TESTIMONY OF LORIE WIGLE, INTEL CORPORATION
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Thank you, Chairman Kerry, for the opportunity to address this hearing focused on the role of information and communications technology (ICT) in improving energy efficiency throughout the US economy. My name is Lorie Wigle. I direct Intel's Eco Technology Program Office and also serve as President of the Climate Savers Computing Initiative (CSCI). I am here today to stress the importance of the Federal Government adopting policies that support and enable the full potential of ICT to drive significant energy efficiency gains throughout the economy.

Recent studies have estimated the ICT industry's contribution to the world's energy and carbon footprint to be two percent and rising.[1] This is what we call the "micro story"—the energy consumption and carbon dioxide (CO_2) emissions associated with individual ICT devices. A major focus of government policy in recent years has been on reducing the growth of ICT's direct footprint. Many of those same studies, however, have highlighted the significant role ICT can play in reducing the footprint of the rest of society—the other 98 percent—through the energy efficiency gains such technologies can help enable. We call this the "macro story."

[1] Gartner Estimates ICT Industry Accounts for 2 Percent of Global CO2 Emissions," Gartner press release, April 2007.

The Triple Challenge of Climate Change, Energy Security and Economic Growth

The U.S. and the world face three difficult challenges simultaneously: Our climate is changing at the same time that we face significant energy security and economic growth challenges. Finding public policies that address all three must be a priority.

Improving society's energy efficiency is the best way to begin addressing the challenges of climate change, energy security and economic growth. By using energy efficiency to lower energy demand, we can reduce emissions of CO_2, reduce the need for energy imports and free up resources for economic growth.

Fortunately, energy efficiency measures are not only cost effective but, in many cases, have a negative marginal cost, meaning they create wealth for society overall. Energy efficiency measures, including approaches driven by ICT, provide a foundation for economic growth by enabling carbon-reducing actions at lower cost, or even a savings of resources.

The ICT Industry Has Made Great Progress on the Micro Story

The ICT industry has made great progress in improving the energy efficiency of the products it designs and manufactures. The chart[2] below shows that progress

[2] Based on statistical comparisons compiled by the Technology CEO Council.

made in the energy efficiency of computation has been orders of magnitude greater than progress made in other technologies.

What's more, the industry has not become complacent and continues to find new ways to deliver products that perform more work while consuming less energy.

Studies Show that Greater Energy Reduction Potential Lies in the Macro Story

Substantial evidence shows that the gains realized by improving the efficiency of ICT devices are dwarfed by the much greater gains from using and networking these devices to improve the energy efficiency of society as a whole. The American Council for an Energy Efficient Economy (ACEEE) looked at the impact of ICT on the energy efficiency of the US economy. The ACEEE report highlights the nexus between ICT and energy intensiveness of the US economy:

"Information and communication technologies (ICT) have transformed our economy and our lives, but they also have revolutionized the relationship between economic production and energy consumption." Specifically, ACEEE found that increasing deployment of ICT in the U.S. over recent decades has been a significant causative factor in the declining energy-intensiveness of the U.S. economy. Comparing the micro and macro story effects, ACEEE concludes that, "For every extra kilowatt-hour of electricity that has been demanded by ICT, the U.S. economy increased its overall energy savings by a factor of about 10…. The extraordinary implication of this finding is that ICT provide a net savings of energy across our economy."[3]

Building on the work of McKinsey and others, The Climate Group and the Global e-Sustainability Initiative (GeSI) in 2008 produced a report entitled, "Smart 2020: Enabling the Low-Carbon Economy in the Information Age" that found that ICT strategies could reduce global carbon emissions by up to 15 percent in 2020 against a baseline of business as usual.[4]

Examples of Where the Potential Lies

Focusing on the U.S. alone, a follow-up report by The Boston Consulting Group for The Climate Group and the GeSI found that the potential emissions reductions from ICT-enabled energy efficiency could be even greater—from 13 to

[3] ACEEE, "Information and Communications Technologies: The Power of Productivity: How ICT Sectors Are Transforming the Economy While Driving Gains in Energy Productivity," Laitner and Ehrhardt-Martinez, February 2008."
[4] Smart 2020: Enabling the low carbon economy in the information age," The Climate Group.

22 percent over the same period. This report identifies, as illustrations, a number of specific ICT-based technologies that hold particular promise, including:

- **Smart Motor Systems** – Optimized for energy efficiency, smart motor systems control and adjust power usage output through variable speed drives and intelligent motor controllers. Smart motors monitor energy use and utilize that data for energy and cost savings. Wireless networks enable inter-machine and system communication for further optimization, and simulation software improves overall plant and manufacturing process design. Smart motor systems have a total abatement potential of 970 Megatons (Mt) CO_2 emissions in 2020.[5]

- **Smart Logistics** – Smart logistics include a variety of ICT applications that enable reductions in energy demand through better journey and load planning. This includes software to improve transport network design, inter-modal shifts to a more efficient form of transport, eco-driving, route optimization and inventory reduction. Smart logistics have a total abatement potential of 1.52 Gigatons (Gt) CO_2 emissions in 2020.[6]

- **Smart Buildings** – Smart buildings (new and existing) are optimized for energy efficiency through technologies that make their design, construction, and operation more efficient. Smart buildings use building

[5] Smart 2020 Report.
[6] Ibid

management systems that employ a computerized, intelligent network of electronic devices designed to monitor and control the mechanical systems (heat and air conditioning) and lighting. They also use solutions to automate power control and/or remotely power on and off devices like PCs. Smart buildings have a total abatement potential of 1.68 Gt CO_2 emissions in 2020.[7]

- **Smart Electrical Grids** – Smart grids integrate ICT applications throughout the grid, from generator to user, to enable efficiency and optimization solutions. These solutions include smart meters to help customers use energy more wisely, as well as: interactive energy generation systems, advanced grid management solutions, demand management systems, greater integration of renewables and transmission and distribution loss reduction equipment. Smart grids have a total abatement potential of 2.03 Gt CO_2 in 2020.[8]

- **Travel Substitution** – Broadband availability can significantly reduce carbon emissions by supporting telework and making many business trips unnecessary. Teleworking alone can contribute savings up to 260 Mt CO_2 emissions each year.[9]

[7] Ibid
[8] Ibid
[9] Ibid

More About the Potential for the Smart Grid

Challenges with Today's "one-way" Power Grid

The way the world delivers electric power is based on designs and plans that date back many decades. It's based largely on a "single-direction delivery" model: a big power plant that sends out power to lots of homes and commercial buildings that receive it.

No one thought that the grid would someday have to support solar power coming from millions of rooftops, or electricity being generated by thousands of wind turbines. But that's the future—and the electricity grid has to get much more "intelligent" to deal with all these different sources. It has to manage energy supply and consumption across the network in a more real-time, efficient fashion, using new metering technologies.

On the consumption side, commercial and residential building waste a tremendous amount of energy because building owners don't know how much energy they are using in real-time, and lack any kind of feedback loops or digital controls to optimize their energy use.

"Smart Grid"

The "smart grid" aims to solve all those problems. By harnessing microprocessors, wireless communications, the Internet, and other technologies, we can not only integrate these new renewable energy sources, but reduce

energy waste, and give consumers more information about how they're using power.

Examples of "smart grid" intelligence

There are a number of integrated microprocessor applications. For example, a modern wind turbine needs as many as 16 embedded microprocessors to control various motor functions, and to enable the turbine to exchange data and operational status with the grid. In the grid itself, embedded processors are being used in grid substations, which locally monitor and manage electricity flow. In smart buildings, low power and embedded processors are being designed into energy management systems and interactive touch screen displays, to help building owners monitor and control their energy use. As the smart grid communications network develops, electricity meters, smart buildings, and utility data centers all must continuously exchange data and communicate with each other over great distances, which can be well served by Broadband technologies such as WiMAX.

The need for standards

The most critical element is in a word: Interoperability. An issue facing smart grids is the absence of an agreed upon specification prescribing how all grid components should be architected and made to communicate with each other.

There are many competing standards and proprietary protocols. To help address this interoperability challenge, Intel recommends that grid systems and consumer-side systems should be designed as "open" platforms and that they make use of Internet protocol. In other words, they should be designed to flexibly support a variety of standard software components and secure interfaces. In June, Intel hosted an IEEE meeting in Santa Clara that brought in energy industry experts to discuss creation of open smart grid standards. And we are actively participating in the process that NIST is leading.

An open grid system will also be "future-ready", supporting new innovations and the integration of future applications and service.

Home Energy Management Systems

Consumers are looking for ways to reduce their energy costs and carbon footprints, by employing microprocessor-based "smart home" technologies. Intel is developing technology for "Home Energy Management Systems", which visually show the consumer their real-time energy use, and enable them to control their energy use, through a "dashboard" which is viewable on any screen: whether it be their Home PC, or on a dedicated Touch Screen Display in their home, or on their Internet-connected TV. Studies have shown that by providing consumers with these types of dashboards and control tools, they are able to reduce their peak home energy use by as much as 40%[10]. Empowered by such computer-based dashboards, home area networks, and social networks,

[10] The Brattle Group "The Power of 5 Percent", The Electricity Journal, October, 2007

consumers are taking control of their personal energy use, and collaborating with others to reduce their carbon footprints. The rise of the “Personal Smart Grid”, in which a consumer is able to monitor and control the behavior of their personal energy assets, spanning rooftop solar panels, smart appliances, and plug-in hybrid/electric vehicles, while taking advantage of the wider smart grid, is imminent if not already upon us.

What is Missing?

While the ACEEE study shows the historic role ICT has played in reducing the energy- and carbon-intensiveness of the U.S. economy, the Smart 2020 analyses demonstrate that even greater benefits are possible. Going forward, the question must be asked: What is missing? What is needed to realize the full energy efficiency potential of ICT?

Realizing this full potential will require aggressive public policies to correct market failures, remove implementation barriers and provide ICT-adoption incentives. Barriers to overcome include:

- Lack of information and understanding about the energy efficiency benefits of ICT.
- Perceived high upfront purchase costs and lack of understanding of lower life-cycle costs.

- “Principal/agent” issues where people occupying a space or operating a business don’t pay the energy bill.
- The perception that many energy efficiency gains are too small to bother with individually when, in fact, they have a major impact when implemented throughout a region or country.

Policies to Realize the Potential of ICT

Governments can take many actions to encourage ICT adoption. While policies will vary depending on national circumstances and cultures, potential actions include:

- **Establishing a national strategy or roadmap** for the use of ICT to improve energy efficiency and reduce CO_2.
- **Leading by example** at all levels, governments—the largest employers, landlords, fleet operators, etc., in the country—demonstrate that the benefits of telecommuting, smart building technologies, teleconferencing and other solutions can help drive better understanding in the private sector of the benefits of ICT.
- **Expanding the availability of broadband** throughout society to take advantage of telecommuting, video conferencing, smart grids and the many energy efficiencies possible through intelligent connected devices.
- **Establishing tax and other incentives** for businesses and consumers to accelerate their purchase and deployment of ICT devices.

- **Changing electricity utility regulation** to permit utilities to earn money from energy-efficiency (“negawatts”), not just from the sale of electricity.
- **Helping create agreed-upon protocols/approaches** for measuring the energy-efficiency and climate impacts of ICT in other economic sectors.

Digital Energy Solutions Campaign (DESC)

To begin addressing some of the barriers to the realization of the full macro story potential of ICT, Intel and other high-tech companies founded and Intel co-chairs a relatively new organization called the Digital Energy Solutions Campaign (DESC). DESC is a coalition of ICT companies, allied with NGOs and trade associations, dedicated to promoting the adoption of public policies, such as those I have just enumerated, that will enable ICT to realize its full potential to improve societal energy efficiency and reduce our carbon footprint.

DESC member companies, in addition to Intel, include AMD, APC, AT&T, Cisco, Dell, EMC, HP, Infineon, Johnson Controls, Microsoft, National Semiconductor, Nokia, Opto 22, Sony, Texas Instruments, and Verizon. In addition, a number of non-governmental organizations and associations are affiliated with DESC, including ACEEE, the Alliance to Save Energy, The Climate Group, the Information Technology Industry Council, ITS America, CompTIA, the Semiconductor Industry Association, TechNet, the Technology CEO Council, and the Telework Coalition.

“ICT and Greening the Federal Government

Intel commends the Obama Administration for the October “Executive Order focused on Federal Leadership in environmental, energy, and economic performance.” It represents in concrete form the DESC policy principle of the Federal government leading by example. We understand that the Executive Branch is very busy figuring out the best way to measure existing performance to provide a baseline for assessing future progress. As it pertains to ICT, the Executive Order clearly encompasses both the micro and macro stories. But we recognize that is perhaps easier to focus on the micro – the Federal government purchasing more efficient ICT equipment – than it is to focus on how that equipment might be used to improve the energy and environmental footprint of the overall operations of Federal agencies. Intel and DESC stand ready to work with the Office of Management and Budget and the Office of the Federal Environmental Executive to explore best practices in bringing ICT to bear in reducing that footprint.”

In the End It Is All About the 100-Percent Solution

Successfully addressing the three challenges of climate change, energy security and economic growth will require attention to both the micro story (improving the energy efficiency of ICT devices) and the macro story (promoting the enabling energy efficiency role of ICT in other sectors). The ICT industry needs to continue to design and produce more energy efficient devices. And policy makers

need to implement programs that address the full energy efficiency potential of deploying such devices and the ICT systems they enable. The Green IT Promotion Council in Japan speaks of both the “green of IT” (micro) and “green by IT” (macro). The goal clearly should be to “minimize the ‘micro’ and maximize the ‘macro.’”

Key Initiatives to Advance the Micro Story

In addition to each individual company in the industry driving the energy efficiency and minimizing the environmental impact from their products, we’re also collaborating to drive systemic efficiencies together. Two groups are playing a critical role here: The Green Grid and Climate Savers Computing Initiative. Intel is a founding member of both.

The Green Grid

The Green Grid is a global consortium of IT companies and professionals seeking to improve energy efficiency in data centers and business computing ecosystems around the globe. The organization seeks to unite global industry efforts to standardize on a common set of metrics, processes, methods and new technologies. The participating companies contribute technical resources to develop and disseminate these metrics and best practices in order for IT departments to optimize their operations.

Climate Savers Computing Initiative

Climate Savers Computing Initiative is focused on improving the energy efficiency of individual computers by improving power delivery (largely through

power supply technology) and driving the adoption of power management (PCs going into low-power states when not in use). When the organization was founded in June of 2007, the goal was taken to reduce CO_2 emissions from computing by ~50% or 54 million tons. To-date the savings from these two focus areas are on the order of ~$36 million tons. More than 550 companies have joined the organization and committed to purchasing energy-efficient PCs and servers for new IT purchases, and to broadly deploying power management.

Conclusion

The ICT industry is aggressively pursuing efficiency at both the micro and macro level and we are eager to collaborate with the Committee to further the policy agenda that supports these efforts.