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Thank you, Mr. Chairman, Ranking Member Ensign, and the member of the Subcommittee for this opportunity to discuss the role of Information and Communication Technology (ICT) in enabling a more energy-efficient economy. My name is Kathrin Winkler and I am the Chief Sustainability Officer for EMC Corporation. EMC is a Fortune 500 technology company headquartered in Hopkinton, Massachusetts. We specialize in building information infrastructure, the digital foundation that enables the applications and information that nearly every organization needs to be effective.

EMC commends this committee for seeking ways to fully marshal the power of ICT as a foundation for realizing the potential of energy efficiency, the ultimate renewable resource.

This morning, I'd like to focus on three major subjects:

1. How the ICT industry is delivering efficiencies in its own use of energy;
2. Why ICT is central to unlocking increased energy efficiency and reducing greenhouse gas emissions throughout our economy; and
3. How government and industry can work together to unleash untapped opportunities with technologies and techniques available today.

It is well known that ICT has been a key driver of economic productivity in this nation for the past half-century. What is less well-known is that, as the American Council for an Energy Efficient Economy (ACEEE) demonstrated in its 2007 report[i], ICT has also been a key driver of energy productivity.

Technology pervades and to a large extent enables every aspect of our economy and our lives. The web has become the world's dominant commercial infrastructure. It supports everything - transportation, the electric grid, supply chains, telephony, education, entertainment, and so on. And the digital information that courses through it is dematerializing more and more of human activity, allowing us to create economic value while reducing our use of physical resources. When you realize that only 20 percent of humanity has access to the web, you get a sense of how much upside remains unrealized.

ICT and the 2%

Let us look first at the ICT industry's direct impact on energy use. The ICT industry has dramatically increased the energy efficiency of its own products and services, improving performance per kilowatt-hour in virtually every generation of product. There have been a number of compelling drivers for this. First is the principle of good engineering requires efficiency to be considered in every design. This has been a core value at EMC since its inception 30 years ago.

Second, there is the constant drive to reduce operational cost for our customers. A continual improvement in price/performance of information technology combined with rising electricity prices means that costs for power and cooling are actually overtaking the costs for hardware.

Third, there is an effort to avoid capital costs. Data centers can cost hundreds of millions of dollars to build new. Capital projects like data center construction or expansion can the delay implementation of

business-critical applications by months or years. Businesses that do not have the capital to build out new data centers may miss new growth opportunities as a result.

And fourth, there is the need to reduce greenhouse gas emissions from the use of fossil fuels upon which we still depend for so much of our grid energy.

The Competition for Efficiency

Energy efficiency is a compelling issue for our customers. Data centers can consume as much as 100 times the energy per square foot as a typical office building. As a result, the ICT industry finds itself competing on three levels. First, with regard to the energy efficiency of our own products, we offer more efficient power and cooling architectures and features that allow products to adjust dynamically to the loads placed on them.

Second, we compete to reduce our carbon footprint within our own operations and throughout our supply chains.

And third, we compete in the market for products that enable efficient ICT infrastructure, because the most significant and immediate opportunities for energy reduction come *not* from the products themselves, but from how they are used. The greatest energy waste comes from powering underutilized ICT assets and from inefficient use of ICT resources.

Technological Advancement

I'd like to share some examples of how EMC and our industry peers are addressing this market.

EMC offers products and services that help our customers manage their information assets with the same rigor with which they manage their other critical corporate assets and without compromising quality, reliability, or business performance.

For example, EMC is majority owner of the Palo Alto, CA-based company VMware. VMware provides a software tool called virtualization that has dramatically changed the technology landscape and ushered in an exciting new phase of ICT consolidation through *server virtualization*. Server virtualization enables a single physical server to run multiple operating systems at one time. Without virtualization, most servers use at only 5 to 15% of their capacity while still drawing most of their power load. With virtualization software, loads can be consolidated onto fewer physical systems for huge energy savings. A typical server virtualization initiative can result in hundreds of underutilized servers being consolidated down to several dozen. Gartner Group estimates that 1.2 million workloads currently run in VMware virtual machines; this represents an aggregate power savings of about 8.5 billion kWh — more electricity than is consumed annually in all of New England for heating, ventilation and cooling[ii]

With data volume growing at 60% per year, additional technological breakthroughs have focused on the efficiency of the storage infrastructure. Solid state drives, also known as flash drives, have no moving parts, and consume 38% less power as their predecessors for same capacity and 98% less for same performance. Where spinning disks continue to be utilized, technology exists to "spin down" the disks when they are not being accessed. Additionally, data de-duplication technology transparently combines redundant copies of data – including all 20 slightly different versions of your last slide presentation - reducing the amount of hardware required to backup all those copies

Cloud Computing, the concept of delivering ICT as a service, much as electricity or telephony are delivered, holds the promise of even more efficient use of ICT resources. Compute clouds can further consolidate systems for greater efficiency and faster deployment. And by using cloud resources to serve peak demand, ICT managers can avoid over-provisioning their own data centers. The President's budget refers to cloud computing as essential "to achieve efficient and effective ICT" and describes the Administration's plans to offer limited cloud computing options throughout the federal enterprise.

EMC is using these technologies in our own data centers, and by doing so, has saved $4.3M over a four-year period and reduced our carbon footprint by over 60 million tons of CO_2. Energy efficiency in our data centers and throughout our corporate facilities allowed us to grow our revenue by more than 50% from 2005 to 2008 while reducing our emissions per dollar of revenue by 19%. And, by engaging our employees in finding new efficiency opportunities, we are on track to achieve an additional 30% reduction in energy intensity over 2005 by 2012.

Coopetition

While ICT firms are competing with one another, we are also cooperating to accelerate implementation of best practices, establish standards for interoperability, and identify new opportunities for efficiency. Organizations such as The Green Grid bring together end users, vendors, and service providers to develop metrics, build tools, educate the community on how to save energy, and collaborate with government and industry organizations around the globe to share knowledge and create a common lexicon for ICT efficiency.

The Other 98%

Yet, this is only 1/50th of the story. It is estimated that ICT accounts for 2% of global greenhouse gas emissions. What about the other 98%? McKinsey tells us that investments in energy efficiency alone could deliver up to half of the emission abatement required to cap greenhouse gas concentrations at 450 parts per million[iii]. Further, they tell us that applying information technology for efficiency in five categories of investment could eliminate nearly 8 metric gigatons of greenhouse gases by 2020 – five times more than it will generate.

The analysis by the American Council on an Energy Efficient Economy shows that during the last two decades, ICT has already produced between six and fourteen kWh of savings for every kWh it has consumed. This phenomenon is apparent in our home state of Massachusetts, historically a leader in information technology, and now a state whose energy productivity is one of the highest in the nation.[iv]

We must take care not to implement policies that would have the perverse effect of inhibiting investment in technologies that will consume some energy, but can abate much more. We do not want to be kilowatt-wise and megawatt-foolish.

ICT in the Broader Economy

I would like to cite just a few of the many examples of how information technology is driving energy efficiency across the broader economy.

The emerging Smart Grid not only uses information technology to transmit rate, usage, and control data, but it will have the information for accurate forecasting and provisioning of electricity, and for responding quickly to external influences such as weather events or unanticipated demand. Consumers will have the information they need to understand the cost implications of their day-to-day choices, enabling them to adjust their behavior accordingly. And it is ICT security technology that will give consumers the confidence they need to participate in what must be an "all hands on deck" effort.

In transportation, ICT is the engine for reducing fuel use through optimization of routing and of freight packing. And our customers in this segment tell us it is doing much more. Aggregating information from their fleets enables them to understand the impact of fuel choices, vehicle technologies, and even driving styles to further remove energy waste.

These same capabilities applied to other dimensions of our infrastructure – buildings, transportation, agriculture - will create systems that are not only automated, but that adjust to demand and other influences such as outside temperatures to generate further efficiencies.

Nor should we overlook the role of ICT in research and development, where high performance computer modeling is accelerating design of new materials and technologies for clean energy and energy storage.

And of course virtual meeting technologies such as web conferencing and TelePresence are having a real and immediate impact. In EMC, our investments in eConferencing have reduced our carbon footprint, saved travel expense, and increased our productivity – a classic win-win-win.

These are but a few of the many examples of ICT as an enabler of energy efficiency. Organizations such as the Digital Energy Solutions Campaign, disseminate information to and collaborate with stakeholders to find, encourage, and measure ICT-enabled energy reduction and carbon abatement.

Implementation Obstacles

But there are barriers in both the 2% and the 98%.

There is still a significant population of stranded and underutilized ICT assets, particularly in smaller data centers that don't have the expertise or capital to invest in improvements. The body of knowledge still resides in the hands of a relatively small number of practitioners. And many data centers and businesses simply haven't taken advantage of the technology and best practices that are available to be deployed today.

In fact, these smaller data centers are proliferating in the national government. The EPA Report to Congress on Server and Data Center Energy Efficiency estimated that the federal government's electricity cost for its servers and data centers was $450 million in 2006 and was doubling every five years, putting the cost for 2011 at nearly $900 million. A 1998 survey of Federal agencies identified 432 agency data centers. In September 2009, agencies reported that the number of Federal data centers had grown to 1,100. This trend runs counter to the well-established best practice of consolidating to fewer data centers to reduce costs, energy consumption, and environmental impacts, while improving service and performance.

1. **Expand the availability of broadband.** EMC strongly supports Congressional programs that expand the reach and quality of broadband in this country. Broadband is vitally needed to take advantage of telecommuting, video conferencing, and the many energy efficiencies possible through intelligent connected devices. Moreover, connected cities and rural areas are vital to the success of the Administration's drive to digitize health records, enable the energy internet, and connect rural schools. While, each of these programs will increase the energy demand for ICT systems, they will provide much greater efficiencies to the broader economy.

2. **Call for a national strategy for the use of ICT to improve energy efficiency and reduce CO_2 in the economy.** A major barrier is an agreed-upon protocol or approach for measuring the energy-efficiency and climate impacts of ICT in other economic sectors. Congress should encourage the Executive Branch to develop a national strategy or roadmap for the use of ICT to improve energy efficiency and reduce our greenhouse gas emissions.

3. **Expand public-private partnership.** The transformation to an energy-efficient economy will be accelerated through complementary actions in public policy, open standards, and technological innovation that can only be achieved through collaboration across segments, and between government and private industry.

Conclusion

To summarize, the ICT industry is in a race to the top. We are investing in technology and business model innovation. We are collaborating to drive standards and competing to drive the market.

Technology and best practices already exist and are in use today; they could have an even greater impact if we conquer the implementation barriers. While we need to continue to invest in innovation, we must also accelerate deployment, and strengthen the public-private partnership to provide both the incentives and the means for economy-wide energy efficiency and reduction of carbon emissions. And we must not focus only on the ICT industry itself – but also on how it enables the other 98%, lest we save ICT kilowatts at the expense of economic megawatts.

Last year marked the 20th anniversary of the World Wide Web. Its inventor, Tim Berners-Lee was asked recently where the web could take us tomorrow. He spoke of the emergence of a web of data that people can share and mash up and use at will, saying "I think when we have a lot of data available on the web about the world, including social data, ecological data, meterological data, and financial data, we'll be able to make much better models from which to draw conclusions."

Thank you, Mr. Chairman, Ranking Member Ensign, and the member of the Subcommittee for this opportunity to share our perspective. EMC is passionate about the current and future contributions being made by the ICT Industry in enabling energy efficiency, the ultimate renewable resource.

[ii] http://www.aceee.org/press/e081pr.htm
[ii] http://www.vmware.com/virtualization/green-it/
[iii] http://www.mckinseyquarterly.com/How_IT_can_cut_carbon_emissions_2221
[iv] http://www.mass.gov/Eoeea/docs/doer/pub_info/Giudice%20FCC%20Testimony%2011302009.pdf