Information and Communication Technologies: Enablers of a low-carbon economy

Explore the many opportunities for Information and Communication Technologies (ICT) to support environmental sustainability and understand the role of ICT for a low-carbon economy.

Although Information and Communications Technologies (ICT) contribute only 2 percent to the global carbon footprint, its potential to effect meaningful change should not be dismissed. The industry is set to save a huge amount of energy and carbon emissions by direct improvements in telecom equipment and the way it is deployed. There is real potential to drive 2020 emission levels down to the levels of 2002 – despite exponential growth in traffic. In addition, ICT is a key enabler in helping to reduce the remaining 98 percent of carbon emissions associated with other societal needs. The ICT industry, through innovative applications and solutions, can enable a projected 15 percent reduction in global greenhouse gas emissions by 2020, representing a tremendous opportunity to make a real, positive impact on our world.
Table of contents

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction</td>
</tr>
<tr>
<td>2</td>
<td>Information and Communication Technologies: Enablers of Sustainability</td>
</tr>
<tr>
<td>3</td>
<td>Enabling a low-carbon economy</td>
</tr>
<tr>
<td>5</td>
<td>Examples of smart ICT solutions and their low carbon effect</td>
</tr>
<tr>
<td>7</td>
<td>Walking the walk</td>
</tr>
<tr>
<td>9</td>
<td>Conclusion</td>
</tr>
<tr>
<td>9</td>
<td>Appendix</td>
</tr>
</tbody>
</table>
Introduction

Information and Communication Technologies (ICT) industries hold unique potential in the drive towards sustainable growth, not only as growth engines for employment and creation of wealth, but also as enablers of a low-carbon economy. While the ICT sector accounts for only about 2 percent of greenhouse gas (GHG) emissions, it has the ability to significantly reduce the remaining 98 percent, by as much as 15 percent according to one study¹.

Innovative ICT solutions from Alcatel-Lucent and others are making it possible to reduce carbon emissions across broad sectors of the economy through, for example, smart grid and smart metering solutions for the energy sector and intelligent transportation systems.

By enabling electricity generators to route power more efficiently, reduce peak capacity requirements and exchange real-time information with customers, smart grid solutions could reduce carbon emissions by 2.03 GtCO₂e over the next decade. In the transport sector, the second leading source of global GHG emissions after energy, ICT solutions could save an additional 1.52 GtCO₂e by 2020. They can improve logistic networks, make it easier to mix transportation modes, define the most energy-efficient type of transport, help optimize routes and reduce inventory needs.

Communications technologies such as teleconferencing and videoconferencing have begun to significantly reduce GHGs from business travel. Likewise, ICT is helping businesses reduce carbon emissions through dematerialization, which involves replacing material documents by electronic ones such as paper-based systems as compared to electronic billing and payment.

ICT solutions and technologies already help make the design, construction and operation of new and existing buildings more efficient. ICT-driven building energy management systems can reduce energy consumption by 5 percent to 40 percent. Such smart building technologies could eliminate 1.68 GtCO₂e of emissions by 2020.

Because climate change and the eco-sustainability challenge are too broad for any single organization, Alcatel-Lucent supports an open, collaborative approach. The company is engaged in research consortia, partnerships, standards bodies, industry groups and other collaborative efforts.

Prime among these is the GreenTouch™ energy efficiency initiative. A global research consortium initiated by Bell Labs, GreenTouch™ brings together leaders in industry, academia and government labs around a shared goal: to make communication networks 1000 times more energy efficient. By reinventing the network, GreenTouch™ will lay the groundwork for tomorrow’s sustainable networks.

To benefit from the extraordinary leverage offered by ICT, government leaders will need to define policies that support the ICT sector’s potential as a driver of sustainable growth. Policy makers, regulators and ICT industry leaders must work together to define the right framework and conditions to support the ongoing development of innovative ICT solutions. Government and public authorities play a crucial role, both as investors modernizing public services and as pioneers and supporters of those innovative initiatives that require broad collaboration and incentives to succeed.

¹ “SMART 2020: Enabling the Low Carbon Economy in the Information Age”, published by the Global e-SuStainability initiative (GeSi) and The Climate Group – June 2008
Information and Communication Technologies: Enablers of Sustainability

In today’s world, sustainability increasingly means reducing carbon emissions as well as achieving durable economic growth. While some are tempted to portray economy and environment as mutually exclusive trade-offs, they must be seen as a single imperative. Growth that is noxious to the environment is clearly unsustainable, as are environmental initiatives that fail to make economic sense. More than any other industrial sector, the Information and Communication Technology (ICT) industries intersect both economy and environment interests.

As those responsible for steering the world’s largest economies tackle the issues of growth and sustainability, the ICT sector offers powerful opportunities. As a virtually inexhaustible source of innovation, ICT industries have demonstrated an ability to stimulate sustained development of new business activities and employment opportunities. The sector’s ability to drive economic growth has been strengthened by the advent of high-speed Internet. In fact, according to a recent World Bank econometrics analysis of 120 countries, for every 10 percent increase in the penetration of broadband services, there is an increase in economic growth of 1.3 percent. This growth effect of broadband is significant and stronger in developing countries than in developed economies.

Figure 1. Growth effects of ICT

At the same time, the ICT sector’s ability to function as a growth engine depends in no small part on its ability to contribute, directly and indirectly, to the most pressing environmental battle of our time, the fight against climate change. It is the sector’s indirect contributions to a low-carbon economy that merit the most attention, due to the ICT industries’ potential to enable energy efficiencies and economies and more efficient resource management across broad sectors of the economy.

Enabling a low-carbon economy

Information and communications technology (ICT) directly accounts for only about 2 percent of global carbon emissions. While ICT providers must continue to find ways to reduce direct ICT emissions, especially with rapidly expanding ICT usage, the sector’s most powerful contribution to a low-carbon economy lies in its potential to reduce the remaining 98 percent.

According to one recent study, the ICT sector can cut greenhouse gas (GHG) emissions by as much as 15 percent (example: 7.8 GtCO$_2$e) by 2020 — five times the sector’s own footprint — with collateral economies of up to $750 billion. The combined environmental and economic benefit can be achieved through innovative communications applications and solutions in areas as diverse as building design and maintenance, transport and logistics, electricity generation, distribution and consumption, travel substitution, product dematerialization and innumerable business process streamlining efforts.

Figure 2. ICT impact: The global footprint and the enabling effect

ICT companies can further help organizations from other sectors and individual consumers reduce emissions by increasing energy efficiency, reducing energy use, virtualizing activities that currently require physical resources, and managing other scarce resources, but also by providing the information and analysis tools that support environmentally responsible behavior.

“With nearly 70 percent of businesses with revenues of US$1 billion or more planning to increase spending on energy efficiency and environmental sustainability within the next 12 months, far-reaching opportunities exist for the ICT sector to be a critical element in the drive to lower emissions,” notes the International Chamber of Commerce (ICC).

---

3 "SMART 2020: Enabling the Low Carbon Economy in the Information Age", published by the Global e-SuStainability initiative (GeSi) and The Climate Group – June 2008

A Huge Opportunity for Savings: 15 percent of Global Emissions (7.8 GtCO₂e) in 2020
Source: Alcatel-Lucent analysis of GeSI SMART 2020 data.

Evaluating the carbon-reducing potential of ICT
To provide businesses, policy makers and the ICT industry with a common form of measurement, the Global e-Sustainability Initiative (GeSI) created a methodology for measuring carbon emissions eliminated or reduced through ICT-based solutions. Alcatel-Lucent uses GeSI’s new ICT evaluation methodology to calculate the carbon reduction benefits of its communication solutions.

5 “Evaluating the Carbon-Reducing Impacts of ICT: An Assessment Methodology”, published by the Global e-SuStainability initiative (GeSI) – September 2010
“Consumers and businesses can’t manage what they can’t measure. ICT provides the solutions that enable us to ‘see’ our energy and emissions in real time and could provide the means for optimizing systems and processes to make them more efficient.”

STEVE HOWARD, CEO, THE CLIMATE GROUP

“The application of ICTs has been shown to make a significant contribution to combating climate change. The new GeSI report provides a roadmap to assess the capacity of ICTs to enable low carbon solutions, and will therefore help establish the business case for going green.”

MALCOLM JOHNSON, DIRECTOR, ITU TELECOMMUNICATION STANDARDIZATION BUREAU

Examples of smart ICT solutions and their low carbon effect

As a long-term contributing partner to the GeSI Climate Change Work Group, Alcatel-Lucent uses the findings of GeSI’s landmark research to develop and promote ways to reduce carbon emissions across broad sectors of the economy.

Alcatel-Lucent solutions offer substantial benefits to industries with relatively large carbon footprints:

- Energy: smart grid and smart metering
- Transportation: intelligent transport systems
- Healthcare: remote patient care and monitoring
- Smart communities: state and local authorities, public safety

Smart grids

Smart grid software and hardware tools enable electricity generators to route power more efficiently, reducing peak capacity requirements and enabling real time, interactive information exchange with customers. Globally, smart grid technologies could reduce carbon emissions by 2.03 GtCO₂e, worth €79 billion.

For example, India loses nearly one-third of its electricity through transmission and distribution losses. These losses, the highest in the world, could be reduced by 30 percent through better grid monitoring and management. Electricity generation currently accounts for 57 percent of India’s total emissions.

Alcatel-Lucent enables utility customers to benefit from smart grid and smart metering solutions:

- **United States**: Alcatel-Lucent smart meters and a smart meter management system enable the Electric Power Board of Chattanooga, Tennessee, one of the largest United States publicly-owned electric power companies, to use power more efficiently and to introduce flexible rates based on changing conditions.
- **Canada**: Alcatel-Lucent is helping AltaLink, Canada’s only fully independent electric transmission provider, to offer customers electric power when they need it, at the most economical price and highest possible reliability.
- **Germany**: An agreement between Alcatel-Lucent and Vodafone is bringing innovative solutions to electricity, gas and water suppliers. The first smart metering managed service is being implemented by Stadtwerke Pasewalk, a municipal utility in Mecklenburg-Vorpommern.
In Korea, the Gachon Energy Research Institute (GERI) of Kyungwon University is partnering with Alcatel-Lucent Bell Labs to develop innovative business models for next-generation smart grids. The Grid 2.0 joint research program aims to fundamentally enhance the efficiency, reliability, security, and intelligence of electric power grids by exploiting the convergence between electric power systems and ICT.

**Smart logistics and transport optimization**

After energy, the transport sector is the second-leading source of global GHG emissions. ICT solutions can help reduce transport needs and streamline logistics. For example, ICT solutions can improve logistic networks, make it easier to mix transportation modes and select the most energy-efficient type of transport. They also help optimize routes, reduce inventory needs and can encourage more energy-efficient driving. As fuel prices rise, logistics companies will accelerate their adoption of ICT-based energy efficiency solutions, which will have a huge impact on reducing their emissions.

Worldwide, GHG emissions savings from smart logistics could total 1.52 GtCO$_2$e by 2020, with energy savings worth €280 billion. In Europe, more efficient logistics could yield fuel, electricity and heating savings of 225 MtCO$_2$e. In the United States, traffic congestion drains $78 billion annually from the economy, in the form of 4.2 billion lost hours. Efficiencies in ground transportation, many relying on ICT, could provide up to an estimated 440 MMT reduction in CO$_2$ emissions and economies of $65 billion to $115 billion.

**The LTE Connected Car**

The ng Connect Program, conceived and founded by Alcatel-Lucent, is a cooperative effort among members of the digital value chain to develop solution concepts that leverage the next generation of network, device and software technologies to improve the end-user experience. The LTE Connected Car solution concept brings together leading auto makers, network operators, application and content providers to create an entirely new mobile platform to support a new class of vehicle and travel-centric applications and services that can also help address climate change issues. New applications and services could help drivers reduce energy consumption and travel time due to real-time traffic, weather and road condition alerts, and features such as remote maintenance (vehicle software and application upgrades) and safety and mechanical telematics that help optimize performance and extend vehicle life.

**Smart buildings**

Smart building technologies help make the design, construction and operation of buildings more efficient, for both existing and new properties. ICT-driven solutions include, for example, building management systems (BMS) that run heating and cooling systems according to occupants’ needs or software that switches off all PCs and monitors after everyone has gone home. Building energy management systems can reduce energy consumption by 5 percent to 40 percent.

Research indicates that, in North America, better building design, management and automation could save 15 percent of building emissions. Globally, smart building technologies could eliminate 1.68 GtCO$_2$e of emissions, worth €216 billion.
E-substitutes economize emissions

Communications technologies such as teleconferencing and videoconferencing are helping to greatly reduce GHG emissions from business travel. Research by the University of Bradford and Sustain IT showed that the use of teleconferencing solutions by BT eliminated 717,494 face-to-face meetings. With each conference eliminating an average total of 267 miles of travel, the report shows that each teleconference economized at least 55 kg of CO₂. Annual net savings came to at least 53,552 tons of CO₂.

ICT can help businesses greatly reduce carbon emissions through dematerialization, which involves replacing material documents by electronic ones or media such as CDs as compared to Internet-delivered MP3 music files. For example, one United States study showed the enormous potential economies gained by switching from paper to on-line billing and payments. If every United States household were to switch, the savings would amount to 3.9 billion pounds of GHG, 1.6 billion pounds of solid waste, 13 billion gallons of toxic waste water and 16 million trees.

Walking the walk

Given the estimated rise in emissions in coming years from ICTs, the ICT sector also needs to improve its own performance.

As noted above, the ICT sector directly accounts for only about 2 percent of global carbon emissions. However without action, this relatively small contribution would double over the next decade, largely as a result of mushrooming demand for broadband services. In North America for example, broadband traffic doubles every two years. Some estimate that, if nothing were done, direct ICT emissions would rise from about the equivalent of 0.5 billion metric tons of CO₂ today to 1.4 billion tons by 2020.

Figure 5. Continued exponential traffic growth

![Continued exponential traffic growth](image)

**Data from:** RHK, McKinsey-JPMorgan, AT&T, MINTS, Arbor, Alcatel-Lucent and Bell Labs
**Analysis:** Linear regression on log (traffic growth rate) versus log (time) with Bayesian learning to compute uncertainty

- Doubling every 2 years
- ~ 40% per year
- ~ 30x in 10 years
- ~ 1000x in 20 years
- Mix of services is important from energy perspective
  - Mobile less efficient than fiber optics
The ICT sector continues to mitigate its own environmental impact. Numerous initiatives are underway to reduce the direct ICT carbon footprint by making information and communications networks more eco-efficient through better product life-cycle audits, design and production processes. Through initiatives such as the Alcatel-Lucent Alternative Energy Program, ICT companies are constantly seeking new ways to power networks through more sustainable energy sources. They are also committed to reduce their carbon footprint. [See appendices “Reducing Alcatel-Lucent’s carbon footprint”]

**Innovation and Collaboration Imperatives**

Climate change and the eco-sustainability challenge are too broad for any single organization. Only collaborative efforts on a global scale can fully address all the facets of the eco-sustainability challenge. That is why Alcatel-Lucent supports an open, collaborative approach and has put this approach into practice through various collaborative efforts, ranging from research consortia and partnerships to standards bodies and industry groups.

GreenTouch™ provides an outstanding example of a private sector initiative bringing together the ICT industry to address energy efficiency. A global research consortium initiated by Bell Labs, GreenTouch™ brings together leaders in industry, academia and government labs around a shared goal: to make communication networks 1000 times more energy efficient. This amounts to operating a communications network for three years on the same amount of power it currently consumes in a single day.

By reinventing the network as we know it, GreenTouch™ will deliver radical approaches to energy efficiency, laying the groundwork for tomorrow’s sustainable networks. By 2015, GreenTouch™’s goal is to deliver a reference network architecture and demonstrations of the key enabling technologies required to make it happen, opening new areas of enterprise in the process.

**Helping policy makers understand ICT impact**

Policy makers seeking to steer their nations through today’s turbulent economic and environmental waters face tough challenges and bold opportunities. To benefit from the extraordinary leverage offered by ICT, they will need to define policies that support the ICT potential to address key societal goals by creating appropriate, investment-friendly conditions, without hampering the flexibility that is a prerequisite for innovation. Policy makers, regulators and ICT industry leaders must work together to define the optimal framework and conditions to support the ongoing development of innovative ICT solutions.

Policy makers also play an important role in educating the public, especially because many energy-saving innovations tend to be invisible. Furthermore, their participation is vital as international standards are set. A global carbon accounting standard, for example, would help stimulate adoption of innovative carbon-reducing technologies, with immediate economic benefits regardless of company location.

In Europe, the ICT sector is working with the European Commission to develop common standards to measure carbon footprints and overcome regulatory hurdles to the marketing of low carbon ICT technologies. This work is being carried out within the ICT for Energy Efficiency Forum (ICT4EE), launched in February 2010.
Conclusion

New and stronger action on climate change is needed. To fulfill its considerable potential to reduce carbon emissions, the ICT sector will need the engagement of all stakeholders. Government and public authorities play a particularly crucial role — both as investors modernizing public services and as pioneers and supporters of those innovative initiatives that require broad collaboration and incentives to succeed.

As governments and companies strive for sustainable growth, innovative ICT solutions can help set priorities and make better, more well-informed decisions on funding, staffing and resource allocation. Advanced high-speed broadband networks are a critical enabler, a vital infrastructure element in the drive toward a low-carbon society. Without them, society will be unable to reap the full CO$_2$ reduction or the collateral economic growth potential offered by Green ICT solutions.

Appendix

Alcatel-Lucent: Improved networks yield direct and indirect benefits

Advances in broadband technology can help to improve environmental sustainability, as demonstrated in the award-winning Bell Labs paper, “Leveraging Advances in Mobile Broadband Technology to Improve Environmental Sustainability” (2009 – The Eckermann-TJA Prize Winners). For example, for cellular networks in urban areas serving high data-rate users, the researchers showed that network energy consumption could be cut by up to 60 percent by combining large capacity macrocells for area coverage with tiny, publicly accessible user-deployed residential picocells. The savings could reach 70 percent as both technologies mature and demand for high data rates increases.

The study also compared the direct and indirect benefits associated with improving telecommunication networks such as enabling teleworking and replacing business travel with video conferencing. The indirect environmental benefits were vastly greater than those achieved directly by improving telecommunications networks alone.

Table 1. Comparison of direct and indirect benefits resulting from advances in broadband technology for Wellington, New Zealand. For comparison, $NZ 1 = $US 0.66 = € 0.48 = $A 0.85 (05 October 2008).

<table>
<thead>
<tr>
<th></th>
<th>DIRECT BENEFITS</th>
<th>INDIRECT BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MACRO-PICO ARCHITECTURE (TODAY)</td>
<td>MACRO-PICO ARCHITECTURE (FUTURE)</td>
</tr>
<tr>
<td>ENERGY REDUCTION PER YEAR</td>
<td>Up to 4500 MWh (60% reduction)</td>
<td>Up to 4000 MWh (70% reduction)</td>
</tr>
<tr>
<td>CO$_2$ REDUCTION PER YEAR</td>
<td>2700 t</td>
<td>2400 t</td>
</tr>
<tr>
<td>COST REDUCTION PER YEAR</td>
<td>$NZ 630,000 (full population)</td>
<td>$NZ 560,000 (full population)</td>
</tr>
</tbody>
</table>
Reducing Alcatel-Lucent’s carbon footprint

Alcatel Lucent is committed to reduce its absolute carbon footprint by 50 percent by 2020 (2008 baseline). To achieve this goal, Alcatel-Lucent has developed a comprehensive approach that takes into account all significant direct and indirect sources of carbon emissions, both by the company and its suppliers.

Internally, Alcatel-Lucent systematically seeks out carbon reduction opportunities by focusing on each of the main direct and indirect contributors to its carbon footprint: electricity consumption, product transportation, packaging and logistics, business travel and others. Mindful of the need to reduce carbon emissions by third parties on behalf of Alcatel-Lucent, the company has also defined a rigorous supplier engagement program. All major suppliers and subcontractors are required to commit to act in an environmentally responsible fashion. Supplier engagement is ensured through such initiatives as audits to ensure compliance with Alcatel-Lucent supplier code of conduct and supplier education initiatives.

By the end of 2009, Alcatel-Lucent reduced its greenhouse gas emissions by 13.2 percent compared to 2008. This was achieved in part due to a 29 percent reduction in emissions from logistics activities. Two major facilities now rely 100 percent on renewable energy.

In 2010, Alcatel-Lucent expects to further reduce emissions caused by logistics activities through a demand-driven logistics program. Supplier engagement efforts will also continue, with an eye towards auditing all key and preferred suppliers by 2012. Half of key and preferred suppliers had been audited as of September 2010.

About the Alcatel-Lucent eco-sustainability strategy

At Alcatel-Lucent, the challenge is not to choose between sustainability and business success but rather to seize the sustainability opportunity as the path to success … for the company and for the planet.

Learn more at www.alcatel-lucent.com/eco.