White Paper
Green ICT.

The Greening of Business.

T Systems

Contents.

1. Introduction.

All over the world, IT is playing an increasingly important role – in both business and individuals' private lives. It is also consuming ever greater amounts of energy and is therefore the source of significant CO_2 emissions. Did you know that IT now causes the release of as much carbon dioxide into the atmosphere as nearly 320 million cars? According to calculations by consultants A.T. Kearney, worldwide IT now generates CO_2 emissions of about 600 million metric tons a year. And if the sector continues growing at the current rate, emissions in Germany alone are expected to increase by another 60 % by the year 2020. Green IT can help curb this alarming trend. Simply by consistently implementing known energy-conserving approaches, the CO_2 emitted by IT systems can be nearly halved.

"Green IT" is what analysts, manufacturers and providers call all IT solutions that save energy at business organizations. These include hardware, software and services. Where hardware is concerned, energy-efficient desktop PCs, thin-client architectures and data-center hardware offer answers, and so do energy supply and cooling systems. In the software and service area, there is significant potential in virtualization, in solutions for dynamic capacity management and data-center planning, and in storage-system offshoring. You cannot purchase or order Green IT directly, but intelligent solutions are available that contribute to sustainability. And with the increasing convergence of IT and telecommunications, it possible to take the Green concept a step further.

The positive approaches of Green IT need to be combined with solutions from the field of telecommunications, such as video-conferencing: Green IT is turning into Green ICT.

Green ICT extends to other, less commonly considered aspects of the entire life cycle. This includes eco-friendly procurement, employee behavior, running data centers on sustainably generated energy, environmentally sound disposal of used electrical equipment, and as much recycling as possible. ICT is not intrinsically "green", because it itself consumes energy and raw materials. But ICT can be leveraged to make business processes more energy-efficient.

This white paper is intended to help companies raise in-house awareness of Green ICT and its possibilities, reduce their carbon emissions, and enhance their success in environmental and business terms. In the following, we show the value that Green ICT adds, and describe possible approaches for office desktop environments and data centers, both of which have central importance, and the associated business processes. We conclude by presenting a number of successful Green ICT projects and providing information on initiatives, additional reading, and options for taking action in connection with Green ICT.

2. Adding value with Green ICT.

The most obvious benefits of Green ICT are reduced environmental impact and cost savings. This is to be seen against the background of increased energy consumption on the part of business – with greater emissions of greenhouse gases as a result. The ecological impact of a business or product is frequently measured and expressed in terms of its "carbon footprint" – and companies are increasingly expected, and willing, to take steps to reduce it within the scope of their commitment to corporate social responsibility. At the same time, energy is becoming an increasingly large cost factor. Here, Green ICT offers major potential for savings, for instance by installing more efficient hardware and making intelligent use of infrastructure.

This suggests that the main motivation for implementing Green ICT is to reduce costs. But a comprehensive Green ICT strategy offers many other benefits – appealing to all stakeholder groups: employee satisfaction increases, the company's standing with capital markets and with society as a whole improves, and the business can attract new customer groups.

Green ICT adds value for all relevant stakeholder groups.

Green products are gaining in popularity among consumers. According to a study by Booz&Co., 10 % of consumers are willing to pay a higher price for green products. And another 60 % are interested in environmentally sound products, although they are not willing to pay more for them (see Figure 1).

Green consumer segmentation (percentage of all consumers).

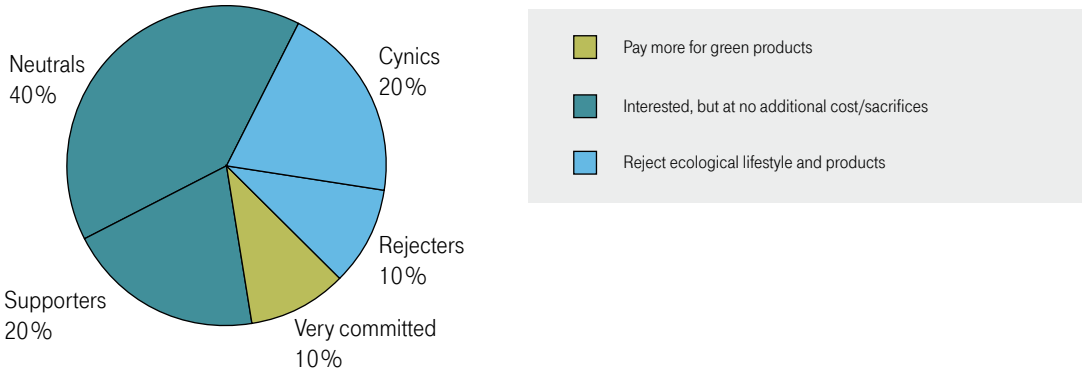


Fig. 1: Booz&Co., Going Green - Addressing Untapped Consumer Potential In The Telecom Industry, 2009.

A recent study by Forrester also shows that 28 % of IT decision-makers at companies in Europe, the Middle East and Africa consider environmental criteria to be very important when purchasing IT products and services. Another 67 % of those surveyed attach relatively high importance to environmental criteria.

The importance of environmental criteria for companies when choosing IT vendors and products.

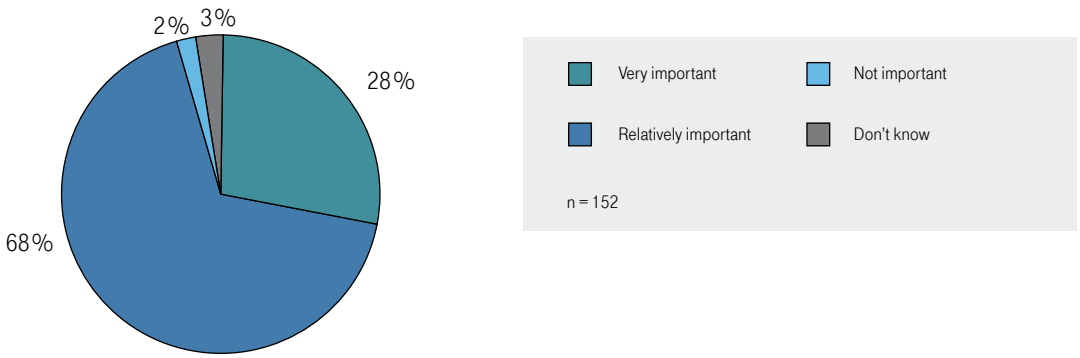


Fig. 2: Forrester, Green IT Adoption By Geography, 2009.

Companies' efforts to fulfill their social responsibilities are also registered outside the directly addressable customer target group. Increasingly, attention is being paid to whether a business's operations are ecologically sound, and their ICT usage sustainable, making them key aspects of a comprehensive corporate social responsibility (CSR) strategy. They are important factors for boosting brand value and improving public image. Cultivating a good relationship with nongovernmental organizations (NGOs) such as Greenpeace – either by conducting joint projects or being mentioned by them – is good for a company's image, and so is a high score in sustainability rankings such as these:

- The Good Company Ranking of manager magazin
- The DAX 30 Sustainability Ranking
- The Dow Jones Sustainability Index
- The Sustain Focus List of Goldman Sachs
- The Climate Disclosure Leadership Index of the Carbon Disclosure Project
- The Sustainability Yearbook of the asset management company SAM in collaboration with PwC
- The Top Green 50 Nominated Outsourcers Ranking in the Black Book of Outsourcing of the Brown-Wilson Group

The impact of a Green ICT strategy on capital markets is often underestimated. But many rating agencies are attaching more importance to CSR activities. As a result, practicing Green ICT can positively influence both share price and company value. As of mid-2009, according to the Sustainable Business Institute (SBI), a total of 301 sustainable funds with an aggregate investment value of around 25.5 billion euros had been approved for public sale in Germany, Austria and Switzerland alone.

But an effective Green ICT strategy does not just have an external impact; it also has internal repercussions. Various studies have shown that employees prefer to work for an environmentally aware organization. This increases trust, loyalty and work satisfaction. A clear commitment to corporate social responsibility also influences prospective new employees in the "war for talent".

How different stakeholder groups benefit from Green ICT.

Environment/society
- Lower CO_2 emissions
- Reduced resource consumption
- Compliance with legal requirements (in the future)

Companies
- Reduced energy costs
- Reduced operating costs of data centers
- Less hardware needed

Employees
- Increased employee satisfaction
- Greater loyalty
- Easier recruitment

Capital market
- Improved ratings
- Higher share price
- Greater company value

Customers
- Greater customer loyalty
- Appeal to new customer groups
- Greater customer satisfaction

Public
- Improved image
- Rounded-out CSR strategy
- Greater brand value

Fig. 3: How different stakeholder groups benefit from Green ICT. T-Systems, 2009.

Green ICT helps cut costs, enhance image, and comply with legal requirements.

A survey carried out by Forrester in 2009 to identify the three most important reasons for Green IT activities revealed that the principal motivation was to cut spending on energy (69 %). The second was to cut down on IT costs (40 %) and the third to improve image. The fourth reason cited was legal compliance (15 %). It is remarkable that cost considerations play an above-average role in the United States, while image and legal compliance are more important in Europe.

The main reasons for Green IT activities.

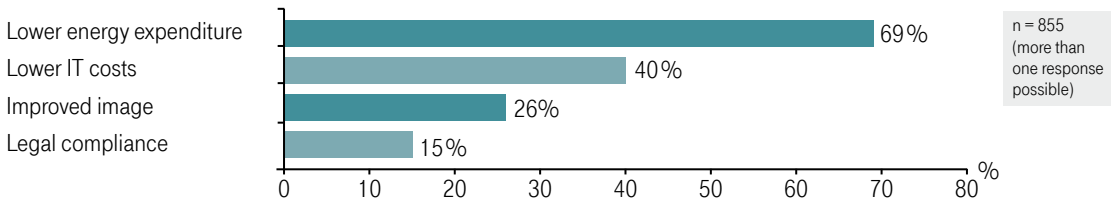


Fig. 4: Forrester, The Recession Dents Green IT's Global Momentum, 2009.

In the EU for example, there are now new rules on hazardous materials in electrical and electronic equipment, and their disposal. Moreover, new EU legislation on consumer-electronics products imposes requirements for standby and off-mode power consumption, and the energy efficiency of chargers and power-supply units, and will soon be extended to include PCs, printers, scanners, etc. With the increasing political focus on climate protection, it may be expected that information technology and telecommunications will be subjected to additional legal requirements. Market researchers Gartner, for example, expect that by 2012, companies will be required to report their CO_2 emissions.

3. How can companies implement Green ICT?

This section shows you how you can achieve the described value adds. A closer look at how ICT causes carbon dioxide emissions reveals two main culprits: office desktop environments and data centers. No less than 40 % of ICT-related CO_2 emissions are caused by desktop computers and their monitors, and another 23 % by servers and cooling systems. We will therefore begin by discussing ways for Green ICT to reduce CO_2 emissions in office environments (see section 3.1) and in data centers (see section 3.2). A Fraunhofer Institute study indicates that electric power consumption for ICT will increase by more than 20 % by the year 2020.

Basic forecast of power consumption for ICT in Germany until 2020.

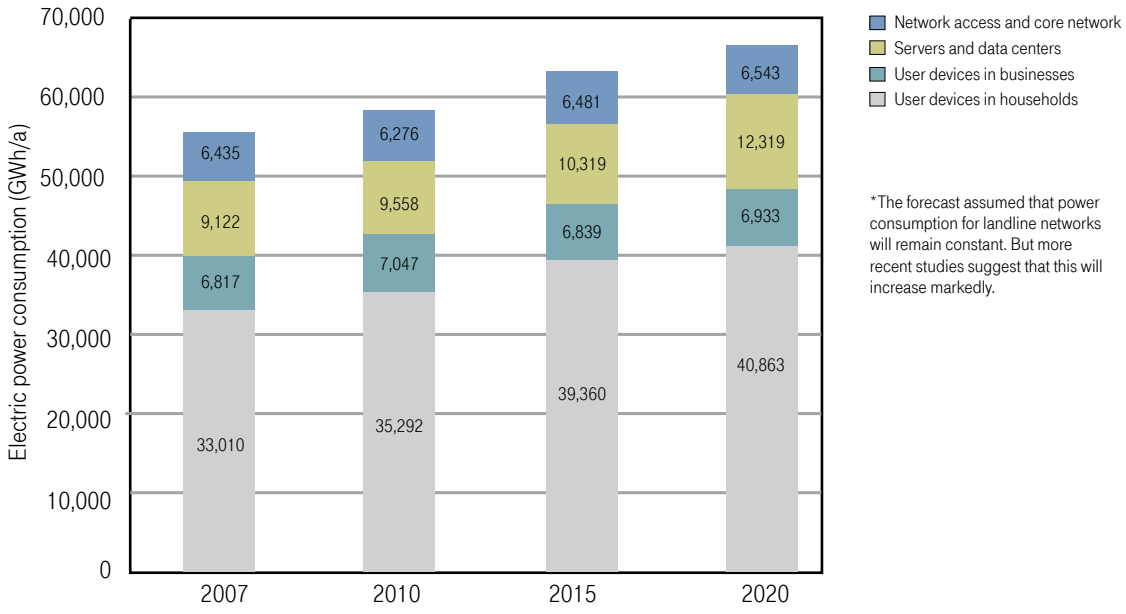


Fig. 5: Fraunhofer IZM, Estimated Energy Requirements as the Information Society Develops Further, 2009.

Green ICT not only protects the environment by reducing the emissions emitted by ICT itself. When effectively and comprehensively applied, it can contribute much more. Green ICT can improve business processes that are not directly involved in ICT, and dramatically lower CO_2 emissions throughout the process chain (see section 3.3). It is here that its true potential becomes apparent: according to Gartner, ICT now accounts about two percent of total global CO_2 emissions, on a level comparable to air traffic, at 600,000,000 metric tons. But Green ICT can also help significantly reduce the other 98 % of all CO_2 emissions not caused by ICT.

3.1 Green ICT in the office.

3.1.1 Energy-efficient use of equipment and use of energy-efficient equipment.
Each and every office desktop offers opportunities to save energy. This involves both energy-efficient use of equipment and the use of energy-efficient equipment.

Leaving a copier switched on overnight uses as much power as it takes to make 1,500 copies. [Experton]

Even without deploying any new technology, significant savings can be realized by encouraging office workers to change their habits. Company policies can be developed and published making employees aware of how they can contribute: for example, through the use of hibernation mode and power-management software for hardware, duplex printing, and generally avoiding unnecessary printouts.

The latest generation of energy-conserving desktop PCs, thanks to their better power units, storage technology and processors, can – in Experton's opinion – slash energy costs by more than 60 %. State-of-the-art LCD screens and thin-client architectures offer further opportunities for savings.

The consistent, enterprise-wide deployment of energy-efficient and cost-saving equipment is a major challenge. Outsourcing the entire office ICT landscape is one way to implement Green ICT – by minimizing the number of desktop computers and printers and maximizing their efficiency.

Companies typically use a large number of, often different, devices for printing, faxing, copying and scanning. This complex landscape often leads to a lack of transparency, and there are often no accurate figures available on the total cost of operation. However, the ratio of users to devices can be significantly improved by analyzing the current infrastructure and actual user requirements: then changes can be made to the type, number and position of devices, ensuring better use is made of available capacity, and reducing stand-by and idle times.

Savings potential in connection with office equipment (€).

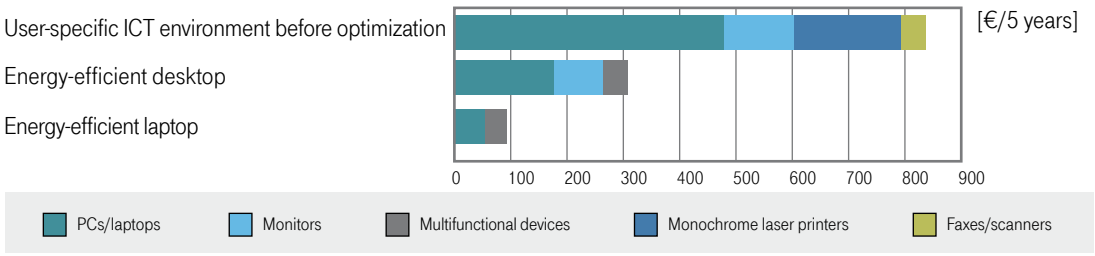


Fig. 6: Deutsche Energie-Agentur (dena), Energy-Efficient IT Equipment at the Workplace: Potential, Procurement and Use, 2009.

A Fraunhofer Society study found out that thin clients are much more energy-efficient than conventional desktop PCs, reducing CO_2 emissions and the cost of purchase and operation. Replacing a desktop PC with a thin client reduces the CO_2 emissions of the desktop system by over 54 %. Even if a LCD monitor is factored into the equation, the saving amounts to 44 %. Thin clients are much lighter and more compact, and consist of fewer components – yielding benefits with regard to transportation, disposal, and consumption of materials.

Environmental comparison: desktop PCs vs thin clients.

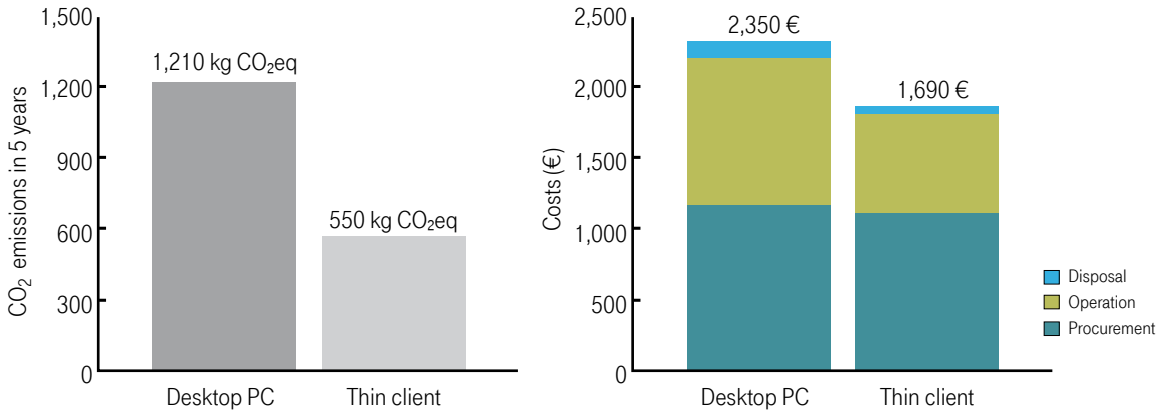


Fig. 7: Fraunhofer UMSICHT, Environmental Comparison of the Climatic Relevance of Desktop PCs and Thin Clients, 2008.

Here is a sample calculation: a company with 300 workstations that equips 75 % of them with thin clients can prevent the emission of about 148 metric tons of CO_2 over the course of five years. This is the amount of a CO_2 that a Volkswagen Golf (Rabbit) would emit if it traveled a distance of 1,093,000 kilometers (27 times the circumference of the earth).

3.1.2 Connected life and work.

Just getting to and from the office inflicts considerable burdens on the environment: millions of commuters spend hours every day on roads, spewing immense amounts of exhaust gases into the atmosphere. Then there are extra trips to business meetings, whether it is for a one-hour discussion with a supplier or a week-long strategy conference.

All this travel is responsible for significant emissions, and is expensive – in 2008, German enterprises spent nearly 47 billion euros on business trips. The 2008 figure was down just slightly over the previous year due to the onset of the recession, after rising repeatedly from 2004 to 2007.

Total costs for business trips, 2004-2008.

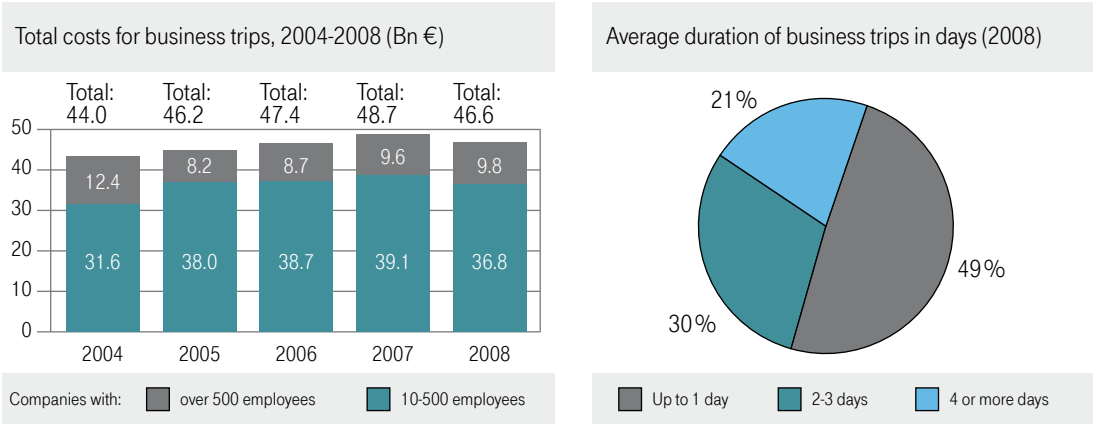


Fig. 8: Verband Deutsches Reisemanagement e.V. (VDR), VDR Business Trip Analysis 2009, 2009.

In 2008, the average duration of business travel remained stable at 2.3 days. Trips without an overnight stay in particular were more frequent – short trips especially offer significant potential for savings when eliminated by telecommunications solutions that enable remote collaboration. This does not only apply to major corporations; high-quality systems are now also available for small and medium-sized companies, which account for about 80 % of all business travel.

Videoconferencing systems enable realistic face-to-face communication, permitting virtual meetings that are every bit as effective as "real" ones. After being used sporadically for years, more recent technical innovations have finally led to their broad acceptance. Various versions of this medium now let people collaborate in virtually any situation, independently of their geographical locations.

There are three main types of videoconferencing solutions:

- Small PC-based solutions that allow individuals to communicate using a simple webcam and a small on-screen video window.
- Medium-sized, room-based solutions that enable participants to communicate via larger screens (approx. 42-inch).
- Telepresence and similar solutions that display participants on life-size screens that make them seem to be actually present in the room. These solutions require fully equipped rooms at both ends.

These tools can effectively replace many business trips. They also support telecommuting and similar models. When employees work at home, this saves not only time and office space but, most importantly, eliminates the need to commute.

In office environments, there is a long and established practice of replacing conventional means of communication with ICT applications. To a large extent, hardcopy letters (along with the corresponding paper consumption, transportation and logistics) have been replaced by e-mail and texting. Further savings potential lies in the creation of electronic work processes. This includes digitizing, archiving and distributing documents by e-mail or uploading them to a website making them available for all downstream operations. This generates savings in terms of paper (according to T-Systems calculations, up to 90%), energy consumption and CO_2.

Today, innovative solutions are available for high-tech "pens" and "paper" that allow the electronic capture of handwriting, creating a seamlessly integrated digital process, saving process costs and preventing information loss. This is described in more detail in the Paper, Pen & Phone reference project given in the final section of this white paper.

A whole new generation of communication and collaboration tools now allows individuals to work together across multiple locations without any loss of quality.

Effective collaboration is a growing challenge, especially when business skills and knowledge are distributed throughout the organization but need to be centrally available. Unified Communication & Collaboration (UCC) combines all key communication channels via a single interface. Everyone can clearly see there whether colleagues or business partners are momentarily available. UCC also makes it possible to coordinate projects worldwide and in real-time, or to advise customers virtually. In a virtual project room, all members of a team can work simultaneously on project documents, and everyone has direct access to every change made and each new version – no matter where they happen to be in the world. This not only saves travel and organizational costs, it also provides all participants – even across multiple companies – with a common project platform equipped with all of the functionality they want, without requiring them to open up their own IT systems to one another.

3.2 Green ICT in data centers.

Did you know that there are more than three million data centers in the world? Germany's data centers alone consume over 10 TWh of power a year. And by 2013 this figure will climb by nearly half unless policymakers, ICT vendors and, above all, data center operators take steps to boost efficiency.

Green ICT could realize enormous savings in all of these data centers. Widespread use of state-of-the-art energy-efficient technologies and solutions, such as virtualization, could push the power consumption of German data centers down to 6.65 TWh by 2013 – almost halving it in just five years.

Power consumption of servers and data centers in Germany.

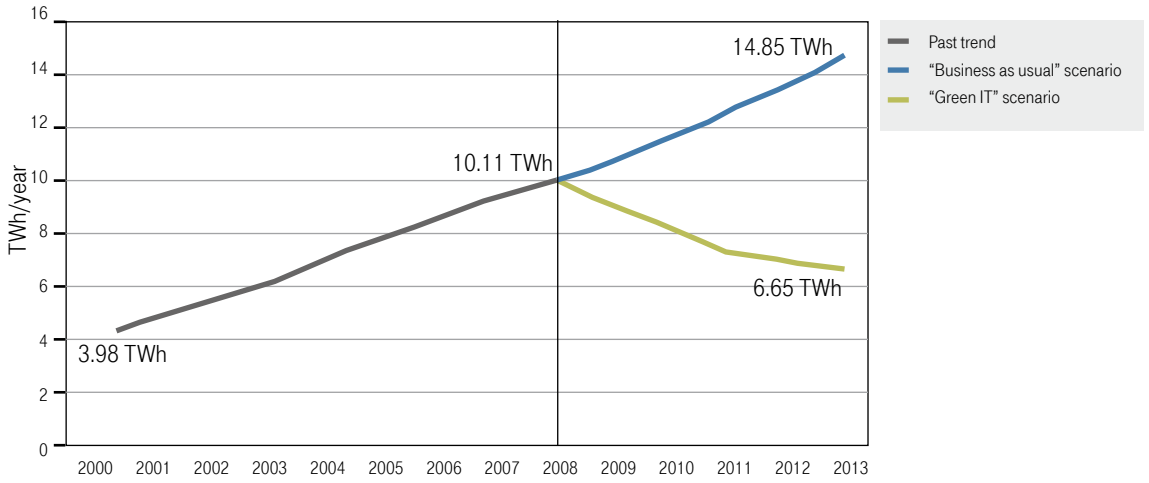


Fig. 9: Borderstep Institut, Energy Consumption and Costs of Servers and Data Centers in Germany, 2008.

The Experton Group also sees potential energy-consumption savings at data centers of at least 50 %. And Deutsche Energieagentur (dena) has determined how much energy can be saved in which areas of data-center operation:

Energy efficiency in data centers: how to save up to 75 % of energy costs.

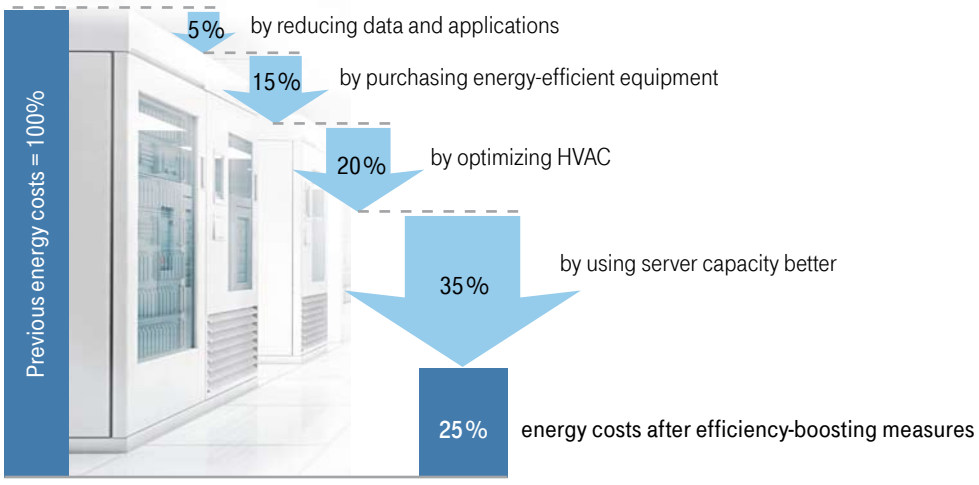


Fig. 10: Deutsche Energie Agentur (dena), Energy-Efficient IT Equipment at the Workplace: Potential, Purchasing and Use, 2009.

Another crucial factor is load. According to Experton, servers in well-organized environments with UNIX machines operate at just 35 to 45% of capacity; with Intel servers, the figure is even lower, at 15 to 30%. On average, only 25 to 40% of data storage capacity is used. Utilization rates can be considerably improved by consolidating servers, storage systems and entire data centers – saving a great deal of energy. Fragmented legacy data-center landscapes can be consolidated to just a few data centers. Outsourcing often plays a major role. An IT service provider, for example, can operate a small number of large, efficient data centers that support multiple customer organizations.

It is also possible to make better use of data-center resources, for example, by virtualization and by deploying shared-services solutions. This involves creating logical systems that are independent of the underlying physical assets. Instead of being dedicated to specific purposes, resources are shared and therefore used more efficiently. The ability to intelligently assign and administer resources is a key function within any virtualization solution. It ensures maximum flexibility in resource allocation. When servers are only operating under part load they still consume nearly as much power as fully utilized ones. Virtualization makes it possible to shut down servers that are largely idle, maximizing savings.

Another possibility is for enterprises to access processing power, storage resources, software and bandwidth on demand over networks. Servers can share resources, and state-of-the-art virtualization technology and standardization can be leveraged to maximize utilzation of existing hardware. T-Systems calculates that this can lower hardware energy consumption by up to 80%.

Virtualization reduces overall costs by making the most of existing resources, especially by means of the following approaches:
- Efficient management of infrastructure.
- Simplified migration, backups and data recovery.
- Server reliability and security: multiple operating systems running in parallel, and isolated from one another.

It is also easier to scale available resources up or down, because virtual server and storage networks can be centrally administered.

Each server and storage system no longer required means savings in terms of
- device-specific power consumption,
- cooling,
- network connectivity, and
- administration.

3.3 Boosting the efficiency of business processes by intelligent use of ICT.

Increasingly, ICT solutions are used to support business processes. These solutions can streamline processes and have enormous potential for reducing CO_2 emissions, because they improve the utilization of resources and allow them to be shared. ICT also permits in-depth monitoring of energy consumption and CO_2 emissions throughout the value chain, so processes and organizational structures can be enhanced accordingly. The potential savings are particularly great in industries with extensive, complex supply chains. Examples involving automotive components, and the development and manufacture of cars, are presented here to illustrate this. But ICT can also have a major impact on supporting processes, i.e. via resource utilization in offices. In industries with complex supply chains, efforts focus on reducing transportation.

According to the European Commission, traffic jams and poor route planning account for 50 % of fuel consumption.

Intelligent transportation systems combine an array of applications to cut fuel consumption by up to 30 %, in conjunction with much lower CO_2 emissions – but with no loss in service quality.

These systems are based on detailed, up-to-the-minute traffic information captured by an extensive network of IT devices and transmitted by telecommunications equipment. Route planners and navigation systems then calculate and continually update the best possible route for vehicles and payloads. The aim is to minimize the distances traveled, and the corresponding time, fuel costs, and to a large extent, CO_2 emissions. Other applications, such as precise satellite- and RFID-assisted positioning solutions, enable more efficient utilization of entire vehicle fleets. These technologies can also be applied to water and air transportation; for example, streamlining airfreight operations could reduce fuel consumption by more than 10 %. Telematics can improve fleet management and capacity utilization; smart road-pricing systems, with incentivization through reduced charges, can encourage the use of low-emission trucks.

Manufacturing industries such as the automotive sector are especially resource-intensive; there is therefore great potential for savings in development and production through the intelligent use of ICT. Increasingly precise and realistic computer-aided simulation and design tools (CAD) are gradually eliminating or at least minimizing the necessity of physical prototypes. Here too, greater attention can be paid to software-aided energy-saving functions for users. At the level of the vehicles themselves, automatic start-stop functions briefly switch the engine off when the clutch is disengaged.

Many non-core, cross-industry processes can be positively influenced by ICT. Energy management is a particularly effective approach. Ideally, energy efficiency should be a key consideration from the outset, i.e. when planning and designing new offices and production facilities, giving rise to “smart buildings”. But innovative energy management systems can also be retrofitted at reasonable expense in existing buildings, adjusting the power consumption of lighting, heating and cooling systems in line with actual requirements.

For private households, various providers are now developing smart metering and home management systems that comply with the EU energy efficiency directive by identifying power-hungry systems and opportunities for savings, and by influencing consumer behavior. IT plays a key role in applications of this kind.

In practically all businesses, paper consumption could be slashed by greater use of e-mail, e-billing and electronic archiving systems. Especially at large national and international organizations with central archives, automated workflows can dramatically accelerate processes by eliminating physical transportation (and the associated traffic).

4. The route to a Green ICT action plan.

Green ICT has been a major topic of conversation among industry professionals for some time – it is unlikely that any ICT decision-maker has managed to avoid all the articles in relevant publications, the systems showcased at CeBIT, and the intensive marketing efforts of providers. Green ICT technologies are now becoming increasingly popular: according to the Forrester report "The Recession Dents Green IT's Global Momentum", the number of businesses that apply environmental criteria when developing and sourcing their IT landscape grew from 25 to 55 % between April 2007 and April 2009. Companies are taking action.

Unfortunately, however, they often lack a systematic approach. Another finding of the Forrester study is that 34 % of organizations are now pursuing a comprehensive Green ICT action plan and another roughly 13 % are working on one (see Figure 11). This is a step in the right direction. Without a cohesive, overarching plan, companies often initiate a variety of individual Green ICT projects but fail to effectively coordinate them. A comprehensive action plan sets out the strategic thrust and goals of Green ICT activities. This allows them to be coordinated, managed and harmonized as a whole. The individual activities can be aligned with the general goals, and implemented in logical order. An effective action plan gives all stakeholders – executive management, employees and customers – a framework of reference. It also makes it easier to realistically assess all potential savings, both environmental and economic.

The route to a Green ICT action plan.
Does your organization have a comprehensive Green IT plan?

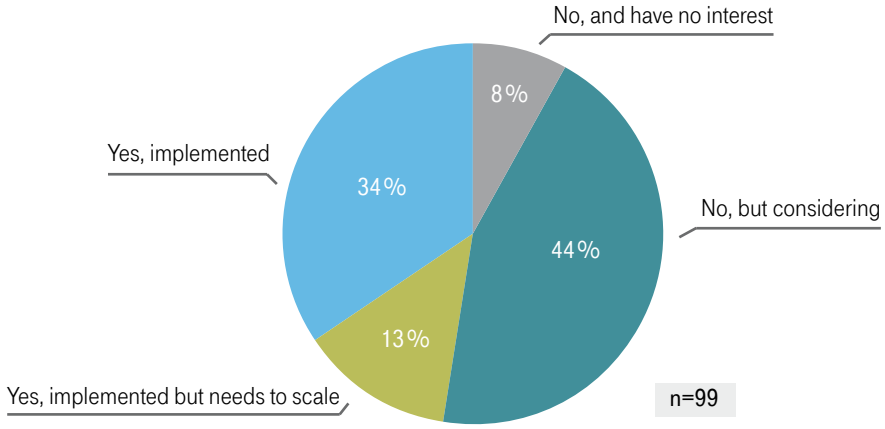


Fig. 11: Forrester, The State of PC Power Management, 2009.

According to T-Systems, the motivation for implementing Green ICT technologies can vary considerably, even within a single organization. They can range from a commitment to environmental protection to the wish to lower energy costs or improve a company's image. The first step must therefore be to evaluate and consolidate these often diverse goals and expectations to create a common understanding and shared acceptance.

An action plan can involve the following steps:

1. Identify expectations
2. Identify the status quo
3. Communicate the action plan
4. Harvest “low-hanging fruit”
5. Implement measurement mechanisms
6. Review the selection process
7. Optimize utilization
8. Raise employee awareness
9. Reengineer the ICT infrastructure
10. Support business processes

After identifying expectations, it is necessary to take stock of the current situation: What Green ICT activities have already been initiated? How can they be combined and aligned? How can Green ICT be incorporated into the overall CSR strategy? What processes are involved in selecting hardware and suppliers? There is a further key point that needs to be addressed in advance: What obstacles have to be overcome, and what limits must be respected?

To strengthen support for the action plan, it is important to identify and reap “low-hanging fruit”. A few simple steps, effectively presented and publicized, can be harnessed to attract the attention of employees and the general public to Green ICT efforts. These high-profile quick wins will build acceptance among employees, and heighten their interest and willingness to play an active role, even before the actual project gets under way. This can be achieved by, for example, disposing of obsolete legacy hardware, implementing an enterprise-wide power management system or joining an environmental protection organization. Then you can proceed to tackle the action plan itself on a broad front.

It is vital for you to make comprehensive measurements. To make the success of a Green ICT strategy visible, you need to, for example, provide a detailed breakdown of data-center power usage. Many ICT managers remain unaware of exactly how much energy their systems consume. A recent Experton study revealed that 85 % of Green IT decision makers do not know how much energy it takes to operate their data centers in concrete terms.

Do you know how much energy your data center consumes in kWh and €?

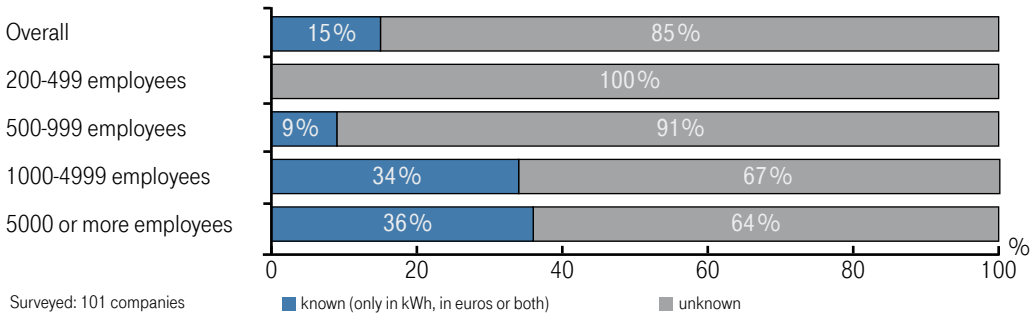


Fig. 12: Experton Group, Green IT Especially Because of the Economic Crisis, 2009.

Of course, the next question is how to achieve and assess any improvements – because "you can't manage what you don't know and measure". ICT and facilities management need to be integrated more closely, the results of measurements need to be available at all levels, and the CIO should be aware of the data center's energy costs.

Existing processes, for example for selecting hardware and suppliers, should be extended to include measurable criteria for environmental protection.

Focus: Green Dynamics model.

To create greater transparency for CIOs, T-Systems collaborated with Dr. Christian Hölzl (Communications & Simulation Engineering at the St. Pölten University of Applied Sciences) to develop the Green Dynamics model, which analyzes and identifies the various factors that influence energy consumption in data centers. Green Dynamics is based on the Business Dynamics Model of Professor John D. Sterman of the Massachusetts Institute of Technology (MIT), which he described in Thinking and Modeling for a Complex World. The method of simulating dynamic systems sheds light on the complexities of ICT energy efficiency in data centers.

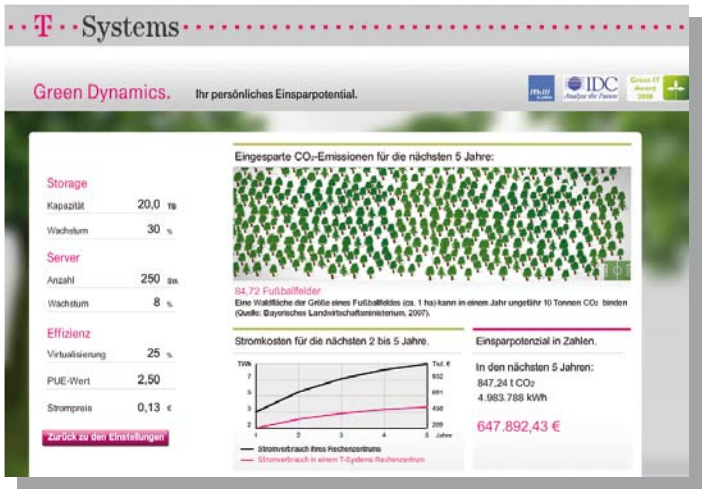
The Green Dynamics model lets you identify and measure how different technological measures increase efficiency and cut energy consumption.

These include different degrees of virtualization, pooling, and improvement of the PUE (power usage effectiveness) metric. The physical resources considered include CPUs, data storage and other assets. The model avoids excessive complexity for the sake of transparency and ease of comprehension. What it accomplishes is quick, reliable evaluation of the current situation, and identification of opportunities for improvement. It therefore makes it easier to make Green ICT decisions without overlooking important factors, and reveals potential for lowering CO_2 emissions.

The findings of these simulations confirm the dynamic behavior of ICT infrastructures and how this influences energy consumption. Here is an example for a data center with 20 TB of storage capacity and 250 servers. A five-year simulation yields the following savings:

- Energy consumption reduced by 4,983,788 kWh
- Costs reduced by € 647,892
- CO_2 emissions reduced by 847.24 metric tons

That is equivalent to a forested area larger than 84 soccer fields; it would take that many trees five years to extract this amount of carbon from the atmosphere. These savings can be achieved by reducing the total amount of hardware (by up to 80 %, with the aid of virtualization), lowering the number of servers (by up to 50 % by pooling and by raising utilization from 15 to 70 %) and optimizing operation (a PUE value of 1.5 is feasible; data centers typically have a value of 2.5).



The Green Dynamics model makes Green ICT more transparent and raises awareness of Green ICT issues both within and outside the organization, while clearly showing how the ICT industry can contribute to cutting global CO_2 emissions.

Fig. 13: Comparison of CO_2 Emissions and Power Consumption: In-house Operation vs Optimized Operation in a Service Provider's Data Center, 2009.

Without investing millions in new equipment and infrastructure, the existing ICT landscape can be improved in many ways, as discussed in section 3. Steps range from eco-friendly disposal of used hardware to improving the data center's cooling system.

All Green ICT efforts must be combined with staff education programs. Employees have to be made aware of how they can lessen environmental impact by a few simple changes in behavior. They cannot be expected to follow and actively implement new policies unless they are familiar with and support the company's environmental protection goals.

Large-scale, long-term projects are needed to reengineer your infrastructure. In contrast to "low-hanging fruit", these initiatives cannot be executed on an ad-hoc basis. They call for in-depth planning. Examples include the introduction of a thin-client landscape and wide-scale replacement of data center hardware – or complete outsourcing of all data centers.

Using ICT to support and streamline business processes as described in section 3.3 should also be an integral part of any action plan. It needs a "green" ICT landscape for ICT to develop its full potential in business processes and help color all parts of the company green. Avoiding unnecessary use of paper, reducing traffic and transport volumes, and optimizing industrial workflows all offer opportunities to significantly reduce CO_2 emissions. At this stage, every company should therefore investigate how the use of ICT could make its business processes simpler and leaner. The intelligent use of ICT will simultaneously reduce the company's total CO_2 emissions.

5. Reference projects.

5.1 Smart IT for DHL parcel collection and drop-off points.

They are convenient for customers, and help reduce road traffic: DHL's automated parcel collection and drop-off points cut the total number of kilometers driven by its trucks and vans by around 600,000 each year. Because multiple parcels can be deposited and picked up in just one place, the distances that have to be driven can be cut significantly. Once all 2,500 proposed automated units are operational, DHL customers will also use their cars far less, eliminating a total of 3.3 million kilometers driven annually. The collection points are centrally located, so customers can conveniently stop on their way to or from work or shopping, and do not need to travel out of their way. This is the conclusion reached by a study carried out by business and transportation consultants KE-Consult. CO_2 emissions will fall by about 980 metric tons yearly if automated collection and pick-up points are installed throughout Germany, ensuring customers can reach them in 10 minutes or less by car. T-Systems is responsible for the smooth, reliable operation of the self-service units – which are connected to a sophisticated, failsafe network infrastructure. The units transmit information on customer orders to a central service center where employees monitor processes. E-mails or text messages are sent to customers notifying them when shipments are ready for collection.

5.2 Paper, Pen & Phone solution in Deutsche Telekom stores.

The Paper, Pen & Phone solution, implemented in the high-street stores of Deutsche Telekom, is a prime example of how innovative technology can save postage and paper, while reducing environmental impact.
Deutsche Telekom operates over 800 shops throughout Germany, concluding several million contracts with customers every year. Until recently, these multipage documents were printed out, signed by the customer and sales employees, and then copied. This meant that customers retained a copy for their own personal records. They could refer to it anytime they liked, even years later, and in the event of a legal dispute could use it as documentary evidence.
For Deutsche Telekom, the archiving process was costly and a burden on the environment: after making a copy it was placed in a stamped envelope and mailed to a scanning center, traveling there by truck. There the contract was taken put of the envelope, the envelope discarded, the contract unfolded and the staple removed. Then it was scanned and the image assigned to the corresponding transaction. Finally, the paper was archived and ultimately disposed.

Paper, Pen & Phone enables this as an invisible ICT solution consisting of ...

... print ... special pen ... a data link ... and software with hosting

Fig. 14: Paper, Pen & Phone.

With Paper, Pen & Phone – P³ for short – T-Systems has evolved a technology that has been around for quite a while in niche applications to generate legally binding electronic documents with handwritten signatures: customers write with a pen on paper as usual. The difference is that now they get to take the original document home with them. There is no longer any need for an additional paper copy, because an electronic version has already been stored in Deutsche Telekom's central electronic archives in a legally binding, audit-ready form.

How is this possible? Paper, Pen & Phone is a complete ICT solution consisting of a central service, local software running on a laptop or accessed over the phone, a special ballpoint pen, a printer and paper.

Since January 2009, documents to be printed out no longer go straight from the source system to the store's printer. Now they take a detour via the P³ server instead. There the document is captured, indexed, and provided with a digital watermark in the form of a unique, barely visible background pattern. A copy is then transmitted to the printer. This takes place many times each and every day, taking just a matter of seconds. When printed out, the watermark is slightly darker.

The customer and the sales professional sign the contract using a special pen that has an integrated camera and sensors. This device captures the signature, including the speed and the pressure applied to the paper. This data is encoded and transmitted via the Deutsche Telekom shop's local PC to a special server. This assigns the signatures to the transaction and generates an electronic copy that is archived in a legally binding, audit-ready form.

The environment benefits because there is no need for documents to be mailed, scanned, or an extra copy to be printed. Now customers take home the original contract signed in ink for filing, instead of the copy. Better customer service, lower environmental impact, lower costs: Green ICT.

5.3 Dynamic Services at Wienerberger.

Wienerberger AG is the world's largest manufacturer of clay bricks, as well as of other building materials. Wienerberger has its group headquarters in Vienna, Austria, and employs 13,200 people in 236 production plants in 26 countries. It has just renewed its outsourcing contract with T-Systems for another five years. T-Systems provides scalable SAP-related resources and services in accordance with fluctuating demand. According to Gernot Zeman, head of the Wienerberger Group's IT infrastructure: "... Wienerberger can concentrate on providing the best possible support for its business processes by outsourcing routine IT tasks such as the operation of our SAP system."

Green ICT is also a high priority for Zeman. "If we look for ways to make IT savings, the environmental aspect jumps right out at us, because power for cooling and infrastructure operation is now one of our main cost factors. But there are new technologies that can significantly reduce energy consumption. For example, we have cut our IT power consumption by about 70% by outsourcing. This not only saves money, but is also good for the environment."

5.4 T-Systems considers power costs when purchasing servers.

When it is time to replace legacy servers with new ones, it pays to carefully compare the available options. In this example, two different systems were being considered. An in-depth comparison produced the following results:

Comparison of two systems from different vendors.

	No. of servers	Total no. of cores	Power consumption during 3 years	Software licensing and maintenance costs during 3 years	Power costs during 3 years	Total cost during 3 years
System 1	5	40	378,771 kWh	€ 282,000	€ 17,000	€ 299,000
System 2	5	88	688,187 kWh	€ 415,000	€ 31,000	€ 446,000
						€ -147,000

Fig. 15: Cost comparison of two server systems.

Both systems deliver the same performance. But system 1 requires significantly fewer cores, which translates into lower license fees, lower software maintenance costs (which are incurred year after year), and lower power consumption.

Extrapolated over three years, this means that System 1 saves about 147,000 euros and generates about 193,000 kg less CO_2 emissions (based on the typical mix of energy sources in Germany in 2007: 624 g of CO_2 per kWh) compared to system 2. This illustrates that intelligent choices can result in major cost and CO_2 savings, even with state-of-the-art equipment.

6. Conclusions.

The issues of climate change and environmental protection have been debated for decades. Now they have become part and parcel of day-to-day business reality; companies are accepting responsibility for the CO_2 emissions they cause and are taking action.

ICT has, in many ways, a vital role to play. It accounts for about two percent of global CO_2 emissions, which must, and can, be curtailed. In addition, through the intelligent use of ICT solutions to support business processes in other industries, it can help curb the other 98 % of emissions.

The deployment of Green ICT makes a valuable contribution to protecting the environment. And businesses themselves benefit. Many of the approaches presented in this document are associated with lower costs, especially those that target energy consumption. They also improve a company's image, and noticeably raise customer and employee satisfaction. And as policymakers increasingly address climate change, new legislation and regulations on ICT can be expected in the near future. So organizations are well-advised to act now.

Some approaches are already being practiced now. According to the German Business Travel Association (VDR), 65 % of German enterprises are already using telephone and video conferencing systems to minimize business travel. And according to the Experton Group, 65 % of German enterprises are virtualizing their servers.

Every organization has its own unique situation, and the first step should therefore be to analyze it. We have already described possible approaches for business processes, data centers and office environments. Quick wins can be achieved by harvesting "low-hanging fruit", for example by encouraging more energy-efficient use of office equipment or duplex printing. Greater potential is available through partnership with an external ICT service provider.

For example, an external provider can add value through their expertise in videoconferencing or electronic archiving, or – like in the case of Dynamic Services – its professionally organized and operated data centers. But be warned: It is vital to plan carefully before modifying business processes. When properly implemented, these measures promise excellent, and lasting, improvements. But it is essential to proceed systematically while coordinating and consolidating all of your Green ICT efforts.

7. Glossary.

Item	Explanation
CAD	Computer Aided Design; software for computer-assisted design work.
Carbon footprint	A company's total CO_2 emissions.
CO_2 eq	Carbon dioxide equivalent: every greenhouse gas can be converted into a corresponding amount of carbon dioxide (CO_2) with the same warming effect. For example, 1 kg of methane (CH4) corresponds to 21 kg of CO_2, according to the Intergovernmental Panel on Climate Change.
Collaboration	Work performed jointly by several persons, for instance via Web-based software.
CSR	Corporate social responsibility; this describes voluntary responsible and sustainable action by a company to the benefit of society, the environment or the economy.
Dynamic Services	A T-Systems offering that makes ICT resources available in accordance with actual demand, for example processing power, storage or SAP applications.
NGO	Nongovermental organization; a typically nonprofit organization without any government involvement.
Power Usage Effectiveness	A metric for the efficiency of energy use; it is calculated by dividing total energy input by the output of the IT equipment. Source: Green Grid Organization
SLA	Service level agreement; This formally agreed-on document usually forms part of a contract for ICT services and establishes quantitative (or qualitative) parameters for regularly checking the services. The SLA contains all relevant rules and responsibilities. Typical SLAs stipulate, for example, operating hours or uptime.
RFID	Radio frequency identification; a technology for information exchange by radio.
Smart building	A building with systems that are ICT-enabled; they can include heating, lighting, multimedia systems, household appliances, bathroom equipment, and connections to external networks such as the Internet.
Thin client	A desktop computer with functionality limited to input/output. The operating system and applications run on central servers and are centrally administered.
Virtualization	The provision of virtual (i.e. non-physical) ICT resources.
Workflow	A predefined sequence of activities.

Source: The studies and articles listed in the Sources section.

8. List of figures.

9. Sources.

Source	Document
[A.T. Kearney 2008]	Green IT – vom Umweltsünder zum Klimaretter
[Booz&Co 2008]	Going Green-Addressing Untapped Consumer Potential in The Telecom Industry
[Borderstep 2008]	Energieverbrauch und Energiekosten von Servern und Rechenzentren in D
[Experton 2007]	Building a Green Server Infrastructure
[Experton 2008]	"Green IT" – im Spannungsfeld zwischen Modewort und wirtschaftlicher Notwendigkeit
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[Experton 2009.2]	Green IT gerade wegen der Wirtschaftskrise
[Forrester 2009.1]	Market Overview: The Recession Dents Green IT's Global Momentum
[Forrester 2009.2]	Green IT Adoption By Geography, Q2 2009
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