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ICT for a
Low-Carbon World
*Activism, Innovation,
Cooperation*



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EXECUTIVE SUMMARY

Companies operating in the information, communications, and technology (ICT) sector have a unique opportunity to trigger significant environmental benefits, not only by upgrading their operations but also by developing greener products and services for their clients. If the sector seizes this opportunity, it can reduce greenhouse-gas emissions by an amount equivalent to five times the carbon footprint of the ICT sector itself, with significant economic upside. So far, however, the ICT sector has largely failed to achieve meaningful consensus on how best to address its myriad challenges. Continuing with this fragmented approach could harm the sector's prospects for a compelling and beneficial contribution to the environmental agenda and could even limit growth. Worse, it could leave ICT companies in the position of reacting individually, and defensively, to patchwork regulatory measures imposed by governments.

To rise to the occasion, ICT companies will need to overcome several challenges, most notably the lack of a metric that can quantify their overall environmental efforts on behalf of clients. To date, there are many ways to measure the results of internal initiatives, but none that evaluates the net effect of ICT products and solutions leveraged specifically to

reduce greenhouse-gas emissions for their customers. ICT companies will also need to take internal measures—such as designating champions for sustainability, setting aside budgetary resources, and devoting more R&D assets to green innovation—and reach outside their organizations by collaborating more with academic institutions and regulators.

ICT CAN CONTRIBUTE TO CHANGE

Over the past decade, business leaders, governments, and leading thinkers around the world have begun to recognize the profound environmental, social, and economic challenges presented by climate change.¹ In the context of that evolving awareness, companies in the ICT sector have the potential to make significant contributions to the reduction of greenhouse-gas emissions that play a role in climate change. This may seem counterintuitive, given that ICT is a relatively clean industry compared with others such as manufacturing and construction. Current estimates

hold that ICT companies will contribute roughly 2 percent of the planet's emissions in 2009, about the same as the aviation industry.²

However, the sector is growing relentlessly on a global scale. As large populations in the developing world enter the digital age, the environmental impact of ICT will only get worse, generating rapid increases in the carbon footprints of some subsectors. The number of PCs in use is projected to double between 2008 and 2014,³ and mobile voice and data traffic is projected to rise fourfold from 2007

to 2012 (see *Exhibit 1*).⁴ As a result, total ICT emissions are on track for a potential 50 percent increase by 2020, to 3 percent of global emissions.⁵

Additionally, the relatively short life cycle of ICT products, and the lack of thought given to dealing with end-of-life ICT assets, has led to a growing dispersal of toxic chemicals. Roughly two-thirds of all PCs end up in landfills, posing serious health risks because of a range of component materials that

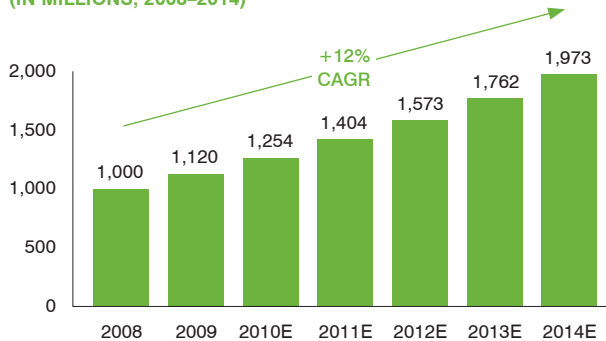
include lead, cadmium, mercury, and arsenic. In short, the sector faces a clear imperative to reduce its direct footprint by decreasing energy consumption of its products and minimizing waste derived from them.

However, ICT companies can trigger much larger environmental changes by enabling energy efficiency in other sectors. In this way, ICT is in a unique position in regard to climate change. Just as the sector's products can

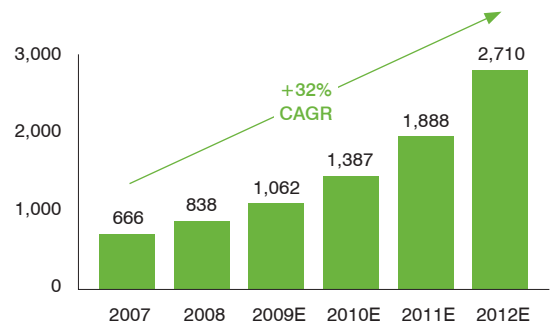
have a multiplier effect in increasing efficiency and productivity among its clients, it can trigger leveraged reductions in emissions among those clients as well, by creating products and services that allow them to more effectively monitor energy use, identify inefficiencies, and transform value chains to become more eco-friendly. The SMART 2020 report, an analysis of ICT's effect on climate change that was commissioned by the Global e-Sustainability Initiative,

Exhibit 1
Growth in a Number of ICT Areas Will Lead to Increased Emissions

GLOBAL NUMBER OF PCS USED
(IN MILLIONS, 2008–2014)



GLOBAL MOBILE TRAFFIC—VOICE AND DATA
(IN BILLIONS OF MB, 2007–2012)



Source: Informa, covering Internet (broadband) users, mobile users, and number of PCs; Internet World Stats; IDC, "Worldwide Datacenter 2008–2012 Forecast"; Ovum Wireless Report

estimates that ICT could enable a reduction of up to 15 percent of global emissions, or five times the footprint of the sector itself (see Exhibit 2).⁶

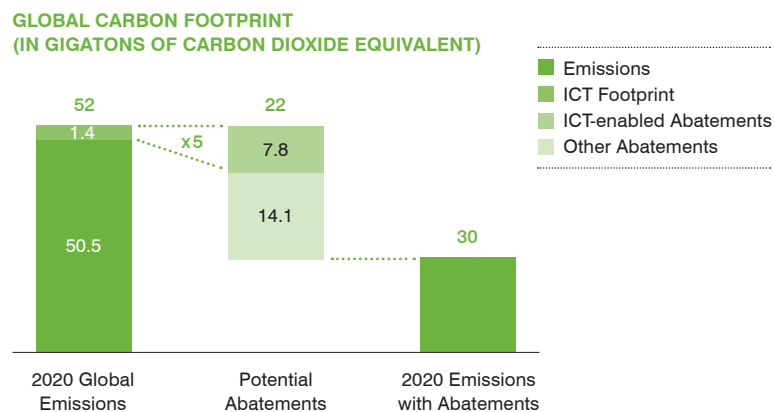
In addition to such environmental benefits, there are significant—and growing—economic opportunities for ICT products and services in the sustainability category. In the transportation industry, the global market for supply chain management software from ICT players is projected to hit US\$8.3 billion

this year, up from \$5.5 billion in 2005. In the urban-planning sector, investment in building-management systems is projected to exceed \$67 billion by 2020. Among utilities, smart grids are leading to significant energy savings and energy abatement, with a market that is expected to grow from \$69.3 billion in 2009 to \$171.4 billion in 2014.⁷

Despite this potential, the ICT sector, usually known for cutting-edge solutions, is not driving the sustainability agenda. To do so, companies in the

sector must seize a number of opportunities. Perhaps foremost among these is to spread awareness of the potential business gains that could be realized from a comprehensive approach to dealing with the problem of climate change. Some ICT companies feel these ventures are worthwhile from an environmental standpoint but don't recognize the possible market demand. Those that have identified potential business gains lack a unified vision or consensus on how best to move forward. At the same time, there is a notable lack

Exhibit 2
ICT-enabled Efficiencies Could Eliminate More Emissions Than the Sector Creates



Source: The Climate Group for GeSI, "SMART 2020: Enabling the Low Carbon Economy in the Information Age"; Booz & Company analysis

of standards, leading to unnecessary competition among companies and confusion among consumers.

To address these opportunities systematically and improve sustainability throughout the ICT sector, leaders in the sector must respond to four imperatives. Only by working on all of these approaches will companies in the sector be making the most of all environmental and economic opportunities.

Innovate: Companies must develop new ICT solutions to address environmental issues. The recently announced Green Touch initiative falls into this category. Green Touch is a global consortium organized by the Bell Labs research arm of Alcatel-Lucent and consisting of service providers (AT&T, Telefónica, Portugal Telecom, China Mobile); academic research labs (MIT, Stanford, the University of Melbourne); government and nongovernmental organizations (CEA-Leti, an applied

research institute for microelectronics in France, among others); and industrial labs (Bell Labs, Samsung Advanced Institute of Technology). The goal of Green Touch is a thousandfold increase in the efficiency of communication networks. It aims to assemble reference network architecture and other necessary components within five years.⁸

Grow: ICT players must adapt, enhance, and grow ICT solutions to address green issues. For example, VMware Inc. increased the market penetration of its virtualization technology in part by demonstrating its environmental impact. The technology allows ICT equipment such as servers and storage facilities to be consolidated in as little as one-fifteenth the original space, resulting in better efficiency and triggering energy savings of 8.5 billion kilowatt-hours. For many customers, return on investment within six months of deploying the software was in excess of 300 percent.

Measure: Although several measurements exist to gauge the impact of green initiatives on a company's internal operations, none considers the leveraged effects of ICT products and services on a company's overall client base. This remains one of the larger barriers to developing an overall environmental strategy for the sector. ICT companies must define an objective metric that can assess this impact.

Enable: ICT players must work in conjunction with governments to establish a regulatory structure that can facilitate innovation and growth of green ICT solutions, through a balance of enforcement and incentive mechanisms. Only by effectively lobbying governments can the sector shape new environmental policies as they're being constructed, instead of reacting to them after they're issued.

MEASURES OF ACTIVISM

Individual ICT companies have adopted a host of strategies to address climate change and other green issues (*see Exhibit 3*). These can be considered along an environmental activism spectrum consisting of four dimensions. By looking at key performance indicators along all four, an index can be assembled that allows companies' environmental efforts to be quantified and compared. The four dimensions include:

Operational Consciousness: This measures the degree to which a company takes steps to improve the sustainability and environmental impact of its own operations by minimizing the use of energy and other resources and initiating green practices such as recycling. Key performance indicators include the carbon footprint from the company's internal operations; the percentage of equipment (heating and cooling equipment, lighting, appliances)

with an environmental certification; the percentage of energy consumed from renewable resources; and the percentage of employees using eco-friendly travel alternatives, such as video teleconferencing, telecommuting, and public transportation.

An example of Operational Consciousness comes from Dell Inc., which is promoting the use of renewable and alternative energy in its facilities. Some 26 percent of its global electricity needs now are served by these sources, which produce negligible or zero emissions. The measure is expected to save the company about \$1 million per year in energy costs.

Product Consciousness: This measures the extent to which a company considers the sustainability and impact of its products through initiatives such as reduced packaging,

Exhibit 3
ICT Companies Are Taking a Number of Measures to Improve Sustainability

OVERVIEW OF IT COMPANIES' GREEN ACTIVITIES (REPRESENTATIVE SAMPLE)

		Dell	Nokia	Siemens	Intel	AMD	Microsoft	Sun Micro-systems	Hitachi	Autodesk	Cisco
Impact on Internal Operations	ISO 14001	✓	✓	✓	✓	✓		✓	✓		✓
	Low-emissions Car Fleet		✓	✓	✓	✓	✓		✓	✓	✓
	Staff Training	✓	✓	✓	✓		✓	✓	✓	✓	✓
	Recycling Program	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Renewable Energies	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Paperless Office	✓			✓		✓	✓			✓
	e-Billing System	✓					✓				✓
Impact on Clients' Operations	Green Enablement Solutions ¹	✓	✓	✓	✓	✓	✓	✓	✓		✓
	Green Innovation Solutions ²		✓	✓	✓		✓		✓	✓	✓

OVERVIEW OF TELECOM OPERATORS' GREEN ACTIVITIES (REPRESENTATIVE SAMPLE)

		AT&T	BT	Telus	Deutsche Telekom	Swisscom	Sprint	Telecom Italia	Telefónica	Telenor	Vodafone
Impact on Internal Operations	ISO 14001	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Low-emissions Car Fleet	✓	✓	✓	✓			✓	✓		✓
	Staff Training	✓	✓	✓	✓	✓	✓	✓	✓		✓
	Recycling Program	✓	✓	✓	✓		✓		✓	✓	✓
	Renewable Energies	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Paperless Office	✓	✓	✓	✓		✓		✓		✓
	e-Billing System	✓	✓	✓	✓	✓			✓		✓
Impact on Clients' Operations	Green Enablement Solutions ¹	✓	✓	✓	✓	✓			✓	✓	
	Green Innovation Solutions ²	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

¹ Green Enablement solutions improve the operation of products in the IT and communications sphere so that they are more environmentally sustainable (e.g., energy-efficient data centers, networks).

² Green Innovation solutions reduce the environmental impact of other companies' products (e.g., fleet management, smart meters, building management systems).

Source: IT companies' websites; Booz & Company analysis

elimination of toxic materials used in product manufacturing, and recyclable components and products. Key performance indicators include the carbon footprint of products, evaluated at all stages of their life cycle (development, manufacturing, distribution, sales, use, and disposal); the percentage of toxic materials in products; the percentage of suppliers audited for eco-friendly products and practices; the percentage of recycled and recyclable materials used in manufacturing; and the percentage of sales that come from eco-friendly channels, such as online.

Looking again at Dell, the company has launched several initiatives aimed at increasing its Product Consciousness. It is focused on reducing its product packaging size, which results in fewer materials used and better shipping efficiency (i.e., more products per truck). The company aims to source 30 to 40 percent of its packaging material from recycled content and to enable 75 percent of its packaging material to be curbside-recyclable by 2012. Its long-term goal is to reduce packaging material by 20 million pounds, leading to \$8 million in annual savings.⁹

Green Enablement: This measures how well a company reduces the carbon footprints of its customers through improvements to current ICT equipment or services such as server virtualization and power-management software. Key performance indicators include aggregated emissions abatements and energy-usage reductions generated through ICT solutions, and the percentage of workforce and budget dedicated to R&D for green products and solutions.

One example of Green Enablement comes from Microsoft Corporation and its power-management initiatives. The company's Windows Server 2008 R2 offers operating efficiencies through virtualization and allows organizations to dramatically reduce power consumption. Through the use of this server, Continental Airlines Inc., which has thousands of PCs running Microsoft Windows, consolidated more than 125 servers and deployed more than 320 virtual machines. As a result, Continental now saves between \$1.5 million and \$2 million in energy costs every year.¹⁰

Green Innovation: This measures the performance of an ICT company in

developing innovative solutions that reduce customers' carbon footprints beyond ICT-related products and activities, such as fleet-management software, smart meters, and intelligent building-management systems. Key performance indicators include non-ICT emissions abatements and energy-usage reductions triggered through ICT offerings, and the percentage of workforce and financial assets dedicated to R&D for developing products that can generate non-ICT environmental benefits.

Autodesk Inc., for instance, offers design software that helps architects model the environmental performance of their creations in advance; this step substantially reduces material waste, increases energy efficiency, and more accurately evaluates project life cycles. One of Autodesk's customers, Adept Airmotive, which makes aviation power plants, used Autodesk Inventor software to design an engine that weighs 28 percent less than traditional engines and uses 30 percent less fuel.¹¹ Another example is Cisco Systems Inc., which delivers the IP-based, secure communications infrastructure necessary for smart grids, connecting a range of

Environmental Activism Index: Overview

Using a selection of key metrics, the environmental activism index (EAI) allows organizations to map their performance in four dimensions (see *Exhibit 4*).

Exhibit 4
Key Performance Indicators for Environmental Activism

	Framework Dimensions	Key Performance Indicators
Environmental Impact of ICT Sector	Operational Consciousness Sustainability within company's own operations	<ul style="list-style-type: none"> - Organization's carbon footprint from operations - Organization's energy consumption from operations - Percentage of equipment (e.g., IT equipment, lighting, heating and cooling, office equipment, appliances) with an environmental certification such as EPEAT or Energy Star - Percentage of facilities having an environmental certification such as LEED certification - Percentage of energy consumed using renewable sources such as solar power - Percentage of materials, such as plastic cans and paper, recycled or refurbished after use - Percentage of employees using eco-friendly travel alternatives (e.g., public transportation, video conferencing, telecommuting) - Percentage of employees having received a formal training session on green practices
	Product Consciousness Sustainability within company's own products	<ul style="list-style-type: none"> - Products' carbon footprint throughout the product lifecycle (e.g., raw materials extraction, packaging, disposal) - Percentage of toxic materials (e.g., brominated flame retardants, polyvinyl chloride plastic, mercury) in manufactured products - Percentage of manufactured equipment that is eco-friendly - Percentage of suppliers audited for eco-friendly products and practices - Percentage of recycled materials used in product manufacturing - Percentage of recyclable materials used in product manufacturing - Percentage of products sold that have been refurbished by company - Packaging eco-friendliness (e.g., efficiently sized packaging, use of recyclable materials) - Percentage of sales using eco-friendly channels (e.g., online sales)
Environmental Impact of ICT on Other Sectors	Green Enablement Sustainability of clients' IT and telecom functions	<ul style="list-style-type: none"> - Aggregated ICT emissions abatements via organization's green ICT solutions (e.g., server virtualization, thin clients, power-management software) - Aggregated ICT energy usage avoided via organization's green ICT solutions - Percentage of budget allocated for R&D projects specific to emissions reduction via ICT equipment - Percentage of workforce dedicated to development of green ICT products
	Green Innovation Business potential of environmental sustainability products beyond ICT	<ul style="list-style-type: none"> - Aggregated non-ICT emissions abatements via organization's green ICT solutions (e.g., e-services, video conferencing, smart buildings) - Aggregated non-ICT energy usage avoided via organization's green ICT solutions - Percentage of budget allocated for R&D projects specific to emissions reduction via non-ICT equipment - Percentage of workforce dedicated to development of green ICT products

Source: Booz & Company

users—from generating stations to end users—to the electricity network. That technology is projected to generate a 14 percent reduction in power-sector emissions by 2020. Cisco values the communication portion of the smart grid market at \$20 billion a year over the next five years.¹²

Bringing the Dimensions Together
 Although each of these approaches is worthwhile, the best, most forward-thinking companies will not consider them in isolation but will instead focus on all four at once. In fact, the

only way to compare ICT companies' environmental efforts is to evaluate all four dimensions.

The most intuitive way to illustrate a particular company's efforts in each dimension is to plot them on a spider graph (see Exhibit 5). This allows for a holistic look at a company's progress in each regard and shows where a company is doing well and where it could improve. The dimensions can then be weighted (according to each dimension's environmental impact) to make

them consistent across companies. The weighted scores can form an environmental activism index (EAI) that will quantify overall efforts and help evaluate companies vis-à-vis their competitors in the ICT sector.

Such an index would go a long way toward filling the void among current environmental metrics by allowing for the measurement not only of the environmental impact of an ICT company's in-house initiatives but also of the impact of its products and services on customers.

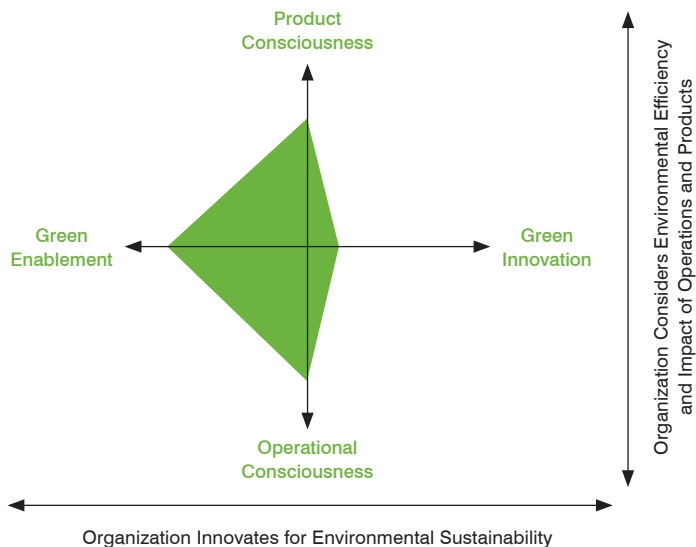
*Exhibit 5
 Companies Should Measure Their Environmental Activism across All Four Dimensions*

ICT ENVIRONMENTAL ACTIVISM MEASURES (SAMPLE COMPANY EAI)

Activism Measures

- Operational Consciousness**
Sustainability within company's own operations
- Product Consciousness**
Sustainability within company's own products
- Green Enablement**
Sustainability of clients' IT and telecom functions
- Green Innovation**
Business potential of environmental sustainability products beyond ICT

Environmental Activism Index



Source: Booz & Company analysis

BUSINESS POTENTIAL

ICT companies that are currently taking bold environmental steps are reaping financial benefits and staking out enviable market positions. A survey of IT professionals across multiple industries showed that more than 50 percent of companies already have green IT solutions or are looking to implement them within a year.¹³ Of these initiatives, more than 80 percent focus on IT infrastructure with data centers, which falls into the category of Green Enablement for ICT companies that market and sell this technology. Such ventures make sense, as green data centers save money by reducing cooling costs, electricity use, and real estate requirements. To date, server virtualization solutions across industries have saved approximately 8.4 billion kilowatt-hours of

electricity per year. Essent NV, one of the leading energy companies in Europe, was able to save almost \$3 million by consolidating its servers in a new data center.¹⁴

Companies actively developing Green Innovation initiatives will be able to target an even broader market, with products that are tailored to multiple industries and have an impact on environmental factors other than IT, such as energy use and waste. IBM recently launched a suite of products aimed at reducing paper use in offices, including enhanced archiving and collaboration software. It simultaneously unveiled a tool that lets companies and other enterprises monitor energy costs within their operations and reconfigure machines to minimize power use.

Companies that are not traditionally considered part of the ICT sector are joining the fray, as well. The green solutions of General Electric's Ecomagination saw revenue growth of more than 20 percent in 2008, with revenues reaching \$17 billion, or nearly 10 percent of the company's total sales. A large portion of the Ecomagination portfolio consists of IT-based and IT-reliant products, some of which have been developed as joint ventures with companies such as Toshiba, Google, and Hitachi.¹⁵ Similarly, Siemens now actively markets the sustainability functions of its Product Lifecycle Management software, which allows tech manufacturers to incorporate environmental factors into all stages of their products, from design to manufacturing to end-of-life disposal and recycling.

Yet although these efforts are laudable—particularly those that help other industries become more environmentally friendly, as opposed to those that improve just the performance of the ICT sector itself—they represent a fragmented approach for the sector. There is limited alignment on the need for or the path toward more environmentally sustainable businesses.

An individualistic approach could lead to missed business opportunities, diminished results, and lost potential to improve environmental conditions. The sector would likely see a number of different technical standards for green ICT solutions or solution components (e.g., energy-monitoring mechanisms). Methods of measuring the positive environmental impact of ICT in other sectors would be

developed in an ad hoc manner, and would see limited sector engagement and enforcement. Customers would continue to show preference for green products, but multiple standards would hinder their uptake, and the business case for “going green” would not be sufficiently compelling.

In contrast, a more collaborative sector approach would have several advantages. Most notably, it would grow the overall market for such solutions and speed up adoption, increasing potential revenue gains for all players. Collaboration would also promote interoperability and standards that improve the customer experience, along with resulting in stronger, more unified lobbying efforts to promote industry positions on green ICT, which can have a greater impact on policymaking and regulation.

THE ROLE OF REGULATORS

Government regulators play a catalyzing role in enabling ICT companies to achieve environmental and economic sustainability. Therefore, a regulatory framework is crucial to engage the ICT sector. The right framework will vary by country, but all will involve a balance of “push” (i.e., enforcement) and “pull” (i.e., incentive) initiatives.

Push measures include recycling mandates, labeling requirements, and efficiency standards, among other statutory approaches. They tend to apply most directly to a company’s external products and services, as opposed to in-house operations. In the United Kingdom, for example,

businesses with revenue of more than £2 million (US\$3.3 million) that supply or import more than 50 tons of packaging each year are now required to recover and recycle a specific amount of packaging waste. At the same time, U.K. statutes require businesses that design, pack, import, or produce packaged goods to minimize packaging volume and reduce the presence of hazardous substances in that packaging.

In another example, Sweden and Italy mandate the use of smart meters, which can substantially improve energy efficiency. In the United States, the state of Pennsylvania passed a

The right regulatory framework will vary by country, but all will involve a balance of regulatory mechanisms based on incentives and enforcement.

law requiring every business to be equipped with such meters within 15 years, and directs utilities to offer pricing plans that reward users (both homes and businesses) that shift their usage to off-peak hours. The goal of Pennsylvania's legislation is to cut electricity use by 3 percent by 2013.

Pull measures include ventures such as education programs, tax incentives, and R&D financing. They are typically used to influence both internal and external operations in a given company or sector. The U.S. government, for example, will spend \$192 million over a 10-year period to help employers encourage employees to take mass transit to work. And Canada set aside C\$300

million (US\$287 million) to reward homes and businesses that implement energy-efficient products.

As regulators decide how best to encourage these technologies, they must consider the impact on companies and other entities outside the ICT sector. For example, although smart grid systems and demand-response pricing are clearly the way of the future, such technology will likely cut into sales volume for utilities, making investments in them unattractive from a purely pragmatic, short-term perspective. In this regard, regulators should look at measures that encourage reductions in energy sales per household while rewarding utilities for improving efficiency in

their operations (for example, allowing utilities to profit from efficiency increases rather than passing all savings through to consumers).

With such a wide range of measures available, there is not only an opportunity but a need for ICT companies to play a greater role in helping governments tailor specific combinations of both incentives and mandates that can best serve given markets. Only by taking a seat at the table during early phases of regulatory construction will the sector be able to define priorities, agree on technical standards, and ensure that governments spur positive environmental change in the most efficient manner possible.

There is not only an opportunity but a need for ICT companies to play a greater role in helping governments tailor specific combinations of both incentives and mandates that can best serve given markets.

THE WAY FORWARD

Although there isn't yet an agenda on what to do or how, there is a growing consensus among industry and activist camps that ICT can contribute significantly to environmental sustainability. This role can unlock significant business potential for the sector, but it will require that companies work together toward developing and promoting ICT solutions. To move forward strategically and make the most of current environmental and economic opportunities, companies should consider several measures. These measures can be grouped into two categories—internal and external.

Internally, companies should:

- *Devote resources* to developing solutions. This includes personnel (such as designating a champion within each

company whose primary task is to drive its sustainability agenda through Operational Consciousness and Product Consciousness) as well as financial resources (e.g., increasing the share of the R&D budget devoted to innovative environmental services and products).

- *Incentivize their managers* to include environmental sustainability, in all facets, as part of their agendas.

Externally, companies should:

- *Increase awareness* throughout the sector of the value and benefits of adopting green ICT solutions. Although many ICT companies are cognizant of the need to improve their own environmental footprint, fewer recognize the economic potential in applying current products and services to green issues, let alone developing new offerings specifically for them.

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- *Encourage collaboration* among sector companies, with the goal of developing technical standards and establishing ICT sustainability centers of excellence and innovation networks. Collaboration with academic institutions is also necessary, to catalyze green innovation.
 - *Develop unified measurements* to evaluate progress. Specifically,

this should include a metric capable of measuring ICT companies' net environmental activism, assessing not only the impact of changes to their own operations and products but also their impact on the operations and products of their clients.

- *Engage regulators* and participate in shaping green policies with implications for ICT companies.

This is not a comprehensive list, and even this may seem a tall order for some ICT companies. Yet the current situation holds tremendous potential for the sector to take greater steps to protect the environment, for consumers to change their behavior, and for technology to save the planet—or, at the very least, for ICT players to cash in on the benefits.

Endnotes

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