

TECHNOLOGY CEO

COUNCIL

A smarter shade of green

**How innovative technologies
are saving energy, time and money**

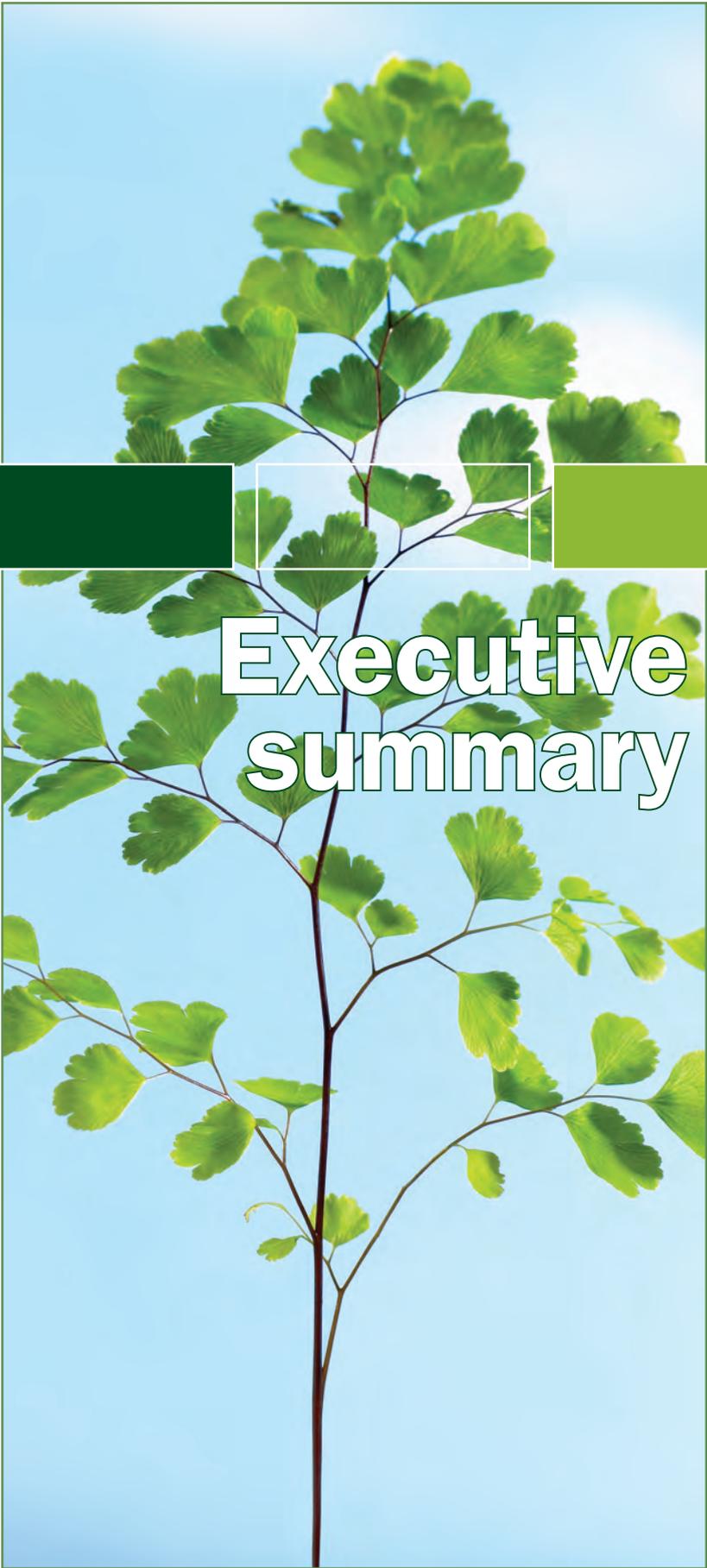




A smarter shade of green

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Executive summary

**We can best
save energy
by investing
more energy
in ICT
applications:
Plug in
to power down.**



Few domestic policy issues invoke greater passion or have greater import than the rising demand for energy and its impact on our economy and environment. From record prices at gasoline pumps to higher energy and consumer expenses to global climate change, Americans are increasingly aware of the enormous challenges posed by this troubling trend.

It's not just the family budget or business bottom lines that are at stake: **The consequences of our energy policies could affect Americans' quality of life and the health of our planet for generations to come.** Americans seem to have reached the tipping point in their desire for a sustainable, greener future. More than 65 percent of voters now report that energy policies will be "important to their vote" in the 2008 elections, according to the Pew Research Center.¹ Public support for leadership, action and progress on

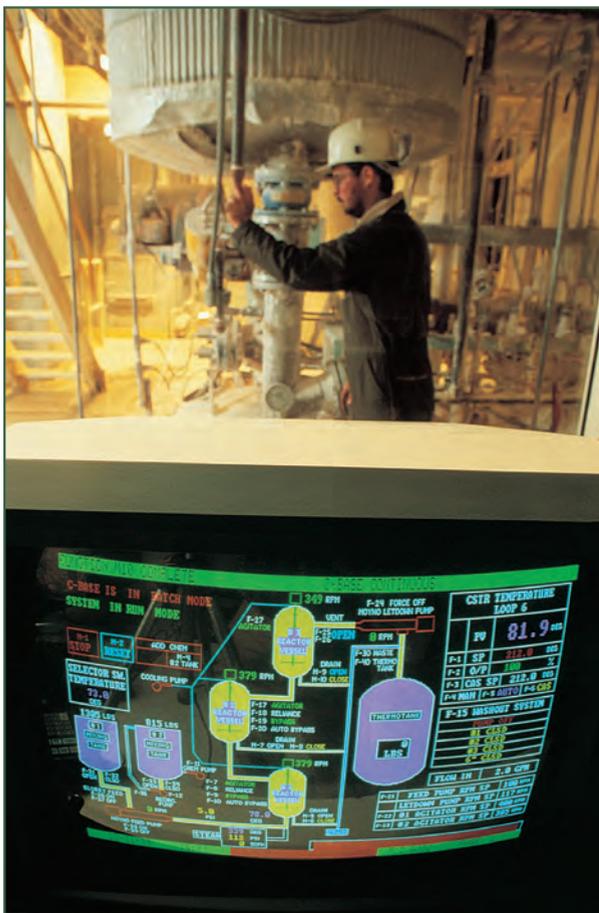
this issue cuts across political, regional and socio-economic boundaries.

All too often, observers perceive this challenge as someone else's failure. "Feckless" government leaders, "fat-cat" oil executives, fast-growing emerging economies and "indifferent" SUV drivers all have been blamed. As a result, solutions are too often perceived as someone else's responsibility. There ought to be a law ... "they" should be stopped ... when will "somebody" act?

The good news is there is a lot we can do together right now. The market is not waiting for any election outcome or government action. Innovators across a variety of business sectors are responding to the growing concerns about our energy and climate future by accelerating their focus on smart, green technologies and business practices. Around the world and across our nation we see significant investment in alternative and renewable energy sources that pollute less and ultimately may cost less.



Even absent new laws and without new sources of energy, there is much that can be done immediately to lessen energy demand without sacrificing economic progress. **Energy efficiency is our country's greatest renewable resource.** It is underappreciated, underutilized and often misunderstood, but it presents a unique opportunity to make our energy dollars go much further, while reducing adverse impacts on our climate.



Information and communications technologies (ICT) have significant experience doing more with less. And ICT is driving increased energy efficiency—fast. In its 2008 landmark study, the American Council for an Energy-Efficient Economy (ACEEE) found that “for every extra kilowatt-hour



of electricity that has been demanded by ICT technologies, the U.S. economy increased its overall energy savings by a factor of about 10.”² From teleworking to traffic management, from virtualization to computer-aided design and manufacture of advanced composite materials, *New York Times* columnist Thomas L. Friedman correctly observes that “you can’t make a product greener—whether it’s a car, a refrigerator or a traffic system—without making it smarter.”³

The ICT industry is investing billions of dollars to research, develop and market advanced, energy-efficiency technologies and business process solutions, creating thousands of new, high-paying jobs in a fast-growing part of the industry. And the smarter systems they are creating already are yielding tremendous benefits for the environment, consumers, and the economy.

Smart technologies are the “brain power” that enable many industries—including transportation, utilities, manufacturing, health care, finance, retail and education, among many others—to reduce their energy and fuel consumption and lessen their impact on the environment. The ICT industry is not just getting smarter, it’s getting greener.

This report highlights just some of the innovative uses of smart technologies and offers some basic recommendations for leaders looking to multiply their benefits. There are, of course, many more technologies already deployed, with other innovations coming online every day that contribute to America's energy efficiency.

It is time for companies that talk green to walk green. The 10 leaders of the Technology CEO Council are pioneering the creation, use and proliferation of smarter technologies and greener business practices. We are inventing the products that increase output while reducing energy needed, developing new ways of doing business that further increase ICT's multiplier impact on energy efficiency. Ideally we can arrive at a new Moore's Law, where succeeding generations of products double throughput while halving energy use.



Of course, this is not enough. We must make our own enterprises the most energy-efficient and climate-friendly in the world. We must lead the multi-sector and multi-stakeholder efforts that develop and disseminate best practices. We must lead on the issues of recycling and e-waste, mitigating any adverse environmental impacts for our products from concept to obsolescence. And ICT leaders must avoid overpromising, so-called "green washing," making climate claims their products and solutions cannot meet.

We hope this report begins a dialogue on additional ways ICT can make our world a smarter, cleaner, safer place.





How smart technologies make the nation and the world more energy-efficient

Smart, energy-efficient technologies create incredible opportunities for everyone—from multinational corporations to small businesses to governments to individuals—to reduce energy consumption, sustain the environment and realize economic benefits. The innovative ICT solutions highlighted here are improving energy efficiency across every industry sector.

Creating and innovating



**The ICT
industry is
producing more
energy-efficient
products and
solutions.**



Virtualization is an innovative technology application that empowers ICT users to reduce energy consumption, demonstrate environmental stewardship and contribute to economic growth. With virtualization, a single computer or server can safely run multiple operating systems and applications simultaneously, tasks previously relegated to separate machines. Virtualization drastically reduces the number of servers, storage devices and related hardware in data centers, resulting in cost savings in real estate and electricity.

To date, more than 1.2 million servers have been virtualized globally, which is equal to saving 8.4 billion kilowatt-hours of electricity a year, according to the Gartner Data Center Conference.⁴ This is more than the heating, ventilation and cooling electricity consumed in New England in a year, according to the Energy Information Administration of the U.S. Department of Energy.⁵

Virtualization solutions are making a difference for a wide variety of information-dependent organizations:

- **CareGroup** is a leading healthcare network of four Boston-area hospitals affiliated with Harvard Medical School. Like many organizations, CareGroup faces growing networks and thousands of demanding users. CareGroup has more than 200 terabytes (that's 2,000,000,000,000 bytes) of medical records online—a figure that's growing by about 25 percent a year.

Given the explosive growth rate of digital information in its system, CareGroup realized it needed to better control the increasing costs and energy demands of its data centers. Working with **EMC** Global Services, CareGroup started a project called "Kill-a-Watt" to analyze and then reduce power consumption across its entire information

network. CareGroup deployed EMC's VMware server virtualization to consolidate underutilized servers, delivering faster, more flexible services to its customers while consuming less energy on fewer servers. By connecting its virtualized servers to consolidated pools of information on networked storage systems, CareGroup reduced peak loads nearly 6 percent in the first year.

- **Purdue University** in Indiana is one of the nation's leading research institutions, with more than 69,000 students, 19,000 staff members and 7,400 courses in more than 500 specializations. Purdue's information technology (IT) staff faces an extraordinary challenge of information growth and the attendant need for increased storage, servers and systems. Storage virtualization technologies from EMC, coupled with server virtualization from VMware, reduced Purdue's administrative energy footprint by almost 20 percent. This energy reduction represents 35 kilowatts of power.

- Using VMware virtualization technology to reduce and consolidate the environment, EMC has been able to virtualize 1,357 of its own



servers onto just 231 physical machines, resulting in infrastructure (space, power and cooling) savings of more than \$4.6 million (a savings of 67 percent) and eliminating nearly 3,159,726 pounds of carbon dioxide emissions over a three-year period.

■ **American Baptist Homes of the West**

(ABHOW), a nonprofit organization that operates continuing care retirement communities and provides affordable housing to seniors in four states, had a similar problem: its server and storage environment had become difficult, costly and time consuming to manage.

Dell helped ABHOW create a virtualized server environment, where four storage servers now handle what 30 used to do. This consolidates and simplifies systems administration and support for ABHOW, giving healthcare professionals more time and resources to focus on caring for their facilities' 4,800 residents.⁶

While the Internet is more virtual than physical, one of its most tangible real-world manifestations is the data center. Data centers are critical to the success of the Internet economy, the nerve centers at the heart of ICT's ability to make our economy more productive and more energy-efficient. Not surprisingly, data center electricity use has more than doubled since 2000. One of the most critical issues in data centers is powering and cooling the electronic equipment. In fact, it can cost more to power and cool a server over its lifetime than it does to buy the server—and information technology facilities are running out of cooling capacity and power.

Advanced cooling techniques include a variety of technology solutions that enable companies to reduce cooling costs in data centers by 15 percent to 40 percent from use of traditional

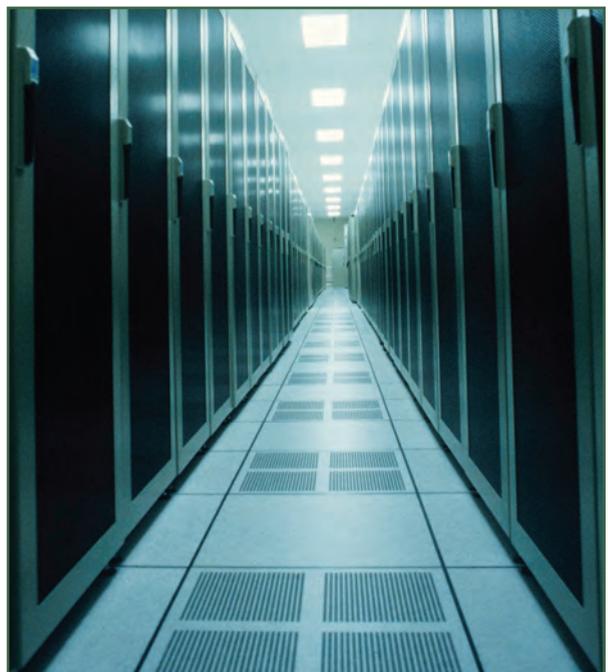
perimeter data center cooling—and meaningfully cut down on carbon dioxide emissions.

Developed over a decade of research efforts in HP Labs, **HP's** Dynamic Smart Cooling solutions empower data center equipment to interact intelligently with the power and air conditioning infrastructure in real time, minimizing its energy draw.

A recent enhancement to this technology application, Thermal Zone Mapping, enables customers to see a three-dimensional model of exactly how much and where data center air conditioners are cooling. As a result, they can arrange and manage air conditioning for optimal cooling, increased energy efficiency and lower costs.

In its own operations, HP's installation of its Dynamic Smart Cooling Solution at one leading-edge data center has so far achieved a 20 percent reduction in energy costs at startup, with a 40 percent reduction expected when the installation is complete. Another 68 installations are expected to be completed by the end of 2008. Such applications improve the resiliency, reliability and adaptability of data center technology as well.

Dell is pursuing similar objectives with its Energy Smart Data Center Assessment service



The Green Grid

Pioneering Data Centers that Cut Power Consumption

The Green Grid is a global consortium of more than 100 of the biggest technology companies in the industry dedicated to advancing energy efficiency in data centers and business computing ecosystems. Founded in 2007 by companies including Technology CEO Council members Dell, EMC, HP, IBM, Intel and Micron, the Green Grid focuses on curbing power consumption of data centers by reducing the energy required to run and cool computing equipment.

The consortium will provide industry-wide recommendations on best practices, metrics and technologies in data center operations, construction and design.

www.thegreengrid.org



that uses computational fluid dynamics to measure airflow and, in conjunction with an analysis of power consumption, determines the best placement of racks, cool and hot aisles, and vents in the data center. Dell's cooling technology partners, Liebert and APC, have improved cooling efficiency by 30 percent over traditional perimeter cooling by bringing additional cooling capacity to select areas of the data center and targeting cold air directly to servers while sucking hot air from the hot aisles of the data center. By combining these cooling technologies with more energy-efficient servers, companies could either reduce their total energy use by 75 percent with the same computing performance, or increase computing performance fourfold while maximizing the same power use.⁷

And **IBM** researchers have developed a Mobile Measurement Technology system with more than 120 sensors for measuring and

collecting data center thermal and airflow characteristics. A specialized modeling tool processes the collected data, develops a three-dimensional rendition of the thermal and flow characteristics of the data center, and calculates key energy-efficiency metrics for the data center. In projects done to date, recommendations have been completed within two to three months, with minimal capital investment and resulting reductions of 7 percent to 10 percent in power demand and 8 percent to 15 percent in power usage.

Climate Savers Computing Initiative

Improving Energy Efficiency in Computers and Cutting Greenhouse Gas Emissions

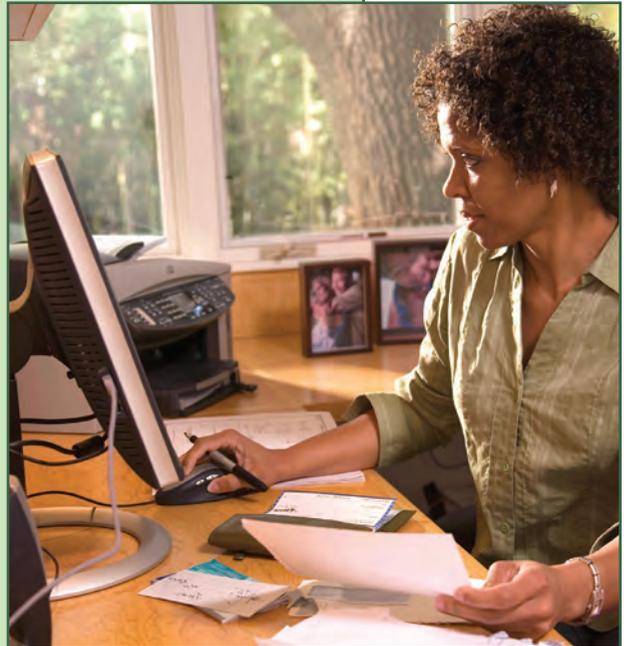
The Climate Savers Computing Initiative, launched in 2007 by companies including Technology CEO Council members Dell, HP, Intel, EMC and Unisys, aims to significantly improve the energy profiles of computers by setting and promoting aggressive new targets for energy-efficient computers, components and power-management tools worldwide.

“By 2010, the Climate Savers Computing Initiative will cut greenhouse gas emissions in an amount equal to removing more than 11 million cars from the road or shutting down 20 500-megawatt coal-fired power plants—a significant step in reducing the emissions affecting our planet,” said Pat Gelsinger, senior vice president and general manager of the Digital Enterprise Group at Intel, a Technology CEO Council company and a founder of the initiative.

Computer and computer component manufacturers participating in the initiative are committed to building energy-efficient products that meet or surpass the guidelines of Energy Star®, a joint program of the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Energy. Businesses also must commit to requiring high-efficiency systems for the majority of their corporate desktop PCs and volume server purchases, and to deploy and use power-management tools on desktop PCs.

Through this initiative, the ICT industry has pledged to reduce the carbon footprint by 54 million tons a year—and save more than \$5.5 billion in energy costs.

www.climatesaverscomputing.org



New applications and technologies are requiring more memory and consuming ever more power. In fact, while most server consumers or data center operators don't realize that memory is a major power-consuming variable within their control, it is estimated that memory consumes 15 percent of a data center server's power. Computers in many offices are left on overnight, wasting power for the approximately 100 hours per week that they are not being used.

Power management of servers and computers presents a significant, readily available, but untapped opportunity for conservation.

Micron Technology has introduced a family of energy-efficient products specifically designed to lower server power consumption. Micron's first Aspen product, the low-voltage DDR2 DRAM in reduced chip count memory modules, was introduced in 2007, and the company is designing more memory technology with energy efficiency in mind.

Data centers can use such technologies to reduce system memory power consumption by approximately 24 percent, or 6 billion kilowatt-hours. On average, this reduction could save worldwide data centers up to \$300 million annually at today's typical energy rates. To better illustrate the point, the power reduction is equivalent to the electricity used annually by about 500,000 households.

To demonstrate the opportunity for improved power management and reduce its own energy impact, **Dell** deployed power-management applications to its own 50,000 client computers. Energy consumption for desktop computers dropped to 5 watts per hour, down from an average of 89 watts per hour when idle, while power consumption for notebook computers declined from a range of 15 to 25 watts per hour to 3 watts per hour.

Dell expects to realize up to a 40 percent reduction in its computer-related energy costs,

which could translate into \$1.8 million in annual savings. And Dell is applying its own experiences to its customers, with power-management settings that are enabling users to reduce the electricity consumption of their computers by up to 78 percent.

Outside Eagan, Minn., **Unisys** has worked to develop a cutting-edge, environmentally advanced data center with innovative sustainability features that incorporate virtualization, advanced cooling and power-management technologies, including:

- A 30-inch raised floor that enables superior air-flow around server computers to simplify maintenance and maximize cooling efficiency;
- A glycol air conditioning system that is 44 percent more energy-efficient than standard data center cooling, with energy-saving fluorescent lamps and ballasts, variable-speed fan systems and lower-emitting emergency generators;
- A sophisticated monitoring and control system allowing power usage to be balanced remotely and continually with fluctuating heating and cooling requirements; and
- A virtualized server environment, which enables computers to perform more tasks more efficiently and reduce carbon emissions by 67 percent compared to computers dedicated to a single application at a customer site.

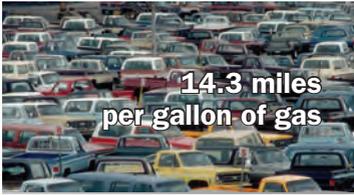
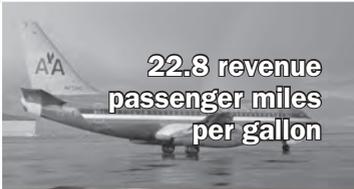
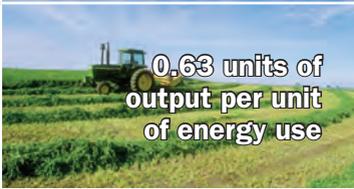
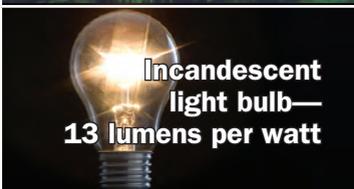
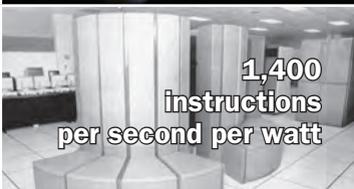
More Bang per BTU

The ICT industry has a long history of doing more with less. Driven by Moore's law, ICT products' output per unit of energy used—bang per BTU, if you will—has likewise grown astronomically. While cars get, on average, 40 percent more miles per gallon of gas in 2008 than they did in 1978, computer systems are delivering 2.8 million percent more instructions per second per watt. Indeed, no industry comes close to achieving ICT's performance

output per unit of energy input over the past 30 years.

Of course, computers are more pervasive today than they were in 1978. While instructions per second per watt may be up 2.8 million percent, the total number of instructions needed has increased even more significantly. The ICT industry is working aggressively to continue making its own products more energy-efficient.

ICT Leads All Sectors in Creating More Energy-Efficient Products⁸

| | 1978 | 2008 | Energy-efficiency improvement |
|----------------------------|---|--|-------------------------------|
| Automobiles |  14.3 miles per gallon of gas |  20.0 miles per gallon of gas | 40 percent |
| Passenger Airlines |  22.8 revenue passenger miles per gallon |  50.4 revenue passenger miles per gallon | 121 percent |
| Agriculture |  0.63 units of output per unit of energy use |  1.46 units of output per unit of energy use | 132 percent |
| Steel Manufacturing |  63 pounds of steel per MBtu |  167 pounds of steel per MBtu | 167 percent |
| Lighting |  Incandescent light bulb—13 lumens per watt |  Compact fluorescent bulb—57 lumens per watt | 339 percent |
| Computer Systems |  1,400 instructions per second per watt |  40,000,000 instructions per second per watt | 2,857,000 percent |

Empowering and enabling



The ICT industry makes it easier for other innovators to create more energy-efficient products and solutions.



Solar energy harnesses the power of the sun to produce clean, greenhouse-gas free and potentially limitless energy. Its operating costs are low because solar energy needs very little maintenance, very few spare parts and no fuel. Smart technology applications are starting to empower more companies and consumers to produce and rely on this sustainable form of energy for their power needs.

Applied Materials realized that the same cutting-edge machines it was using to produce flat-panel displays could be retooled to make thin-film solar panels, while the machines that make chips also could make wafers for solar cells—both critical components of solar electricity applications. Reconfiguring its equipment, Applied Materials' initiatives promise to lower the cost of solar electricity by standardizing and improving the solar manufacturing process, much as it did for the semiconductor process.

The largest participant in Silicon Valley Power's green power initiative, Applied Materials is also a major consumer of renewable energy. In 2007, the company agreed to purchase more than 8 million kilowatt-hours of clean, renewable energy

annually from wind and solar generation sources in California. This represents approximately 12 percent of the energy used in the company's Santa Clara facilities and will reduce the company's greenhouse gas emissions in Silicon Valley by more than 5 percent.

Intel is now the single largest purchaser of renewable energy credits (RECs) in the United States, topping the EPA's list of Top 25 Green Power Partners. The EPA estimates that Intel's annual purchase of 1.3 billion kilowatt-hours of green power has the equivalent environmental impact of avoiding the carbon dioxide emissions of more than 185,000 passenger vehicles per year, or is the equivalent electricity needed to power more than 130,000 average American homes annually.

Traffic congestion takes a significant budgetary, social and environmental toll in metropolitan areas all over the world. The amount of fuel wasted by congestion in U.S. urban areas alone increased by 480 percent, from 500 million gallons to 2.9 billion gallons—that's 58 fully loaded supertankers—from 1982 to 2005. Traffic congestion creates a \$78 billion annual drain on the U.S. economy in the form of 4.2 billion lost hours—that's 105 million weeks of vacation—and all that wasted fuel.⁹

Traffic management technologies enable highway officials and drivers to anticipate and better manage the flow of traffic, prevent bottlenecks, institute market-based pricing mechanisms, and encourage people to use energy-efficient vehicles and public transportation.

In 2007, the city of Stockholm, Sweden, decided it was time to address its perennially crowded roads that suppressed productivity, depressed drivers and polluted the air. The city turned to **IBM** to develop and deploy a congestion



pricing system of software, algorithms and cameras, which read license plates on highways as vehicles pass by. Drivers pay a toll or fee, which varies depending on the time of day, the amount of traffic and the type of vehicle—a strategy known as congestion pricing. Rush-hour travelers, and those who drive gas-guzzlers, for example, pay a premium to use major highways, while those

driving in off-peak hours, in a hybrid car or by less-traveled routes get a price break. The system alerts drivers via an electronic device in their cars when there is an accident or bottleneck and provides alternate routes.

IBM's system worked so well in its first seven months that the city voted to keep it in place permanently. During the trial, the system cut traffic congestion by 25 percent and encouraged 40,000 more people to use public transit.¹⁰

Now, other major metropolises worldwide, including New York City, are interested in this smart, energy-conserving technology. And highway engineers around the world are employing additional ICT systems to save energy, such as **route guidance navigation systems, weigh-in-motion equipment** at truck inspection stations, and **smart pass wireless devices** to cut exhaust at toll plazas.

Chicago Climate Exchange

Industry, Public Sector Commit

to Reducing 540 Metric Tons of Greenhouse Gases

The Chicago Climate Exchange (CCX), launched in 2003 and including Technology CEO Council members IBM, Intel and Motorola, is the world's first and North America's only active trading system to reduce greenhouse gases.

CCX members are leaders in greenhouse gas management and represent all sectors of the global economy, as well as public-sector innovators. These members make a voluntary, but legally binding, commitment to meet reduction targets for greenhouse gases. Those that reduce below the targets can sell or bank contracts representing metric tons of carbon dioxide; those

that pollute above their targets can buy the contracts as offsets.

Total CCX baseline emissions under reduction commitments by 2007 will exceed 540 metric tons of carbon dioxide.

www.chicagoclimatex.com



Chicago Climate Exchange

The built environment has a profound impact on energy consumption. In the United States alone, buildings account for 65 percent of energy consumption, 36 percent of energy use, 30 percent of greenhouse gas emissions, 30 percent of raw materials use, 30 percent of waste output and 12 percent of potable water consumption, according to the U.S. Green Building Council.¹¹

Smart technology applications that support **green building and manufacturing** are our best hope of turning the tide on these numbers.

Intel has a longstanding goal of reducing energy consumption in its manufacturing operations by 4 percent per year per unit of production from a 2002 baseline—a goal that it has consistently met or exceeded through a combination of efficiency upgrades in existing buildings and designing the latest, energy-efficient technologies into new facilities and manufacturing equipment.

For years, Intel has dedicated several million



dollars annually to implement conservation projects at facilities worldwide. As a result, the company's energy use per unit of production has been reduced by more than 20 percent since 2002. In 2007 alone, Intel implemented projects that saved approximately 90 million kilowatt-hours of energy; in the last seven years, the company has saved nearly 500 million kilowatt-hours. That's enough energy to power about 50,000 U.S. homes.

Intel also is working with its suppliers and other semiconductor companies to develop energy-efficiency standards and targets for **new manufacturing tools** in giant fabrication plants (fabs). Its most recent manufacturing process uses new, high-efficiency vacuum pumps that reduce total fab electricity consumption by 5 percent. This is important, as manufacturing tools account for about 40 percent of the energy used in a fab.

Meanwhile, the Intel Design Center, currently under construction in Haifa, Israel, was designed to achieve silver certification by the Leadership in Energy and Environmental Design (LEED) system developed by the U.S. Green Building Council. Techniques used to reduce energy consumption include a patio that brings natural light into the center of the floors and sophisticated control systems with ultra-efficient air conditioning and electrical systems that recycle energy.





Similar gains in efficiency have come from improvements in **glass coatings**. Direct energy purchases for household and vehicle use constitute approximately one-third of the energy demand in the United States.

Applied Materials designs and manufactures equipment that coats architectural glass with low-emittance (low-e) materials, which are high-quality metal or metallic oxide films on glass that reduce the flow of heat into and out of buildings. Applied Materials' low-e glass equipment has helped reduce the cost of energy-efficient glass tenfold over the past decade.

The company's installed base of glass coating tools has enabled the application of energy-efficient films on more than 20 billion square feet of architectural glass. This is the equivalent of saving 57 large oil tankers' worth of oil—or enough energy to heat about 30,000 homes for

one year. Applied Materials' glass coating technology even produces better automobile gas mileage. The use of Solar Infrared Reflective glazing reduces interior vehicle heat, which means the air conditioner works less. The result is a 7.5-percent savings in vehicle tailpipe emissions and fuel savings of 0.6 miles per gallon.

Smart technologies enable individuals to make smart decisions as well. Everyone talks about empowering consumers, but when the **Pacific Northwest National Lab** actually tried it, they found significant energy savings. **IBM** Research set up an advanced, live marketplace where households and utilities could effectively buy and sell electricity every five minutes, with a smart metering system that encourages energy conservation.

One hundred and twelve homeowners were given **digital thermostats** and computer controllers for their water heaters and clothes dryers, all connected to the Internet. There the homeowners set their ideal home temperature based on fluctuating electricity prices, programming instructions based on the cost-benefit tradeoffs they preferred.

The results of this research project were impressive—and suggest that peak loads on utility grids could be reduced by almost 15 percent per year, saving the equivalent of 30 large coal-fired power plants over 20 years.¹²

Climate Leaders

Industry-Government Partnership Recognizes Environmental Leaders

Climate Leaders is an EPA industry-government partnership that works with companies to develop comprehensive climate change strategies. Partner companies commit to reducing their impact on the global environment by completing a corporate-wide inventory of their greenhouse gas emissions based on a quality management system, setting aggressive reduction goals, and annually reporting their progress to EPA.



Through program participation, companies including Technology CEO Council members Applied Materials, Dell, EMC, IBM, Intel and NCR create a credible record of their accomplishments and receive EPA recognition.

<http://www.epa.gov/climateleaders>

Sustaining and saving



**ICT products
and solutions
can reduce
adverse
impacts
on the
environment.**

Few ICT energy-saving applications have received more attention than **teleworking technologies**. Millions of Americans already are leveraging wireless and fixed broadband communications to work from home offices or conduct meetings from multiple locations, connecting virtually through multimedia applications and services. These technologies save time, money and energy, and thus reduce the environmental impacts of hours spent commuting on the road or traveling in the air. With bandwidth increasing, telecommuting technologies improving and applications for remote work expanding, we can expect significant environmental improvements from telework going forward.



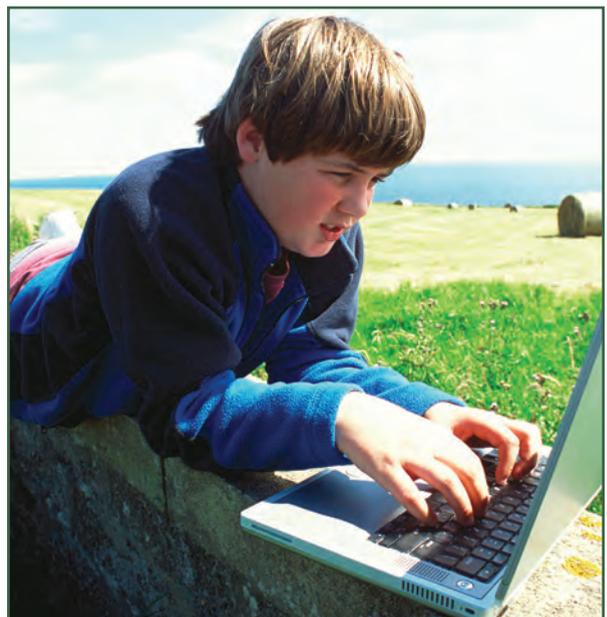
Consider that the U.S. white-collar workforce burns more than 583.3 million gallons of gasoline commuting to and from work each week. By contrast, according to research conducted by TIAx of Cambridge, Mass., the estimated 3.9 million telecommuters in the United States reduced gasoline consumption by about 840 million gallons last year, while curbing carbon dioxide emissions by nearly 14 million tons—the equivalent of removing 2 million vehicles from the road every year. Just

one day of telecommuting saves the equivalent of up to 12 hours of an average household's electricity use and 1.4 gallons of gasoline, reducing carbon dioxide emissions by 17 kilograms to 23 kilograms per day.¹³

Similar results could be expected elsewhere around the world. A 2006 study by the European Telecommunications Network Operators Association and the World Wildlife Fund concluded that if 20 percent of business travel in the European Union (EU) were replaced by non-travel means, such as audio or video conferencing, they might save about 25 million tons of carbon dioxide by 2010; 22 million more tons could be saved if just 10 percent of EU employees became telecommuters.¹⁴

HP is among the innovators that are developing cutting-edge **virtual presence technologies** that increasingly enable global corporations to dispense with planes, trains and automobiles in favor of virtual meetings. HP's Halo system, for example, fosters a vivid, face-to-face environment in real time that makes people in different locations feel like they are in the same room.

Motorola is another leader in developing both **wireless and fixed broadband networks, mobile devices, customer premises equipment and in-vehicle public safety devices and services**. Motorola's wireless broadband solutions connect people



wherever they work or live and deliver information—voice, data or video—at high speeds in real time everywhere: indoors, outdoors and on the move. Presently Motorola solutions are supplying efficient, cost-effective connectivity and access in more than 4,000 networks in 120 countries around the world, delivering on the promise of increasing productivity, improving safety and reducing energy consumption.

Technology CEO Council companies are at the forefront of enabling and practicing telework and telecommuting. Six of our members were among the EPA's 133 "2006 Best Workplaces for Commuters," and four members—Intel, IBM, Applied Materials and EMC—were among the top twenty.¹⁵

Automated teller machines (ATMs), self-service kiosks and point-of-sale electronic payments make financial transactions between businesses and their customers fast and easy. Such smart **transaction management technologies** enable companies to better handle the increasing volume and sophistication of these transactions—and reduce the maintenance, material, energy and fuel costs associated with them.

NCR has developed a **smart deposit system** for banks, such as the **Delaware County Bank and Trust** and **Kennebec Savings Bank** in Maine, to capture the image of a deposited check immediately at the ATM. This allows the payment to be processed digitally right through the clearing system while the physical check remains in the ATM. Because the payment is no longer dependent on the collection of the physical check, courier runs to collect the checks, along with back-end transportation related to check processing, can be largely eliminated.

Banks that convert their multifunction ATMs to NCR's Intelligent Deposit system can reduce scheduled service trips—and security risks—related to physical check collection by



approximately 80 percent. An estimated 40,000 off-premise ATMs across the United States are candidates for conversion. Assuming a baseline check collection rate of five times a week and a collection route distance of five miles for each ATM, conversion of all 40,000 off-premise ATMs to Intelligent Deposit would reduce vehicle mileage associated with check collection by approximately 800,000 miles per week. Assuming vehicle fuel efficiency of 15 miles per gallon, more than 50,000 gallons of fuel could be saved each week due to the efficiencies gained.

For the retail, financial, travel and hospitality industries, NCR has developed **two-sided thermal printing technologies**, which allow simultaneous printing on both sides of a thermal paper receipt or document, reducing paper consumption by up to 40 percent or more. This likewise results in less energy consumed by paper production and distribution, as well as less waste disposal, air emissions and wastewater. A typical medium-sized grocery chain implementing two-sided thermal printing could reduce annual paper consumption by more than 700,000 pounds, enough to reduce paper mill energy use by more than 200,000 kilowatt-hours and fuel consumption by more than 35,000 gallons annually.

For a View of Smart Technologies in Action, Visit Greenville, USA

Welcome to Greenville! Our citizens take great pride in our town, especially the things we are doing to keep our environment clean and use energy more efficiently. Everyone—our citizens, our businesses and our government—is doing their part to make our town the smartest energy user around.

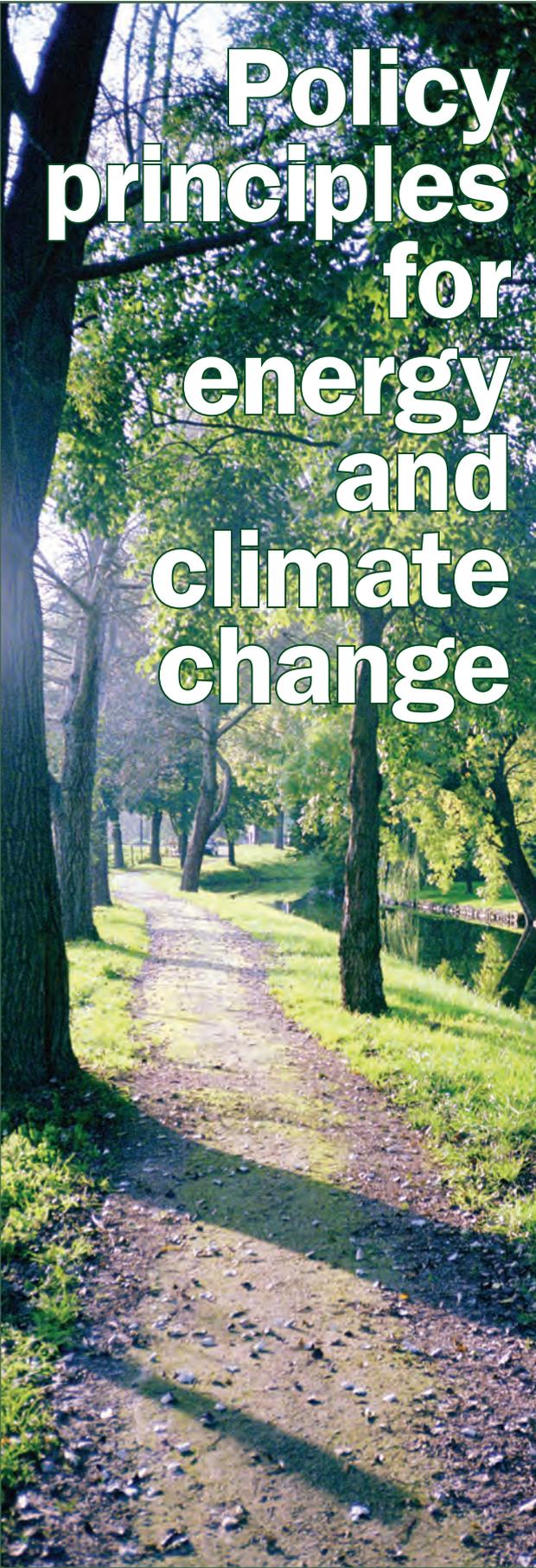
We invite you to visit our homes, hospital and businesses. Many of the things we are doing can be done elsewhere—around the world and in your own backyard. Keep an eye out for the innovative technologies available today—from smart meters to server

virtualization to power grid and traffic management—that are reducing our energy needs and making our planet cleaner.

The Technology CEO Council created this interactive, Web-based virtual environment to demonstrate practical ways that smart technology applications can improve the quality of life in American communities. We hope students, business leaders and policy makers will visit Greenville to see a smarter shade of green in action.

www.techceocouncil/greenville.org





Policy principles for energy and climate change

- 1. Private-sector leaders need to lead.** Companies that talk green need to walk green and not wait for government mandates or bailouts.
 - All businesses should develop holistic energy-efficiency strategies that include robust deployment of efficiency-enhancing information and communications technologies.
 - Corporate energy strategies should set high goals and give maximum flexibility to achieve these goals.
 - Business leaders should develop multi-sector initiatives to develop best practices, share information and results and encourage excellence.
- 2. Government must lead by example.** As the nation's largest user of energy, government must expand its own use of energy-efficient technologies, including smart ICT solutions.
 - Government energy strategies should set high goals and give maximum flexibility to achieve these goals.
 - The President should select a federal agency as the "Center of Energy Efficiency Excellence," the preeminent model for system-wide deployment of the best solutions.
- 3. Government should encourage innovation and recognize excellence.**
 - Government should invest in research initiatives seeking newer and more transformative ICT solutions that further drive energy efficiency and innovative renewable energy sources.
 - National educational programs to expand awareness, Presidential awards for excellence in applying ICT to energy efficiency and extension agent programs to help small and medium-sized businesses are all valuable.
- 4. Governments at all levels should use policy levers to encourage efficiency and discourage inefficient uses of energy.**
 - Trade and tariff barriers, capital depreciation and tax incentives all influence market behavior.

Conclusion

Energy efficiency is a national imperative. Americans are looking for a clear and thoughtful approach to our energy challenges and they want solutions that support a greener, sustainable world. By making our economy more energy-efficient, environmentally friendly and globally competitive, innovative information and communications technologies are a critical component to any solutions. Counterintuitive though it may seem, we can best save energy by investing more energy in ICT applications: **Plug in to power down.**

As the CEOs of some of America's leading technology corporations, we urge policy makers to lead by example in this era of change, by encouraging investment and innovation in smart technologies, and by creating incentives for best practices for consumers and organizations.



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About the Technology CEO Council

The Technology CEO Council is the technology industry's leading public policy advocacy organization composed exclusively of chief executive officers from America's leading high-tech companies. Technology CEO Council companies generate more than \$350 billion in annual revenues and employ more than 850,000 workers around the world.

Founded in 1989, and formerly known as the Computer Systems Policy Project, the Technology CEO Council is dedicated to advancing policies that ensure and promote U.S. competitiveness through technology leadership. Our CEOs regularly visit Washington to work with policy makers on issues of importance to the nation and high-tech industry. We offer insights and recommendations through reports and white papers on issues having a transformative impact on society.

The Technology CEO Council is presently focused on public policy initiatives that enable the globally integrated economy (such as open markets), empower businesses and consumers (such as energy efficiency and health information technology), and advance American competitiveness (such as patent reform and investments in research and innovation).



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TECHNOLOGY CEO

COUNCIL

Technology CEO Council
1341 G Street, NW
Suite 1100
Washington, DC 20005
202.585.0216

www.techceocouncil.org

