial requirement. And out of these two only KLA Tencor Corp (yield enhancement equipment for the semiconductor industry) displays a score that is truly significantly below zero.

G.A.R.P. stock selection lists - long & short ideas based on the 'Green ICT' topic

Long positions Company	Growth score	Value score	Green ICT z score	Market Cap in US$	Price 15/05/08	Short positions Company	Growth score	Value score	Green ICT z score	Market Cap in US$	Price 15/05/08
ASML Holding	4.00	3.54	1.47	13,304.8	29.93	KLA Tencor Corp	2.41	2.85	-1.45	8,330.9	46.27
Cisco Systems Inc	3.21	3.50	0.24	157,966.4	26.50	Neopost SA	1.83	3.08	-0.28	3,631.8	114.53
EMC Corp.	3.69	4.00	0.06	37,362.9	17.80	Rohm Co Ltd	1.87	2.54	0.02	6,910.2	65.08
Tom Tom	3.55	3.58	-0.07	2,289.9	39.85	Mitsumi Electric	2.38	2.00	0.04	3,010.2	34.92
Applied Materials Inc.	3.35	3.46	-0.23	26,630.4	19.64	Advantest	2.61	1.54	0.11	4,533.5	27.19
Corning Inc	3.50	3.38	-0.27	42,314.2	27.05	Brother Industries Ltd	2.22	2.92	0.85	3,836.5	13.87
OC Oerlikon Corporation AG	4.29	3.42	-0.48	2,416.8	359.92	Konica Minolta Holdings	2.69	3.08	0.95	9,408.1	17.72
Nortel Networks	3.21	3.92	-0.67	3,569.1	8.23	Motorola Inc	2.72	2.69	1.15	22,841.0	10.13
Micron Technology Inc	4.15	4.30	-1.01	6,668.7	8.84	Ricoh Co Ltd	2.47	3.23	1.30	12,950.0	17.62
Nvidia Corporation	3.43	3.50	-1.23	13,211.5	23.78	Canon	2.50	3.00	1.32	63,925.5	53.34
						Fujitsu	1.67	2.69	1.37	15,390.3	7.44
						Seiko Epson Corp.	1.75	2.67	1.70	3,995.9	24.67
						TOSHIBA CORP	2.75	3.00	1.80	27,061.5	8.42
						NEC Corporation	1.93	2.54	1.88	10,655.1	5.26

Source WestLB Research, JCF

Appendix

Table of EPEAT criteria

(R: required, O: optional)

Reduction/elimination of environmentally sensitive materials

(R) Compliance with provisions of EU RoHS Directive on its effective date
(O) Elimination of intentionally added cadmium
(R) Reporting on amount of mercury used in light sources (mg)
(O) Low threshold for amount of mercury used in light sources
(O) Elimination of intentionally added mercury used in light sources
(O) Elimination of intentionally added lead in certain applications
(O) Elimination of intentionally added hexavalent chromium
(R) Elimination of intentionally added SCCP flame retardants and plasticisers in certain applications
(O) Large plastic parts free of certain flame retardants classified under European Council Directive 67/548/EEC
(O) Batteries free of lead, cadmium and mercury
(O) Large plastic parts free of PVC

Materials selection

(R) Declaration of post-consumer recycled plastic content (%)
(O) Minimum content of post-consumer recycled plastic
(O) Higher content of post-consumer recycled plastic
(R) Declaration of renewable/bio-based plastic materials content (%)
(O) Minimum content of renewable/bio-based plastic materials
(R) Declaration of product weight (lbs)

Design for end of life

(R) Identification of materials with special handling needs
(R) Elimination of paints or coatings that are not compatible with recycling or re-use
(R) Easy disassembly of external enclosure
(R) Marking of plastic components
(R) Identification and removal of components containing hazardous materials
(O) Reduced number of types of plastic material
(O) Moulded/glued-in metal eliminated or removable
(R) Minimum 65% re-usable/recyclable
(O) Minimum 90% re-usable/recyclable
(O) Manual separation of plastics
(O) Marking of plastics

Product longevity/life cycle extension

(R) Availability of additional three-year warranty or service agreement
(R) Upgradeable with common tools
(O) Modular design
(O) Availability of replacement parts

Energy conservation

(R) ENERGY STAR®
(O) Early adoption of new ENERGY STAR® specification
(O) Renewable energy accessory available
(O) Renewable energy accessory standard

End-of-life management

(R) Provision of product take-back service
(O) Auditing of recycling vendors
(R) Provision of rechargeable battery take-back service

Corporate performance

(R) Demonstration of corporate environmental policy consistent with ISO 14001
(R) Self-certified EMS for design and manufacturing organisations
(O) Third-party-certified EMS for design and manufacturing organisations
(R) Corporate report consistent with Performance Track or GRI
(O) Corporate report based on GRI

Packaging

(R) Reduction/elimination of intentionally added toxics in packaging
(R) Separable packing materials
(O) Packaging 90% recyclable and plastics labelled
(R) Declaration of recycled content
(O) Minimum post-consumer content guidelines
(O) Provision of take-back programme for packaging
(O) Documentation of re-usable packaging

Key product criteria for ENERGY STAR-qualified computers

Tier 1 Energy efficiency requirements: effective 20 July 2007

Product type	Tier 1 requirements
Desktops, integrated computers, desktop-derived servers and gaming consoles	Standby (Off mode): <= 2.0 W Sleep mode: <= 4.0 W Idle state*: Category A: <= 50.0 W Category B: <= 65.0 W Category C: <= 95.0 W *Note: desktop-derived servers are exempt from the Sleep level above.*
Notebooks and tablets	Standby (Off mode): <= 1.0 W Sleep mode: <= 1.7 W Idle state*: Category A: <= 14.0 W Category B: <= 22.0 W
Workstations	TEC Power (PTEC): <= 0.35 * [PMax + (# HDDs * 5)] W *Note: Where Pmax is the maximum power drawn by the system as tested per the test procedure in Section 4 of Appendix A, and #HDD is the number of installed hard drives in the system.*

Source ENERGY STAR, EPA

Tier 1 Power supply and power management requirements: effective July 20, 2007

Efficient power supply requirements	**Internal power supplies:** 80% minimum efficiency at 20%, 50%, and 100% of rated output and minimum power factor 0.9. **External power supplies:** either ENERGY STAR qualified or meet the no-load and active mode efficiency levels provided in the ENERGY STAR external power supply (EPS) specification.
Power management	**Monitor Sleep mode:** within 15 minutes of user inactivity **System Sleep mode:** within 30 minutes of user inactivity

Source ENERGY STAR, EPA

Blue Angel label for computer products – basic requirements

Devices must have a recyclable design

Devices must have a recyclable design and meet the requirements of the German Electrical and Electronic Equipment Act. Neither chloro-organic or bromo-organic compounds, nor carcinogenic, mutagenic or reprotoxic substances may be added to the plastics used in casings. An imperative exists to minimise production-related impurities caused by heavy metals. Dyes that can release carcinogenic amines may not be used. Plastic parts with a weight greater than 25 grams shall be definitely marked. Parts supply shall be guaranteed for a minimum of 5 years from the end of production. Product take-back shall be guaranteed. Devices may usually be returned to municipal collection sites as one starts out from a possible private follow-up use of computers from the business sector.

Maximum limits on power consumption

The maximum power consumption limits of system units and portable computers in energy-saving modes are set, as are the respective permissible default times. The latter may be reduced by the user. The on/off switch should be located on the front of the device. Activation of this switch should set the device into Off-mode. The power consumption of monitors should meet the ENERGY STAR requirements, Vers. 4, Tier 2.

Noise emissions

Noise emissions are characterised by the guaranteed (declared) level of sound power determined on the basis of international standards. Noise emissions are limited and are to be determined separately in idle mode, with the hard disk activated, with an optical drive activated and at high load. Noise emissions caused by keyboards are to be tested and indicated in accordance with the relevant standard. However, for the time being there will be no evaluation of the findings of tests within the scope of the eco-label award.

System units and portable computers shall be upgradeable

System units and portable computers shall be upgradeable. Keyboards and monitors shall meet standardised ergonomic requirements. Much weight is attached to detailed user information in product documents. Information relevant to the award of the Blue Angel label, such as energy-saving possibilities, noise development, guarantee of repairs and product take-back, shall be summarised in a separate information and data sheet, and attached to devices. These data sheets should also be published on the applicant's website.

Climate Savers Computing Initiative (CSCI)

CSCI requirements: volume server minimum efficiency targets and purchase commitment level

	July 2007-June 2008	July 2008-June 2009	July 2009-June 2010	July 10-June 2011
85% PSU	≥20%	≥80%	≥80%	100%
89% PSU		≥20%	≥40%	100%
92% PSU				≥20%

Source Climate Savers Computing Initiative

Electronic Industry Code of Conduct (EICC) – environmental standards

Environmental permits and reporting

All required environmental permits (e.g. discharge monitoring) and registrations are to be obtained, maintained and kept current, and their operational and reporting requirements are to be followed.

Pollution prevention and resource reduction

Waste of all types

Waste of all types, including water and energy, is to be reduced or eliminated at the source or by practices such as modifying production, maintenance and facility processes, materials substitution, conservation, recycling and re-using materials.

Hazardous substances

Chemicals and other materials

Chemicals and other materials posing a hazard if released into the environment are to be identified and managed to ensure their safe handling, movement, storage, recycling or re-use, and disposal.

Wastewater and solid waste

Wastewater and solid waste generated from operations, industrial processes and sanitation facilities are to be monitored, controlled and treated as required prior to discharge or disposal.

Air emissions

Air emissions of volatile organic chemicals, aerosols, corrosives, particulates, ozone-depleting chemicals and combustion by-products generated from operations are to be characterised, monitored, controlled and treated as required prior to discharge.

Product content restrictions

Participants are to adhere to all applicable laws and regulations regarding prohibition or restriction of specific substances, including labelling laws and regulations for recycling and disposal. Participants are also to adhere to processes to comply with each agreed-upon customer-specific list of restricted and hazardous materials.

GeSI – activities

Supply chain

Constantly growing membership

The Supply Chain Working Group (SCWG) was formed at a time when many companies within the ICT sector were starting to address issues such as labour standards and working conditions within their extended supply chains. It was recognised that the issues being addressed and the approaches that companies were taking were common, but that

the impact of this effort could be greater if companies worked together and developed an industry-wide approach. From six founder companies, the SCWG now has 12 members and is constantly growing.

In 2004 a number of North American-based electronics companies developed the Electronics Industry Code of Conduct to address supply chain standards. The code's authors and a number of its adopters formed the EICC Group with very similar aims to those of the SCWG, and in 2005 a memorandum of understanding was signed between the two groups, bringing them together with a common strategic plan.

A consistent set of tools and processes

The main aim of this collaborative effort is to develop and deploy a consistent set of tools and processes to measure, monitor and improve corporate responsibility in supply chains across the ICT sector. In doing so, member companies will:

- Promote and develop good practice
- Aim to eliminate duplication
- Respect generally recognised principles
- Seek to be consistent with recognised standards, codes and regulations
- Adopt a principle of continuous improvement
- Co-operate with other companies and groups inside and outside the sector
- Seek input from other stakeholders

Activities

Specific activities and tools that need to be developed

Working within the framework of a supplier engagement model, the group has identified a number of specific activities and tools that needed to be developed, which have been assigned to dedicated working teams. These address the development of:

- A supplier self-assessment questionnaire
- Risk assessment tools
- Common audit protocols and a joint audit process
- A web-based data management tool (E-TASC)
- A learning and capability-building strategy

The SCWG has been coordinating the work of these teams and overseeing consolidation of the output into a comprehensive supply chain management system.

Climate change

The potential of ICT to mitigate climate change

ICT has the potential to mitigate global climate change when it removes the need for travel- and paper-based processes and leads to greater worker productivity. Nonetheless, ICT impacts climate change through the increasing use of fossil fuel to generate electricity for manufacturing and running ICT equipment, applications and services. According to data from the Carbon Disclosure Project, greenhouse gas emissions by the

ICT sector are small relative to its share of the world economy. However, the amount of total electricity consumed by ICT is increasing steadily, despite improvements in the efficiency of electronic components. Electricity demand for new and increased ICT services now exceeds the energy being saved by efficiency improvements. Energy loss when equipment is left on standby or is not performing its main functions is also highly significant.

GeSI set up a working group as a result of the first global workshop on ICT and climate change in 2004. This event brought together ICT sustainability and energy experts from Europe, North America and Japan to explore emerging challenges, opportunities and technical solutions relating to energy efficiency and global climate change.

Initiating solutions through the development of measurement systems

The Climate Change Group is working to identify the overall impact of ICT and to initiate solutions through the development of measurement systems. Currently, the group is developing a tool to quantify carbon credits for using video/teleconferencing as an alternative to business travel. Its goal is to provide an online emissions measurement tool that can be used by any individual or company to generate offset credits in accordance with the ISO-14064 standard. The plan is to make video/teleconferencing the first ICT service to receive the economic benefit of carbon trading. The group is also evaluating the different video/teleconferencing options on the market and is investigating other ways to use communication tools to avoid travel.

Accountability

Sustainability reporting has evolved significantly in the past few years. An increasing number of companies have engaged with stakeholders to clarify reporting standards and verification. However, it is often unclear what stakeholders really look for in these reports. In 2005 GeSI held a series of workshops entitled 'Technology Convergence and Corporate Sustainability Reporting in the Information Society'.

GeSI also convened a multi-stakeholder task force to develop a Telecommunications Sector Supplement to the GRI 2002 Sustainability Reporting Guidelines. This was done in partnership with the GRI and with financial support from the European Commission. Given the breadth of the ICT sector, this initial supplement is focused on the telecommunications industry.

E-waste

Programmes to re-use and recycle existing equipment

GeSI is exploring ways of reducing the increasing challenge of e-waste, including programmes to re-use and recycle existing equipment. GeSI is working with the Mobile Phone Partnership Initiative (MPPI), a UN public-private partnership of the Basel Convention with representatives of mobile phone manufacturers, telecom operators, phone recyclers, NGOs and representatives of the Basel Convention Secretariat. The MPPI aims to:

- Reduce the environmental impact of mobile phones
- Influence consumer behaviour
- Promote environmentally sound management of used and discarded mobile phones

Materiality

Identifying key issues of material concern

The group's overall objective is to identify key issues of material concern regarding the ICT sector as identified by GeSI members, other ICT companies, investment analysts, civil society groups and other stakeholders. The outcome of the materiality process will be a list of issues that are potentially material to all companies in the ICT sector. The findings of the materiality process were due to be published in early 2008.

Multi-stakeholder dialogue

The global issues will be addressed by consultation with stakeholders through a series of global multi-stakeholder dialogues focused on areas where the ICT sector can make the most substantial contribution to sustainable development. It will be categorised by ICT industry sub-sectors such as consumer electronics, service providers, internet and equipment manufacturing, and will be forward looking – an important consideration, given the speed of development in the ICT industry. The outcome is intended to deliver the following benefits:

- Companies can support their own materiality processes and assist in the development of sustainability reports and strategies.
- Investment analysts can gain understanding of the issues considered most material to companies in the ICT sector, and thereby be assisted in their research of and engagement with the ICT sector.
- GeSI can focus the development of its own future strategy and work plan to cover those issues most material to the ICT sector.

Reporting

EN3 Direct energy consumption by primary energy source; and EN4 Indirect energy consumption by primary energy source

Company	Definition in respective company report	2007	2006	2005	2004	2003	2002
IBM	**Total direct consumption (GJ)**		**5,494,258.0**	**6,111,583.0**	**6,787,593.0**		
	Biofuels		0.0				
	Ethanol		0.0				
	Hydrogen		0.0				
	total direct consumption of renewable primary energy		0.0				
	Coal		0.0				
	Natural gas		4,937,999.0	5,371,109.0	6,120,748.0		
	Fuel distilled from crude oil		556,259.0	740,474.0	666,845.0		
	Total direct consumption of non-renewable primary energy		5,494,258.0	6,111,583.0	6,787,593.0		
	Total indirect consumption (GJ)		**19,484,161.0**	**18,234,759.0**	**16,535,867.0**		
	Solar		183.0	183.0	183.0		
	Wind		391,697.0	50,089.0	48,812.0		
	Geothermal						
	Hydro energy						
	Biomass-based intermediate energy		897.0	897.0	897.0		
	Hydrogen-based intermediate energy						
	CHP/Wind/Biomass		896,750.0	377,496.0	695,570.0		
	Solar/Wind		30,504.0	44,246.0	44,246.0		
	Renewable indirect sources		1,320,031.0	472,911.0	789,708.0		
	Electricity		18,164,130.0	17,761,848.0	15,746,159.0		
	Heating and cooling						
	Steam						
	Nuclear energy						
	Non-Renewable indirect sources		18,164,130.0	17,761,848.0	15,746,159.0		
Ericsson	Fuels (GWh) (scope 1 of GHG measured at each site/location)		22.0	20.0	30.0	40.0	46.0
	Total indirect consumption (GWh)		**590.0**	**460.0**	**500.0**	670.0	829.0
	District heating consumption (GWh)		60.0	60.0	80.0	90.0	100.0
	Electricity consumption (GWh)		530.0	400.0	420.0	580.0	729.0
HP	**(Sum natural gas use and renewable energy purchasing in m kWh)**	**418.0**	**449.1**	**501.4**			
	Natural gas use (m kWh)	356.6	437.7	430.4			
	Natural gas use per unit floorspace (kWh/m^2)	62.5	74.0	71.0			
	Renewable energy purchasing (m kWh energy and renewable energy credits)	61.4	11.4	NA			
	Electricity use (million kWh)	**2,704.0**	**2,759.0**	**2,801.0**			
	Electricity use per unit floorspace (kWh/m^2)	474.0	464.0	460.0			

Source WestLB Research, company reports

EN3 Direct energy consumption by primary energy source; and EN4 Indirect energy consumption by primary energy source (cont'd)

Company	Definition in respective company report	2007	2006	2005	2004	2003	2002
ASML	**Total energy consumption (x 10^{12} Joule)**	**750.0**	**707.0**	**680.0**			
	- Electricity used	447.0	425.0	392.0			
	- Fuels purchased	357.0	330.0	340.0			
	- Energy cogeneration plant	54.0	48.0	52.0			
	Energy use / net sales ('000s kJ/€)	0.20	0.20	0.27			
	Natural gas used (for cogeneration plant) (10^{12} J)	126.0	113.0	125.0			
	Inert gas consumption (10^6 m^3)	12.8	10.5	9.2			
Dell	Electricity usage (m kWh)	~ 410	~ 380	~ 370	~ 300	~290	
	- US offices, labs, data centres	~ 210	~ 200				
	- global manufacturing & fulfilment	~ 200	~ 180				
Cisco	**Worldwide energy consumption (GWh)**	**898.0**	**856.0**	**753.0**			
	Normalized worldwide energy consumption / sales (GWh/US$ bn)	25.7	30.1	30.4			
Nokia	**Energy consumption (GWh)**		**850.0**	**810.0**	**770.0**	**540.0**	**690.0**
	Electricity total (GWh)		680.0	639.0	603.0	540.0	528.0
	District heating, total (GWh)		93.0	96.0	94.0	102.0	104.0
	District cooling, total (GWh)		2.0	2.0	2.4		
	Gas, total (GWh)		65.0	71.0	69.0	67.0	57.0
	Oil, total (GWh)		9.5	1.7	2.0	1.0	0.0
Toshiba	**Energy (TJ)**		**53,395.0**				
	- Electricity (TJ)		45,500.0				
	- City gas (TJ)		4,473.0				
	- Bunker A heavy oil (TJ)		1,092.0				
	- LPG (TJ)		954.0				
	- Kerosene (TJ)		68.0				
	- Light oil (TJ)		768.0				
	- Others (TJ)		540.0				
	Energy (Products logistics in Japan) (kJ)						
	- gasoline (kJ)		236.0				
	- light oil (kJ)		24,807.0				
STM	Electricity consumption (GWh)		2,469.0	2,341.0	2,148.0		
	Consumption of electricity - normalised (kWh/production unit; 1994=100)		53.3	56.7	58.6	63.2	70.1

Source WestLB Research, company reports

EN16 Total direct and indirect greenhouse gas emissions by weight

Company	Definition in respective company report	2007	2006	2005	2004	2003	2002
Ericsson	**Total CO_2 emissions (t)**		**730,000.0**	**703,000.0**	**550,000.0**	**526,000.0**	**635,000.0**
	CO_2 emissions from sites energy consumption (t)		153,000.0	128,000.0	138,000.0	186,000.0	235,000.0
	Other relevant indirect GHG emissions (t)		577,000.0	575,000.0	412,000.0	340,000.0	400,000.0
	- Transports (t)		440,000.0	440,000.0	280,000.0	185,000.0	215,000.0
	- Travel (t)		97,000.0	92,000.0	89,000.0	101,000.0	118,000.0
	- Commuting (t)		40,000.0	43,000.0	43,000.0	54,000.0	67,000.0
Nokia	**Total CO_2 emissions (t)**		**331,609.0**	**296,445.0**	**204,085.0**	**181,885.0**	**11,600.0**
	Direct CO_2 emissions total (t)		15,755.0	14,743.0	14,445.0	13,600.0	
	Indirect CO_2 emissions total (t)		315,854.0	281,702.0	189,640.0	168,285.0	
Cisco	**Greenhouse gas emissions ('000s t CO_2)**	**311.0**	**349.0**	**312.0**			
	Normalised GHG emissions / sales (t CO_2 / US$m)	8.9	12.3	12.6			
IBM	**Total direct and indirect GHG emissions (t CO_2e)**		**2,674,673.0**	**2,718,651.0**	**2,381,673.0**	**2,545,677.0**	
	CO_2 direct (t CO_2 eq)		294,197.0	348,248.0	367,404.0	383,751.0	
	CO_2 indirect Scope 2 (t CO_2 eq)		2,125,110.0	2,140,978.0	1,824,019.0	1,962,284.0	
	CH_4 direct (t CO_2 eq)						
	N_2O direct (t CO_2 eq)*		12,400.0	0.1			
	HFCs direct (t CO_2 eq)		4,600.0	4,865.0	4,212.0	2,316.0	
	PFCs direct (t CO_2 eq)		228,781.0	218,816.0	177,529.0	190,355.0	
	CF_6 direct (t CO_2 eq)		9,585.0	5,744.0	8,509.0	6,971.0	
	Subtotal Direct (t CO_2 eq)		549,563.0	577,673.1	557,654.0	583,393.0	
	Subtotal Ind. Scope 2 (t CO_2 eq)		2,125,110.0	2,140,978.0	1,824,019.0	1,962,284.0	
	Total direct and indirect GHG emissions (t CO_2 eq)		2,674,673.0	2,718,651.1	2,381,673.0	2,545,677.0	
	Subtotal Ind. Scope 3 (from G3 EN17) (t CO_2 eq)						
Dell	CO_2 emissions from electricity use (metric tons)	~ 380,000					
HP	**Greenhouse gas emissions (t CO_2e)**	**1,516,300.0**	**1,598,500.0**	**1,551,300.0**			
	GHG emissions per unit of floorspace (t CO_2e/m2)	0.266	0.269	0.255			
	PFC emissions (t CO_2e)	13,687.0	15,373.0	NA			
	GHG emissions from HP employee business commercial air travel [t CO_2e]	289,000.0	289,000.0	279,000.0			
	GHG emissions from HP auto fleet [t CO_2e]	14,300.0	NA	NA			
	- USA + Canada	87,200.0	89,400.0	86,600.0			
	- Asia Pacific + Japan	2,500.0	NA	NA			
	- Europe, Middle East + Africa	71,400.0	85,400.0	70,600.0			
Toshiba	**Greenhouse gases (t CO_2e)**		**3,410,000.0**				
	CO_2		2,440,000.0	232,000.0	227,000.0	224,000.0	
	ratio to net output (compared to 1990)		63%	66%	70%	72%	
	other than CO_2		96,600.0	96,100.0	97,500.0	103,100.0	
	- PFC		700,000.0				
	- HFC		50,000.0				
	- SF_6		210,000.0				
	- Others		10,000.0				
	Greenhouse gases during transport (product logistics in Japan) (t CO_2)		72,000.0				

* 2005 figure for IBM's direct N_2O emissions appears to be incorrect

Source WestLB Research, company reports

EN16 Total direct and indirect greenhouse gas emissions by weight (cont'd)

Company	Definition in respective company report	2007	2006	2005	2004	2003	2002
STM	**Global warming (MTCE)**		**563,363.0**	**626,420.0**	**522,877.0**		
	CO_2 due to energy (direct & indirect emissions) (ktons)		1,039.0	1,157.0	1,046.0		
	Direct emissions due to PFCs (ktons)		728.0	747.0	718.0		
	Transportation emissions (ktons)		242.0	242.0	231.0		
	Total emissions (ktons)		2,009.0	2,146.0	1,995.0		
	Sequestration due to implementation of reforestration projects		81.0	40.0	3.0		
	Total net CO_2 emissions (ktons)		1,928.0	2,106.0	1,992.0		
	CO_2 emissions - normalised values (ktons CO_2/wafer out; 1994 = 100)		40.0	48.0	52.0	57.0	63.0
ASML	**Total emissions of greenhouse gases (10^6 kg)**	**67.3**	**63.6**	**60.2**			
	CO_2 direct (from purchased fuels)	26.9	24.9	25.3			
	CO_2 indirect (from purchased electricity)	40.4	38.7	34.9			
	NO_x direct (from purchased fuels)	26.9	24.9	25.3			
	GHG emissions / net sales (t/m Euro)	17.7	17.7	23.8			

Source WestLB Research, company reports

EN22 Total weight of waste by type and disposal method

Company	Definition in respective company report	2007	2006	2005	2004	2003	2002
Ericsson	Waste, total (t)		23,000.0	18,500.0	23,350.0	27,000.0	29,900.0
	- Special treatment (hazardous) (t)		531.0	280.0	350.0	440.0	440.0
	- Landifll (t)		5,230.0	6,200.0	9,000.0	10,782.0	11,980.0
	- Incineration (energy recovery) (t)		5,490.0	3,100.0	4,000.0	4,572.0	5,080.0
	- Recycling of materials (t)		8,320.0	6,800.0	8,500.0	9,432.0	10,480.0
	- Reuse (mostly packaging) (t)		NA	2,200.0	1,500.0	1,782.0	1,920.0
	- Recycling of electronics (t)		3,310.0	NA	NA	NA	NA
Nokia	**All waste, total (t)**		**49,952.0**	**35,236.0**	**27,072.0**		
	Solid waste, total (t)		49,668.0	34,612.0	26,605.0	25,600.0	24,600.0
	Recovery rate (%)		83%	82%	84%	78%	76%
	Other waste, total (t)		284.0	624.0	467.0		
	Recovery rate (%)		62%	79%	71%		
Cisco	*only % of total waste, but no figures on total amount*						

Source WestLB Research, company reports

EN22 Total weight of waste by type and disposal method (cont'd)

Company	Definition in respective company report	2007	2006	2005	2004	2003	2002
IBM	**Total waste generated (MT)**		**132,419.2**	**121,339.4**	**149,688.5**	**146,386.0**	
	Total - hazardous (in MT)		11,542.4	12,492.3	13,093.7	11,656.1	
	Total - non-hazardous (in MT)		120,876.8	108,847.1	136,594.8	134,729.9	
	Composting - hazardous		0.0	0.0	0.0		
	Composting - non-hazardous		0.0	875.9	0.0		
	Re-use - hazardous		1,618.7	0.0	663.9		
	Re-use - non-hazardous		0.0	6,770.6	0.0		
	Recycling - hazardous		1,155.1	942.6	2,307.8		
	Recycling - non-hazardous		89,915.3	69,967.9	107,472.7		
	Recovery - hazardous		446.4	1,499.3	953.2		
	Recovery - non-hazardous		0.0	1,284.8	0.0		
	Incineration - hazardous		814.9	710.8	716.4		
	Incineration - non-hazardous		3,023.0	1,510.2	2,302.6		
	Incineration for energy recovery - hazardous		26.7	2.2	84.7		
	Incineration for energy recovery - non-hazardous		0.0	3,855.1	1,447.0		
	Landfill - hazardous		3,786.8	4,114.0	2,697.9		
	Landfill - non-hazardous		21,516.6	18,856.2	22,072.9		
	Deep well injection - hazardous		0.0	0.0	0.0		
	Deep well injection - non-hazardous		0.0	0.0	0.0		
	On-site storage - hazardous		2.6	8.9	0.0		
	On-site storage - non-hazardous		227.0	196.0	0.8		
	Other treatments - hazardous		3,691.1	5,214.5	5,669.8		
	Other treatments - non-hazardous		6,194.9	5,530.2	3,298.9		
	Recycling - hazardous		3,247.0	2,444.1	4,009.6		
	Recycling - nonhazardous		89,915.3	82,754.4	108,919.6		
Dell	*NA*						
HP	Nonhazardous waste (tonnes)	89,275.0	106,492.0	102,567.0			
	Nonhazardous waste landfill diversion rate (% of total produced)	88.4%	88.2%	87.8%			
	Hazardous waste (tonnes)	8,936.0	8,638.0	7,001.0			
	Total cumulative recycling - computer hardware and supplies combined [million pounds]	1,170.0	920.0	755.0			
	Total cumulative recycling - computer hardware and supplies combined [tonnes]	530,000.0	420,000.0	340,000.0			
	Total annual recycling - computer hardware and supplies combined [million pounds]	250.0	165.0	140.0			
	Total annual recycling - computer hardware and supplies combined [tonnes]	113,000.0	75,000.0	64,000.0			
	Total annual re-use of equipment [millions of units, approximate]	3.0	2.4	2.5			
	Number of countries/regions/territories with HP return and recycling programs	52.0	45.0	42.0			
	further information available on recycling by region, type, % of markets covered by program, % of materials recycled into new products, % of energy recovery						

Source WestLB Research, company reports

EN22 Total weight of waste by type and disposal method (cont'd)

Company	Definition in respective company report	2007	2006	2005	2004	2003	2002
Toshiba	**Waste, total amount generated (t)**		**235,962.0**				
	Amount recycled (t)		208,732.0				
	Amount for final disposal (t)		10,370.0				
	Final disposal rate		4.4%	5.0%	6.0%	6.8%	
	Total amount of waste generated / final disposal ('000s t)		236.0	239.0	252.0	242.0	
	- metal chips ('000s t)		78.0	77.0	87.0	85.0	
	- waste acid ('000s t)		21.0	27.0	41.0	35.0	
	- sludge ('000s t)		42.0	37.0	36.0	34.0	
	- waste paper ('000s t)		36.0	35.0	30.0	28.0	
	- waste plastics ('000s t)		18.0	20.0	20.0	21.0	
	- glass ('000s t)		7.0	6.0	7.0	9.0	
	- others ('000s t)		34.0	37.0	31.0	30.0	
	Weight recycled (t)		67,351.0				
	TVs		14,277.0				
	Refrigerators		16,827.0				
	Washing machine		14,746.0				
	Air conditioners		7,313.0				
	PCs		508.0				
	Weight of end-of-use products recovered (t)		87,827.0				
STM	Landfill waste (% of total waste)		4.8%	8.3%	6.7%	5.9%	14.8%
	Waste recycled (%)		80%	78%	80%	73%	65%
ASML	Total waste materials disposed ('000s kg)	1,277.0	1,033.0	942.0			
	Non-hazardous waste materials ('000s kg)	1,149.0	960.0	894.0			
	Hazardous waste materials ('000s kg)	128.0	73.0	48.0			
	Total waste materials disposed / net sales (kg/m Euros)	335.0	287.0	372.0			

Source WestLB Research, company reports

Net revenues (as reported)

Company	Definition in respective company report	2007	2006	2005	2004	2003	2002
Ericsson	Net sales (MSEK)		178,000.0	152,000.0	132,000.0	118,000.0	146,000.0
Nokia	Net sales (EUR m)		41,121.0	34,191.0	29,371.0		
Cisco	Net sales (US$ m)	34,922.0	28,484.0	24,801.0	22,000.0	18,900.0	
IBM	Revenues (US$ m)		91,424.0	91,134.0	96,293.0	89,131.0	81,186.0
Dell	Net revenue (US$ m)	57,420.0	55,788.0	49,121.0	41,327.0		
HP	Net revenue (US$ m)	104,286.0	91,658.0	86,696.0			
Toshiba	Net sales (Yen bn)		7,116.4	6,343.5	5,836.1	5,579.5	5,655.8
STM	Net revenues (US$ m)		9,854.0	8,882.0	8,760.0		
ASML	Net sales (EUR m)	3,809.0	3,597.0	2,529.0	2,465.0	1,543.0	

Source WestLB Research, company reports

Exchange rates

Average exchange rates	2007	2006	2005	2004	2003	2002
US$ to EUR	1.366	1.240	1.298	1.183	1.102	0.899
Japanese Yen to US$	118.635	114.875	105.775	108.985	120.185	128.705
Swedish Krona to US$	6.720	7.499	7.037	7.727	8.253	10.283

Source Datastream

Ratings – Best and worst scores on a sector-by-sector basis

'Green ICT': Overall – best and worst scores within each sector

GICS sector level 4	number of companies	Green ICT score median	max	min	company with ... highest scores	lowest scores
Communications Equipment	11	-0.07	1.29	-1.43	Ericsson	Juniper Networks, Research in Motion
Computer Hardware	9	1.19	1.88	-0.23	NEC Corporation	Wincor Nixdorf AG
Computer Storage & Peripherals	6	0.05	1.70	-0.52	Seiko Epson Corp.	SanDisk Corp.
Office Electronics	6	0.90	1.32	-0.28	Canon	Neopost SA
Semiconductor Equipment	7	-0.23	1.47	-1.45	ASML Holding	KLA Tencor Corp
Semiconductors	18	-0.48	1.05	-1.68	STMicroelectronics	Marvell Technology Group

Source WestLB Research, SiRi

'Green ICT': Reporting & Policy – best and worst scores within each sector

GICS sector level 4	number of companies	reporting & policy score median	max	min	company with ... highest scores	lowest scores
Communications Equipment	11	0.32	1.19	-2.72	Motorola Inc	Research in Motion Ltd.
Computer Hardware	9	0.76	0.97	-1.20	Sun Microsystems Inc	Wincor Nixdorf AG
Computer Storage & Peripherals	6	-0.22	0.97	-0.76	Seagate Technology Inc	Logitech International SA
Office Electronics	6	0.76	1.63	-0.33	Canon	Neopost SA
Semiconductor Equipment	7	-0.33	0.76	-0.76	Advantest	Lam Research Corp.
Semiconductors	18	0.11	1.19	-2.18	STMicroelectronics	Marvell Technology Group

Source WestLB Research, SiRi

'Green ICT': Products & Services – best and worst scores within each sector

GICS sector level 4	number of companies	products score median	max	min	company with ... highest scores	lowest scores
Communications Equipment	11	-0.52	0.77	-1.17	Alcatel-Lucent, Ericsson	Juniper Networks, Nortel, Qualcomm, Research in Motion
Computer Hardware	9	0.12	2.06	-0.28	NEC Corporation	IBM
Computer Storage & Peripherals	6	-0.52	1.74	-1.17	Seiko Epson Corp.	SanDisk
Office Electronics	6	0.45	1.42	0.12	Canon, Ricoh	Brother Industries, Neopost, Xerox
Semiconductor Equipment	7	0.12	1.74	-1.17	ASML Holding	KLA Tencor Corp, Lam Research
Semiconductors	18	-0.52	0.12	-1.17	Advanced Micro Devices, a.o.	ARM Holdings and others

Source WestLB Research, SiRi

'Green ICT': Production – best and worst scores within each sector

GICS sector level 4	number of companies	production score median	max	min	company with ... highest scores	lowest scores
Communications Equipment	11	-0.30	1.32	-1.11	Ericsson	Juniper Networks
Computer Hardware	9	1.32	2.40	-0.17	TOSHIBA CORP	Wincor Nixdorf AG
Computer Storage & Peripherals	6	0.10	1.46	-0.30	Seiko Epson Corp.	SanDisk Corp.
Office Electronics	6	0.85	0.92	-0.71	Brother Industries, Ricoh, Xerox	Neopost SA
Semiconductor Equipment	7	-0.10	1.31	-1.59	ASML Holding	KLA Tencor Corp
Semiconductors	18	-0.55	1.25	-1.43	STMicroelectronics	Broadcom, Marvell, Microchip Technology, Nvidia Corp.

Source WestLB Research, SiRi

WestLB Research: Distribution of ratings as of 02 June 2008

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