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"Get Smart on the Smart Grid: How Technology Can Revolutionize Efficiency and Renewable Solutions."
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Thank you, Chairman Markey, Ranking Member Sensenbrenner, and Members of the Committee, for the opportunity to testify on how a Smart Grid can revolutionize efficiency and increase the use of renewables. This issue is critical to this Committee and to the nation because electric generation is the largest source of greenhouse gases in the world, responsible for approximately 40% of CO2 emissions in the United States[i] and is expected to be responsible for 50% of growth in global energy related CO2 emissions from 2006 to 2030[ii]. Thus, substantial improvements in the way we produce and use electric power could have an immediate impact and must be a part of the path to energy independence.

<u>CURRENT Group, LLC</u>

CURRENT's Smart Grid solution is in commercial operation today combining advanced sensing technology with low latency IP based communications and enterprise analysis software and related services to provide location-specific, real-time actionable data that is easily integrated into a utility's existing IT infrastructure. Our technology is being used by utilities around the world including in several of the largest Smart Grid deployments. For example, President Obama highlighted a project that uses our technology as an example of a Smart Grid to be funded when he signed the ARRA stimulus bill last week.[iii] We are also a participant in several European Union-sponsored projects, including one led by Iberdrola, the world's 4th largest electric utility, to expand the use of Smart Grid technology to benefit electric utilities and residents of the European Union. Most recently we were honored by the World Economic Forum as a 2009 Technology Pioneer.[iv]

As Congress recognized in both the Energy Independence Act of 2007 and the American Recovery and Reinvestment Act of 2009 (ARRA), the application of technology to electric power is a key component of reducing carbon emissions. Here in the United States, the Electric Power Research Institute (EPRI) has estimated that a Smart Grid could reduce carbon from electric power by 25% or roughly 10% of overall U.S. CO2 emissions.[v] It is estimated this savings has the same impact as removing 140 million cars from the road.[vi] A recent Climate Group study concluded that deploying a Smart Grid is the largest single global information technology solution to climate change, more than investing in Smart Buildings, Smart transportation systems or improvements in motors and industrial processes. They projected a Smart Grid around the world could save over two Gigatons a year of carbon or roughly 5% of total global emissions.[vii]

<u>What is the Smart Grid?</u>

Today, the electric grid, especially the local distribution system, which is the part we usually see around our homes and offices, works much the way it did 50 or even 100 years ago. As Dr. Michael W. Howard of EPRI testified before the House Subcommittee on Energy and Air Quality, a Smart Grid combines millions of sensors throughout the grid and an "advanced communication and data acquisition system to provide real-time analysis by a distributed computing system that will enable predictive rather than reactive responses to blink-of-the-eye disruptions".[viii]

A Smart Grid, in many ways is like an Internet for Electricity, a network of devices that are monitored and managed with real-time communications and computer intelligence. A Smart Grid discovers grid performance and conditions using intelligent sensors capable of detecting problems and/or opportunities for improvement that are widely distributed on the electric grid. It makes adjustments locally or communicates back to the central control center where it is combined with information from other grid devices and utility systems. This information is further analyzed to create Actionable Intelligence that tells a person or a device on the grid to take a specific action. The information can come from any point on the electric grid, from the generation plant or renewable source through transmission to the substation to devices on the grid to devices within a home or business to the Plug-In Hybrid Electric Vehicles (PHEVs) and can require the control or action of any other device.

This is the same kind of monitoring and managing a network that has developed over the last 20 years and now happens routinely in the telecommunications and Internet networks around the world.

For example, Xcel Energy, the first utility in the United States to deploy a fully integrated Smart Grid in Boulder, Colorado, describes a Smart Grid as "the integration of the fuel source to the end-use consumer and all touch points in between. We believe that everything from a piece of coal or a breeze of wind to the thermostat has to be part of the smart grid and that it must include integration among all of the components."[ix]

It is important to note that certain of these actions require a complete loop from sensing of the initial situation to the completion of the Actionable Intelligence action in a matter of seconds or even milliseconds. As Smart Grids are further deployed, utilities will operate much more of a self-healing, self-optimizing electric grid with these actions occuring in the background in real-time like an autopilot system on the airplane or least cost routing in the Internet.

To achieve the Smart Grid vision, it is important that a network use real-time communications, as well as the open standards like Internet Protocol (IP) as required for funding under ARRA. The Smart Grid will provide the network platform for the distribution of electricity and also enable the attachment of currently unimagined numbers and kinds of devices and software applications to improve both the performance and the usefulness of electricity. For example, it is highly likely neither the “Google” nor the “iPod” of home energy management has been invented yet and it is just as likely that it will not be invented by a traditional vendor of utility equipment. If the Smart Grid network, the devices that attach to it and the software applications that run on them are not designed to a common open standard, the Smart Grid will be delayed or degraded and rate payers will have to pay to replace devices before the end of the their useful lives. Indeed, we believe that ultimately, in many cases, it may be appropriate to leverage existing IP public networks like the existing cable, DSL or wireless 3G or WIMAX networks.

How does the Smart Grid benefit us?

We believe there are four primary benefits to a Smart Grid:

- **System Optimization** – Delivering “least cost” power from the substation to the home
- **Increased use of Renewables** – Integrating renewables and distributed generation into the existing grid
- **Operation and Reliability Improvements** – Improving and automating the

operations of the electric distribution network

- **End-User Energy Management** - Enabling end users to modify their energy consumption behavior

While the fourth benefit of End-User Energy Management gets the most media attention and will certainly be part of the solution, the Climate Group estimates that 85% of the carbon reduction benefits of a Smart Grid come from the first two items (Optimization and Renewables) and only 15% will come from End-User Energy Management.[x]

Let me provide a little more detail on each of the areas:

System Optimization – Advanced sensing and controls are used to deliver only the power needed at any particular time while also minimizing any inefficiency in the operation of the grid itself. It is estimated such optimization can reduce electric generation requirements and related carbon by 3 to 5% without impacting on, or requiring any change in, customer behavior.

Integrating Renewables – Widespread renewables create several problems for the existing electric grid. First, as opposed to centralized power plants that send electricity one way from the plant to the home, renewables out on the grid itself (like a solar panel at a big box retailer) create a two-way power flow on a grid that is designed to go one way. This means that the utilities' assumptions about how the grid operates and typical loads are no longer valid and that increased monitoring is required. Second, utility practices today are presently, and rightly, designed to minimize variability. However, renewables are inherently variable or intermittent. The wind does not blow when the temperature is hot but thunderstorms do occur, both of which often happen when electric demand is at its highest, thus reducing the output of renewables such as wind or solar at a critical time. As electric grids have to be in balance, a sudden drop in generation from renewables requires the utility to adjust other generation, storage or the usage itself to keep the system in balance. For example, at one California utility, only 8 to 9% of the capacity of certain wind resources can be relied upon for peak capacity planning, thus requiring continued purchase and use of coal or gas based power plants or energy storage, whose availability in scale is limited. A Smart Grid's system optimization and demand response capabilities can be paired up with the renewable resources so that when the renewable source is varying, the overall load can be varied as well. This will reduce or eliminate the need for backup coal or gas based power generation plants. In turn, this will not only directly reduce emissions but will also free up utility capital to be shifted from purchasing conventional power sources to buying more clean renewable power. The MIT Technology Review recently stated "without a radically expanded and smarter electrical grid, wind and solar will remain niche power sources."[xi]

The use of PHEVs creates both opportunities and challenges. PHEVs have the potential to be a large contributor to reducing transportation emissions as well as to serve as a source of energy storage. At the same time, they represent the potential for a new type of electric usage – a device that can appear on the grid anywhere (i.e., home, work, shopping center or even vacation destination) and in large numbers, especially at peak hours when people arrive home from work. A Smart Grid will be required to manage the complexity of both the storage capability and the variable nature and location of the charging.

Operation and Reliability Improvements – Today, due to the lack of monitoring, many parts of the electric distribution grid are run until they fail. Such failure causes a blackout. This is very expensive to the U.S. economy as EPRI estimates that for every dollar spent on electricity in the United States (approximately $343 billion in 2007), the U.S. economy incurs $0.50 in lost productivity and other costs from outages.[xii] A Smart Grid can detect problems on the grid before they occur enabling utilities to move towards the more predictive maintenance model used in other industries. One of our customers that uses our Smart Grid technology has stated it "is able to monitor its electric delivery system, obtaining a steady stream of data that can be analyzed for potential problems. . . . Issues are often resolved before consumers even realize that there was a problem."[xiii] Another of our utility customers reported that it has shifted budgets from reactive to preventive maintenance as a result of our Smart Grid solutions providing them for the first time, the necessary information to detect potential faults and outages and allows it to fix the problem before the issue becomes an outage.

End-User Energy Management – This includes smart meters for both residential and commercial customers as well as a variety of building and in-home energy management devices like programmable thermostats. We believe that the case for using advanced meters, pricing and control systems for commercial and industrial customers who consume approximately 65% of overall electric power in the United States is strong, the approximate $40 billion required for residential metering may be better spent and produce significantly higher benefits by implementing a Smart Grid on the grid itself along with a more selective installation of advanced meters.

Some utilities are presently focused on "Smart Meter" projects for residential customers that will cost $325 or more per household and have a 20 year payback.[xiv] In most cases, approximately 55% of the 20 year benefit payback from Smart Meters comes from operating cost reductions, primarily as a result of laying off electrical workers[xv]. The remaining benefits depend on customers voluntarily shifting their usage based on pricing signals to reduce peak demand. Smart Meters themselves do not in any way "automatically" reduce customer electricity use.[xvi] They simply allow the utility to record not only how much but when the electricity is used and, in some cases to communicate that information to a display within the home. This in turn permits the utility to impose rate structures that penalize usage during peak periods by imposing higher charges on such usage. Consumers who are able to do so may respond to these higher prices by shifting the time of their usage to off-peak periods. They can do so in many ways, from choosing not to run certain appliances during the peak period, turning their thermostats up or down as the case may be, etc. Programmable thermostats and communicating thermostats may also be installed to automate the process, although the cost of doing so will be in the hundreds of dollars per household. It must be noted that 40% of American homes do not have central air conditioning and thus do not have a use for a programmable thermostat.[xvii] Additionally, many classes of customers, such as the elderly, night workers and families with young children at home may find it difficult to change their electric usage patterns and thus would be potentially penalized by higher time of use rates during peak periods.

Unfortunately, Smart Meters will not greatly reduce CO2 since the primary benefit is reducing load at the 50 or so peak hours of a year, not to eliminate the usage itself.[xviii] Ironically, this usage shift may be environmentally worse since it may move usage from a time at which the incremental power source is gas to a time when the incremental power source is coal with a resulting increase in CO2 emissions. Indeed, the Department of Energy (DOE) has recognized this and has warned state regulators and others that "policymakers should exercise caution in attributing environmental gains to demand response, because they are dependent on the emissions profiles and marginal operating costs of the generation plants in specific regions."[xix]

A Smart Grid benefits case developed with leading industry consultants and electric utilities projects over $3 billion of benefits enabled by CURRENT's technology for a representative one million home utility over 17 years with an IRR of greater than 25%. This IRR is 2 to 3 times the typical IRR required in a utility project and is before any benefits for reduced carbon emissions and greatly exceeds the returns of most Smart Meter business cases which barely break even. In addition, a number of the high impact Smart Grid applications can be deployed on a standalone basis and often exceed the cost of the applications in as little as 2 to 3 years.

<u>What does our experience from operating Smart Grids show us?</u>

We have learned a tremendous amount over the last six years deploying our technology with electric utilities and their customers. Several points stand out:

First, we believe the potential for system optimization is significant and a Smart Grid can help achieve this. We generate, transmit and distribute more power than is needed to the end customer. In historical terms, it make sense since utilities were penalized for low voltages, there was plenty of inexpensive power and no worries about carbon. In a carbon constrained world with tightening demand and difficulty in building new power generation facilities and transmission, utilities need a Smart Grid to reduce the amount of power delivered. However, as discussed below, they need an incentive to do so.

Second, while a part of the solution, changing customer behavior can not be the sole or primary measure to produce improvements in the way electricity is delivered and used. As discussed above, tens of millions of Americans do not have thermostat controlled cooling. Therefore, they have no reason to spend the additional hundreds to thousands of dollars on in-home energy management equipment when they get a smart meter installed. In addition, the average American household spends less than $0.15 per hour on electricity[xx]. With often quoted savings of 5 to 10% of peak demand, consumers who change their usage would expect to save only several pennies an hour.

Third, between the ARRA stimulus funding, cap and trade systems and renewable portfolio standards, we believe renewables (and similarly PHEVs) are going to have a bigger, quicker impact on the grid than most people expect. In one of our deployments, we have already identified residential solar panels which were feeding power back on to the grid without the utility's knowledge, creating a potential safety hazard for utility work crews. One customer has identified the need to have an accurate measure of the power being produced by various distributed renewables in order to better forecast load and schedule generation for its operating plan.[xxi]

Fourth, open standards are important as noted in the provisions of ARRA. We are already integrating our open standard technology with multiple grid device manufacturers, in-home energy management systems and with a variety of back office utility systems. If each interface must be custom developed, substantial delays and additional costs will result.

What are the hurdles to more Smart Grid deployments?

It is clear that utilities have to be incented to deploy Smart Grid technology. In general, under traditional regulatory models, a utility's cost is largely fixed and its revenue is the product of the number of kilowatt hours sold multiplied by the price per kilowatt hour. There is thus no reason to believe that a for-profit entity will (or should) spend money in order to earn less. As a result, utilities have strong regulatory and financial incentives to spend money on more traditional items, such as new power generation plants, rather than acquiring new technology to make more efficient use of existing power. An added aspect of such disincentives is that because a utility can earn a much higher rate of return on new generation plants than on conservation, it will spend more on such traditional assets. Xcel Energy pointed out that "the real risk in a true coal-to-cool-air, wind-to-light implementation of the smart grid is that these technologies that transform conservation and efficiency efforts can lead to degradation of the regulated return and uncompensated demand destruction."[xxii]

Additionally, utilities are subject to regulator review of their investment decisions and regulators, consumer advocates and the utilities themselves are still learning about Smart Grid. Utilities often anticipate that their discretionary adoption of new technology may be politically challenged or that cost recovery will be denied after the fact. Finally, as an integrated end to end solution, Smart Grid creates value all along the utility and the customers, including to society in the form of lower outages and less carbon. Regulatory policy has to be structured to assure that the entire value creation is included in the benefit case so that utilities can be assured appropriate rate recovery.

Summary

Smart Grid is the largest single information technology investment that can be made to reduce CO2 emissions in the world. A Smart Grid is an end to end integration of management and control from the power plant or renewable to the grid to the home, business, thermostat or PHEV. The highest potential CO_2 reductions come from focusing on the grid itself. The technology exists and presently is delivering real benefits in the field to utilities. Regulatory policy needs to be aligned to encourage the deployment of the Smart Grid and to assure the utility a fair rate of return. Finally, encouraging a Smart Grid also will help American companies gain and preserve market leadership in what is fast becoming a worldwide market. Countries all over the world need a modernized electric grid, and companies from the United States can be leaders in this global market. Indeed, CURRENT and other American companies already are pursuing such international opportunities, which will create high tech jobs here at home.

End Notes

[i] U.S. Department of Energy (DOE), *Emissions of Greenhouse Gases in the United States 2007*, December 2008 pg 1, 14.

[ii] International Energy Administration, *World Energy Outlook 2008,* pg 391.

[iii] President Obama's remarks upon signing the American Recovery and Reinvestment Act of 2009, February 17, 2009. "The investment we are making today will create a newer, smarter electric grid that will allow for the broader use of alternative energy. We will build on the work that's being done in places like Boulder, Colorado." (*Xcel Energy SmartGridCity*[TM] *project)*

[iv] Further information about CURRENT is available at http://www.currentgroup.com

[v] Electric Power Research Institute. 2003. '*Electricity Sector Framework for the Future: Achieving the 21st Century Transformation'* Available at: http://www.epri.com., pg 42.

[vi] Energy Future Coalition, *'National Clean Energy Smart Grid Facts'* Available at http://www.energyfuturecoalition.org/files/webfmuploads/Smart%20Grid%20Docs/Smart_Grid_Fact_Sheet.pdf., 2009.

[vii] The Climate Group *'SMART 2020: Enabling the low carbon economy in the information age'*, 2008 available at http://www.theclimategroup.org/assets/resources//publications/Smart2020Report.pdf pg 9, 12.

[viii] *See* Testimony of Michael W. Howard, Ph.D., P.E., Senior Vice President, R&D Group, Electric Power Research Institute, "*Facilitating the Transition to a Smart Electric Grid*," Before the House Subcommittee on Energy and Air Quality, May 3, 2007.

[ix] Xcel Energy. 2008. *'Xcel Energy Smart Grid A White Paper'* Accessed 01 Oct 2008. Available from http://birdcam.xcelenergy.com/sgc/media/pdf/SmartGridWhitePaper.pdf.

[x] The Climate Group *'SMART 2020: Enabling the low carbon economy in the information age'*, 2008 available at http://www.theclimategroup.org/assets/resources//publications/Smart2020Report.pdf pg 70.

[xi] Talbot, David *"Lifeline for Renewable Power",* MIT Technology Review, January/February 2009

[xii] Electric Power Research Institute. 2003. '*Electricity Sector Framework for the Future: Achieving the 21st Century Transformation'* Available at: http://www.epri.com., pg 40.

[xiii] Oncor Press Release quoting Jim Greer - Senior VP of Asset Management and Engineering (Sept 19, 2007).

[xiv] For example, Southern California Edison is spending $1.981 billion to replace approximately 5.3 million meters ($373 per meter). Over a 20 year useful life, the project is expected to result in benefits of $1.990 billion or a net present value of $9 million. (See SCE Decision at http://www.sce.com/NR/rdonlyres/6DC13EB1-0AFA-40A8-B9E3-93546F24015C/0/081114_A0707026Final_Decision.pdf.)

[xv] Brockway, Nancy, National Regulatory Research Institute, '*Advanced Metering Infrastructure: What Regulators Need to Know About Its Value to Residential Customers*', February 2008 pg 18 highlights two different utility regulatory filings where between 53 and 60% of the operational benefits related to eliminating manual meter reading costs

[xvi] Synapse Energy Economics, Inc for New Jersey Department of Public Advocate, '*Advanced Metering Infrastructure – Implications for Residential Customers in New Jersey*' at 7 (July 2008)

[xvii] U. S. DOE Energy Information Administration (EIA), Office of Energy Markets and End Use, "*2005 Residential Energy Consumption Survey*". The same survey indicates of the people who have central air conditioning. According to data from the same study and EIA total sales data, electric heat represents less than 1% of overall electric sales.

[xviii] Synapse Energy Economics, Inc for New Jersey Department of Public Advocate, '*Advanced Metering Infrastructure – Implications for Residential Customers in New Jersey*' at 13 (July 2008)

[xix] U.S. DOE Report to Congress, Feb 2006 "*Benefits of Demand Response and Recommendations"* pg 29

[xx] U. S. DOE Energy Information Administration, *"Electric Sales, Revenue, and Average Price 2007, Table 5 U.S. Average Monthly Bill By Sector, Census Division and State"* January 2009.

[xxi] While many people suggest that net metering (the ability to track the net between the usage of the home or business) and the solar panel is enough, our customer believes it needs to have each number at the gross value to assure adequate reserves.

[xxii] Xcel Energy. 2008. *'Xcel Energy Smart Grid A White Paper'* Accessed 01 Oct 2008. Available from http://birdcam.xcelenergy.com/sgc/media/pdf/SmartGridWhitePaper.pdf.