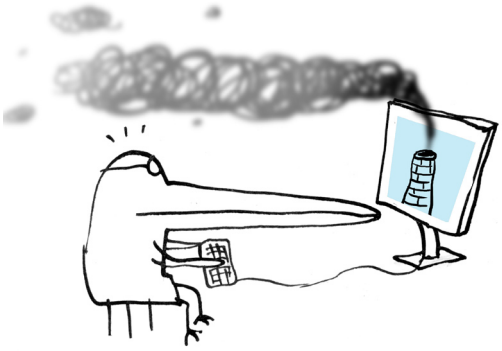
The McKinsey Quarterly



INFORMATION TECHNOLOGY

OCTOBER 2008

How IT can cut carbon emissions

Information and communications technologies will become a major source of greenhouse gas emissions but can abate far more of them.

Giulio Boccaletti, Markus Löffler, and Jeremy M. Oppenheim

Article at a glance

Greenhouse gas emissions associated with making and powering the world's computers and telecom networks are growing fast. Despite efforts by technology manufacturers and users to make these tools more energy efficient, rapid growth in demand for computing and communications—particularly in developing nations—is creating a big carbon footprint.

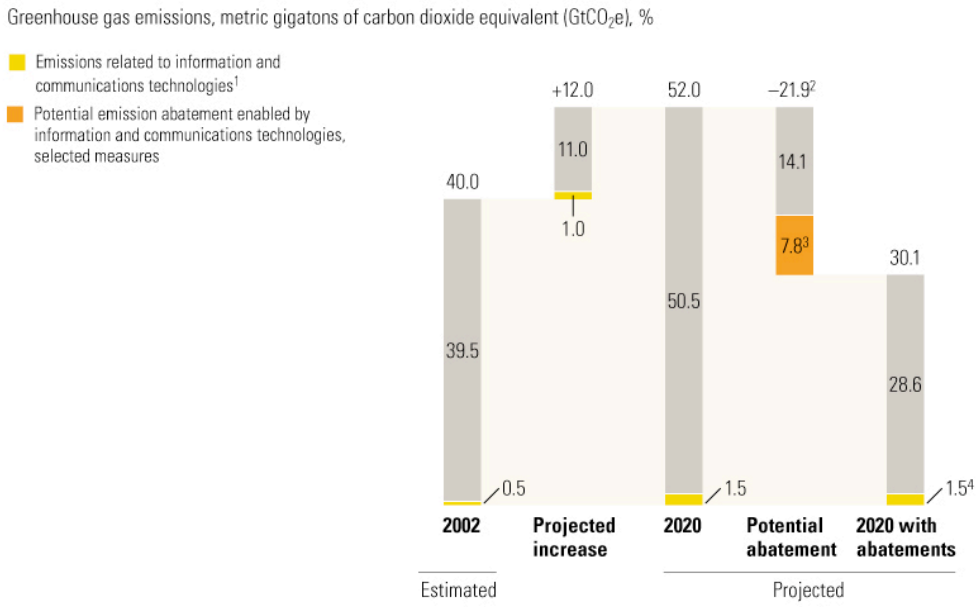
The good news is that information and communications technologies can reduce far more emissions than they generate.

McKinsey&Company

The rapidly growing carbon footprint associated with information and communications technologies, including laptops and PCs, data centers and computing networks, mobile phones, and telecommunications networks, could make them among the biggest greenhouse gas emitters by 2020. However, our research also suggests that there are opportunities to use these technologies to make the world economy more energy and carbon efficient. An analysis of five groups of abatement opportunities finds that such technologies could help to eliminate 7.8 metric gigatons of greenhouse gas emissions annually by 2020 (Exhibit 1)—equivalent to 15 percent of global emissions today and five times more than our estimate of the emissions from these technologies in 2020.

EXHIBIT 1

Part of the problem—and the solution



[1]Includes laptops and PCs, data centers and computing networks, mobile phones, and telecommunications networks.
[2]Includes emissions abatement of 17.1 metric $GtCO_2e$ reflected in McKinsey's global abatement cost curve; some double counting with additional measures is possible.
[3]Includes emissions abatement of 2.9 metric $GtCO_2e$ reflected in McKinsey's global abatement cost curve, plus additional abatement of 4.9 metric $GtCO_2e$ from estimates in this study.
[4]Includes effects of known technological innovation in 2020 forecast; does not include effects of any additional abatement potential related to information and communications technologies.

To calculate their carbon footprint—what it was in 2002 and 2007, and what it will be in 2020—we looked at the level of emissions associated with their use of energy and with their manufacture and distribution. We used standard industry estimates for growth in the number of computers and peripherals, data centers, and telecommunications networks and devices. Then we estimated the power usage of

today's and tomorrow's installed base of these technologies, factoring in improvements in energy efficiency that could appear during the next few years, as well as current and future assumptions about fluctuating levels of power usage throughout the day. Finally, we assessed the emissions from the energy consumption of information and communications technologies (adjusting for regional variations) and added assessments of the emissions from their manufacture, transport, and disposal.

These technologies now account for 0.86 metric gigatons of emissions a year, or about 2 percent of the emissions added to the atmosphere globally. The world's increasing need for computation, data storage, and communications is driving rapid growth in the emissions associated with such technologies. By 2020, they will account for about 3 percent of all emissions: 1.54 metric gigatons, or twice what the United Kingdom produces today. What's more, this figure assumes that significant efforts will be made to improve the energy efficiency of devices, components, other equipment, and data centers. Although we looked into the most promising measures now on the drawing board to cut energy consumption during their manufacture and use, these technologies will proliferate so rapidly as to dwarf even the gains anticipated from these efforts.

The adoption and use of information and communications technologies in China, India, and other developing economies will account for much of this growth (Exhibit 2). Emissions from the manufacture and use of PCs alone will double over the next 12 years as middle-class buyers in emerging economies go digital. Similarly, worldwide growth in the use of mobile phones will triple their carbon footprint by 2020, in large part because of their consumption of silicon and rare metals. But the fastest-increasing contributor to emissions will be growth in the number and size of data centers, whose carbon footprint will rise more than fivefold between 2002 and 2020 as organizations in all sectors add servers to meet rising demand—even as companies and governments alike attempt to become more energy efficient.

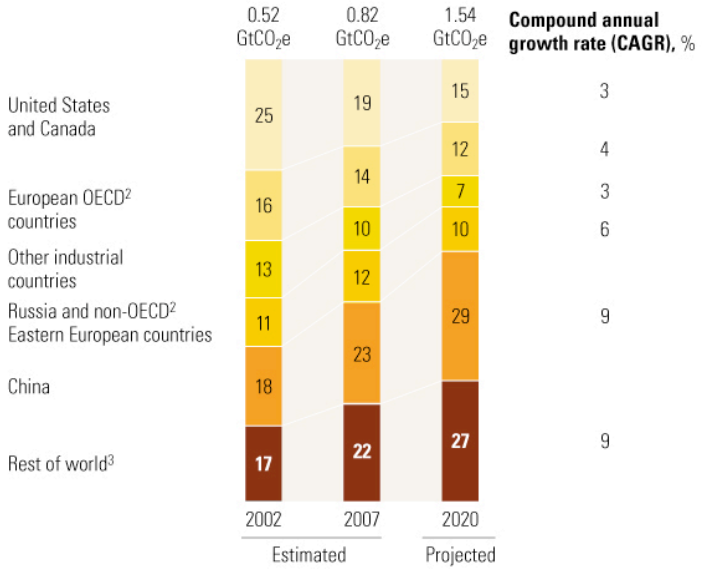
Yet there is good news too: information and communications technologies can help abate far more emissions in the general economy their own production and use generates. We estimated this abatement potential by studying all known opportunities to optimize energy productivity in four sectors—buildings, power, transport, and manufacturing. Then we calculated the specific energy savings and the associated abatement potential for one significant group of opportunities in each of the sectors. We also looked at a set of opportunities that cut across sectors: telecommuting and other technological substitutions for emission-producing activities. In just these five areas, we identified annual reductions of 7.8 metric gigatons of carbon emissions by 2020. Because we did not review all prominent opportunities to reduce them—for example, we excluded satellite surveillance to monitor deforestation and herding, two of the largest contributors to climate

change—the full impact of information and communications technologies could be much greater.

EXHIBIT 2

The dark side of development

Greenhouse gas emissions from the use of Information and communications technologies[1] by geography, metric gigatons of carbon dioxide equivalent ($GtCO_2e$), %



[1]Includes laptops and PCs, data centers and computing networks, mobile phones, and telecommunications networks.
[2]Organisation for Economic Co-operation and Development.
[3]Includes Brazil, Egypt, India, Indonesia, and South Africa.

They are particularly effective as a platform for energy efficiency when improvements take place on a large scale—for instance, optimizing energy usage in millions of buildings. In these circumstances, automation and networks can capture small advantages easily and cost-effectively.

In the manufacturing sector, smart controls can make motor systems in factories more efficient. The use of information and communications technologies to optimize the energy efficiency of motors in China's plants, for example, could cut emissions by 200 metric megatons a year, as much as the Netherlands produces today. The annual energy savings would amount to €8 billion, to say nothing of an additional €4 billion in the value of the emissions (at a carbon rate of €20 per metric ton). The value at stake globally in using these technologies to optimize the energy efficiency of such motors would be about €68 billion (€53.7 billion in energy savings and €14.7 billion in carbon savings). By 2020, seizing this opportunity could reduce emissions by 0.68 metric gigatons annually.

As for the power sector, sensors in grids can monitor the distribution of power more efficiently and help reduce losses. One grid in India that used information and communications technologies to monitor electricity flows reduced its losses from the transmission and distribution of power by 15 percent. In India, where the generation of electricity accounts for almost 60 percent of emissions, reducing transmission losses by 30 percent could save €9 billion a year. Globally, a more efficient grid could generate €61 billion in energy savings and abate 2.03 metric gigatons of emissions by 2020.

Smart transportation systems, such as the technology used to manage complicated truck logistics, could reduce emissions globally by 1.52 metric gigatons a year. In Europe, companies with six or fewer trucks own 60 percent of the fleet. If smart transportation technology were to manage the flow of truck traffic in Europe—as it already does on some German highways—truckers could work together to optimize their loads.

In buildings, more sophisticated technology can monitor lighting, heating, and ventilation systems. For the United States alone, that could cut the commercial-building sector's energy bill by nearly 30 percent a year. Globally, smart buildings could cut emissions by 1.68 metric gigatons a year.

Besides the opportunities in these four sectors, we studied the possibility of reducing emissions by "dematerializing" physical goods and processes through telecommuting, video conferencing, Internet shopping, and downloading content rather than using paper, CDs, DVDs, and so on to covey it. We found that these kinds of substitutions cut emissions significantly—by 0.5 metric gigatons a year—but far less than the 7.3 metric gigatons in annual emission reductions from improved energy efficiency in factories, buildings, electricity grids, and truck fleets. That is a somewhat unorthodox conclusion.

Users and vendors of information and communications technologies alike will need to innovate. If governments introduce a price on carbon emissions or if energy prices rise further (or both), the increased costs of production could be passed on to buyers. This would challenge IT managers and companies that purchase IT and telecom equipment in large quantities to rethink the way they manage the demand for and supply of IT services, as well as their use of IT applications. At the same time, companies that make everything from control devices to computer components, software to networking gear, will have a big incentive to invest in energy-saving products and services and thus help to reduce greenhouse gas emissions. Increasing demand for information and communications technologies that promote abatement will create attractive growth opportunities for those companies.

About the Authors
Giulio Boccaletti is a consultant and **Jeremy Oppenheim** is a director in McKinsey's London office; **Markus Löffler** is a principal in the Stuttgart office.

Related Articles on mckinseyquarterly.com

"How the world should invest in energy efficiency"

"Business strategies for climate change"

"How companies think about climate change: A McKinsey Global Survey"