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# Electric Energy T&D MAGAZINE

APRIL 2011 Issue 3 • Volume 15

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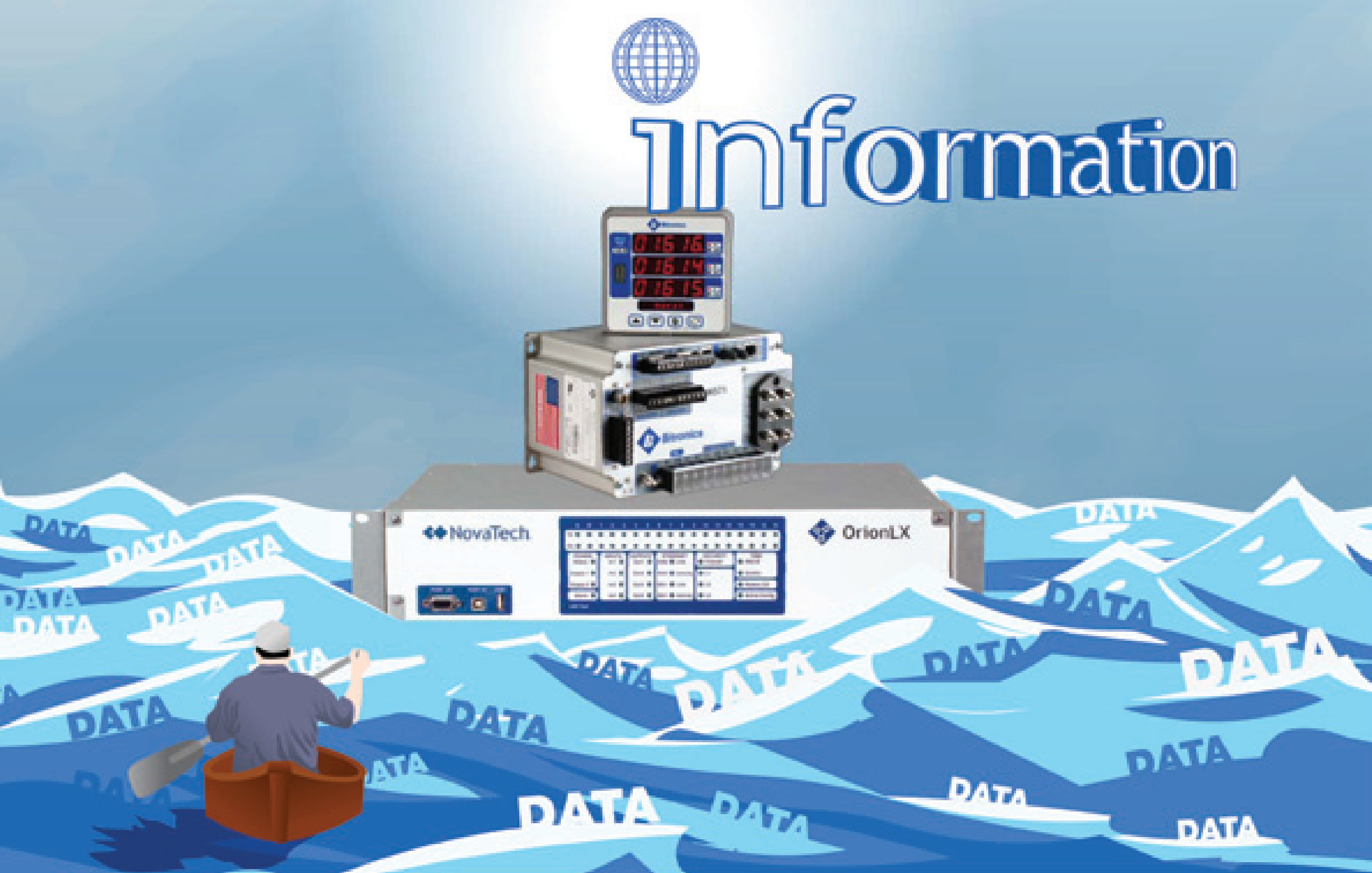


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# Electric Energy T&D MAGAZINE



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page 20


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**Electric Energy Magazine is published 6 times a year by: Jaguar Media Inc.**
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page 26


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Post Publication mail agreement #40010982
Account #1899244




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Michael A. Marullo,
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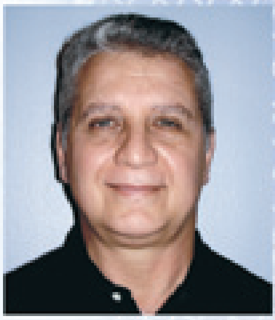


# Are We There Yet?

I saw a really cute cartoon in the newspaper the other day. It showed two kids in the back seat of a car with their parents in the front, obviously taking the boys on a trip of some sort. One little boy was asking the quintessential question: "Are we there yet?" But before the parents could answer – assuming they even intended to answer – the second little boy answered for them. His answer was classic: "It depends on where we're going," he said.

Gee, I wish I'd thought of that answer when my own kids were little... but of course, I didn't. So naturally, that got me thinking about the Smart Grid (a logical leap, right?) and where we're going with that particular problem child. As many of you probably heard, the Electric Power Research Institute (EPRI) just released a report putting a financial point on that question. I freely admit to not reading all 162 pages of this report, but it's available on the EPRI website if anyone is so inclined.

The report is titled, *"Estimating the Costs and Benefits of the Smart Grid: A Preliminary Estimate of the Investment Requirements and the Resultant Benefits of a Fully Functioning Smart Grid"* (EPRI, Palo Alto, CA: 2011.1022519)[1]. Wow, that's quite a mouthful, isn't it? Just think about that for a minute. My hat's off to EPRI for even undertaking such a formidable task, and speaking as a market research professional myself, I must say the outcome is pretty impressive. Putting not only a cost, but also an estimated ROI on something as squishy and ambiguous as the Smart Grid is no small task, and even though the preparers would probably admit to taking a few "swags" here and there (it's not like there's a wealth of information from ever having done this before, you know!), as an industry we've got to start somewhere with trying to get our collective arms around it.

So what are those numbers? Well, the executive summary of the EPRI report says this:
"Factoring a wide range of new technologies, applications and consumer benefits the investment needed to implement a fully functional smart grid ranges from $338 billion to $476 billion and can result in benefits between $1.3 trillion and $2 trillion."

That's certainly one glaring data point to think about, especially in the context of having already committed something like $8-10 billion to the task if we consider both the $3.4 billion in ARRA ("Stimulus") funds and the matching funds required of utilities taking advantage of those federal dollars. Yep, that's a whole lot of money! But compared to the EPRI estimate, it's really a relatively modest beginning.

The report also balances the projected costs with anticipated benefits, which include (and I quote):

- More reliable power delivery and quality, with fewer and briefer outages;
- Enhanced cyber security and safety with a grid that monitors itself and detects and responds to security and safety situations;
- A more efficient grid, with reduced energy losses and a greater capacity to manage peak demand, lessening the need for new generation;
- Environmental and conservation benefits, better support for renewable energy and electric-drive vehicles; and,
- Potentially lower costs for customers through greater pricing choices and access to energy information.

These are all noble – and ostensibly achievable – objectives, but one big problem that I see is the rather broad perception among consumers that all of the money committed and/or currently being spent isn't doing anything useful – or at least not anything deemed positive – for most ratepayers. And whether you agree or disagree, just look at all of the backlash around things like the alleged negative health effects of RF-connected meters, data privacy issues, perceived overbilling, inaccurate meter readings, wrong-minded investment priorities and so on.

Some of these issues have legitimate foundations; most do not, and instead merely offer emotional responses to what amounts to a chronic lack of understanding and consumer education. They are also the result of the ongoing misconception that the Smart Grid is all about Smart Meters... and for the four millionth time – that is NOT the case. I believe that if most people understood what the Smart Grid is really all about, a whole lot of the controversy could be put aside rather quickly.

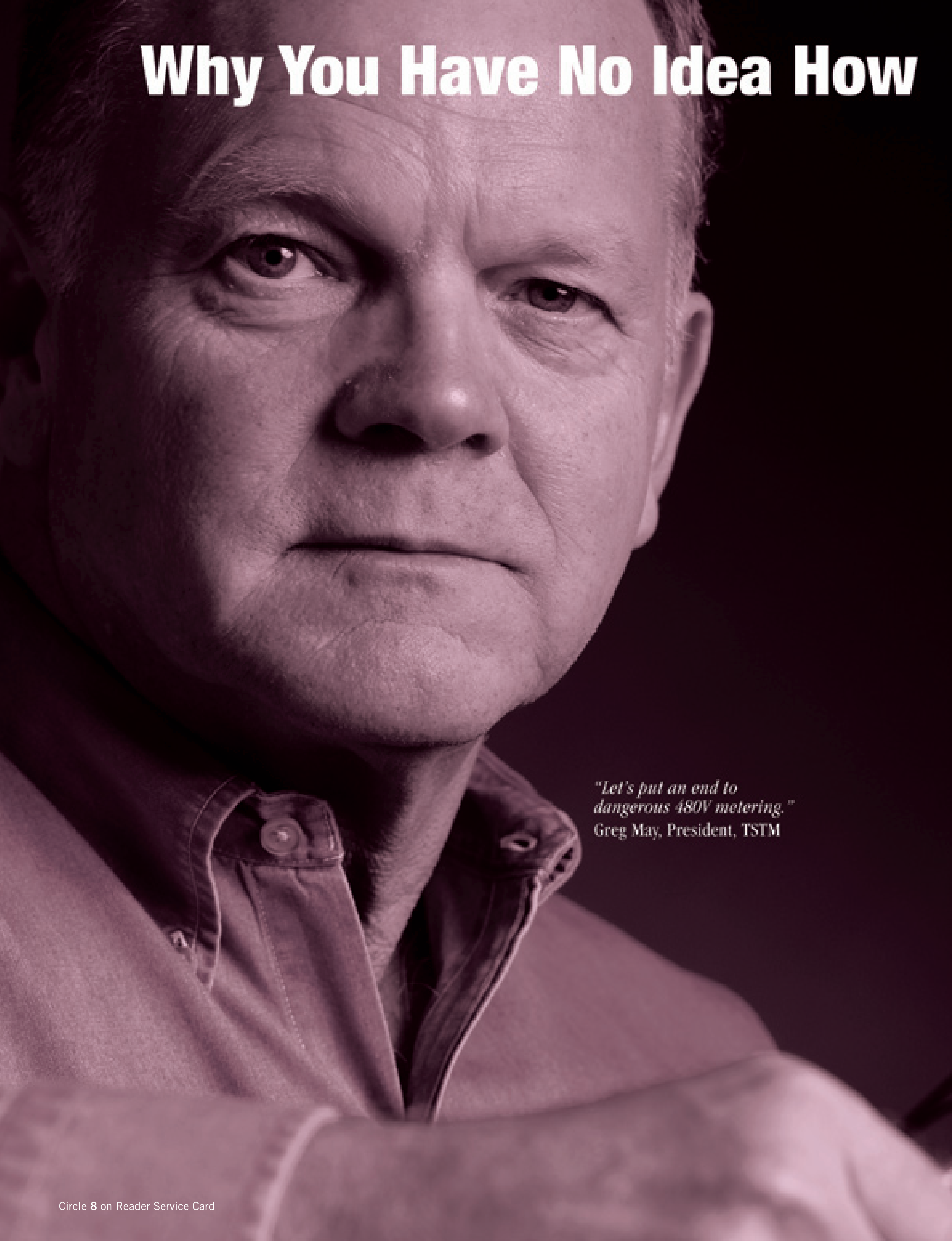
Let me also offer another example of why I think most consumers are thoroughly in the dark about Smart Grid initiatives. This has to do with the 'grid communications' piece, which is a very substantial part of what is needed for the Smart Grid to become a reality. Case in point: One of the forums I belong to is questioning whether the new (so called) "4G" cellular service is up to meeting the requirements of a 21st century Smart Grid. Specifically, the question posed was: "How big a role do you think 4G access technologies will play in new smart grids and smart metering?"

There were a lot of contributions to this post, but most failed to respond to a fundamental truth; that is, no one can say (definitively) what "4G" actually is – or will be – with any real conviction. That's because so far, 4G is being defined by advertisements and sales literature, rather than any type of technical specification or standard. (Hint: That's why all of the major carriers can get away with claiming "the nation's fastest 4G network!")

But, while hype might work for consumer cellular markets where promises of "blindingly fast" speed are considered a guarantee, and slick ads using jargon like "LTE (Long-term Evolution)" are used to define the future capabilities, until/unless there is a written and broadly adopted specification, no one can possibly say with any certainty whether "4G" networks can live up to Smart Grid expectations or not.

So, the moral of this story is simple: If we want to know if we're "there" yet, we first need to do a better job of saying where it is we're trying to go and then – much more specifically – how we plan to get there. – ***Ed***.

[1] This analysis updates EPRI's 2004 EPRI assessment, which estimated the cost of implementing a smart grid at $165 billion. The updated analysis assumes steady deployment of smart grid technologies beginning in 2010 and continuing through 2030.


Why You Have No Idea How
"Let's put an end to dangerous 480V metering."
Greg May, President, TSTM
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# INDUSTRY NEWS

## U.S. Environmental Protection Agency Recognizes APS with Highest Honor for Energy Efficiency

Phoenix, AZ, -For the second consecutive year, Arizona Public Service has earned the U.S. Environmental Protection Agency's highest honor – The ENERGY STAR Sustained Excellence Award – for continued leadership in protecting the environment through energy efficiency.

APS received the award on April 13 at a ceremony in Washington. The award recognizes the APS ENERGY STAR Homes Program and the APS Home Performance with ENERGY STAR Program for promoting energy efficiency and reducing greenhouse gas emissions.

The ENERGY STAR awards are presented to a select group of organizations that exhibit outstanding leadership year after year. Award winners are selected from more than 17,000 organizations across the country that participate in the ENERGY STAR program.

"To be honored by the EPA for our leadership is high praise indeed. It validates the effort we are making to create a sustainable energy future for Arizona," said Terry Orlick, APS Director of Marketing. "The real significance of our commitment to energy efficiency is what it means to our customers – our programs empower them to use energy in the most efficient and affordable manner possible."

Since the launch of the company's first energy efficiency program in 2005, APS programs have helped customers save more than 11.5 billion kilowatt-hours (kWh) of electricity over the expected life of the energy efficiency measures installed; these energy savings are equal to more than $1 billion in customer savings. The kWh savings equate to reducing greenhouse gas emissions by more than 10 billion pounds, the equivalent of taking nearly 900,000 cars off the road.

"APS's long term leadership and commitment to energy efficiency demonstrates the types of accomplishments that we can all achieve in reducing greenhouse gas emissions and protecting our global environment," said Elizabeth Craig, Acting Director of EPA's Office of Atmospheric Programs. "We look forward to their continued partnership and leadership."

In addition to receiving the Sustained Excellence Award, APS is a proud partner of the Foundation for Senior Living (FSL), Arizona's Home Performance with ENERGY STAR sponsor, who also will receive an EPA Partner of the Year Award for Program Delivery – Emerging Markets.

"We launched the APS Home Performance with ENERGY STAR Program in 2010 and in just one year, Arizona has become one of the fastest growing markets for home energy retrofitting in the country," said Gavin Hastings, APS Senior Marketing Coordinator. "This program not only offers significant energy savings for our customers, but will continue to create green jobs for Arizona."

This is the fifth consecutive year APS has been recognized nationally by the EPA. In 2007, the company won Partner of the Year for Excellence in Program Delivery of its APS Residential CFL Lighting Program, and for the past three years APS has won Partner of the Year for Excellence in Program Delivery of the ENERGY STAR Homes Program.

"To be recognized five years running by the EPA validates APS's focus on best serving our customers," said Tom Hines, APS Energy Efficiency Program Manager. "This year, APS is being honored for sustaining a seasoned and successful program and for delivering a new, up-and-coming program. Moving forward, we will continue to develop and expand programs that help our customers save energy and money – that's our ultimate goal."

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# INDUSTRY NEWS

## Duke Energy to Deploy Energy Storage Technology at Texas Wind Farm

### 36-Megawatt Battery Storage System Will Be World's Largest at a Wind Farm

Charlotte, NC, April 14, 2011 - Duke Energy intends to store electricity generated at its Notrees Windpower Project in west Texas using an energy storage and power management system developed by Austin-based Xtreme Power.

In November 2009, Duke Energy announced plans to match a $22 million grant from the U.S. Department of Energy (DOE) to install large-scale batteries capable of storing electricity produced by the company's 153-megawatt (MW) Notrees wind farm, located in Ector and Winkler counties. After due diligence, Duke Energy chose Xtreme Power (www.xtremepower.com) to design, install and operate a 36 MW-capacity Dynamic Power Resource™ system at the wind farm. When complete, the battery storage system will be one of the largest of its kind in the world.

This system will store excess wind energy and discharge it whenever demand for electricity is highest – not just when wind turbine blades are turning. In addition to increasing the supply of renewable energy during periods of peak demand, Xtreme's Dynamic Power Resource™ solution will help stabilize the frequency of electricity traveling throughout the power grid.

Duke Energy will work closely with the Energy Reliability Council of Texas (ERCOT) to integrate the wind power and battery storage solution into the state's independent power grid. The Electric Power Research Institute (EPRI) will advise the project team, collect data and help assess the potential for broader adoption of energy storage solutions throughout the industry. Results from the storage project at Duke Energy's Notrees wind farm will be shared publically through the DOE's Smart Grid Information Clearinghouse.

The DOE grant was made possible by the American Recovery and Reinvestment Act of 2009. In January 2011, DOE and Duke Energy agreed upon the terms and conditions of the grant. Duke Energy will elect to receive the matching funds for the energy storage and management solution once the company has completed its due diligence.

Duke Energy is targeting an in-service date for the battery storage system by late 2012.



## Investment of More Than $15 Billion Annually Would Meet Future Electricity Needs

Ottawa, April 7, 2011 - Canada's electricity sector will require more than $15 billion in investment annually over the next 20 years to replace or refurbish aging infrastructure and meet growing electricity needs through 2030, according to a Conference Board of Canada analysis released on April 7.

"Electricity is an important component of the Canadian economy. Canadians enjoy some of the lowest electricity prices among developed countries, and much of our power comes from renewable sources," said Len Coad, Director, Energy, Environment and Technology Policy.

"With half of the generation assets built before 1980, the industry faces a pressing need to accelerate investment in infrastructure at all levels. Much of electricity infrastructure is in need of replacement or refurbishment. An annual investment of $15 billion is a substantial increase over levels in recent decades."

The study, Canada's Electricity Infrastructure: Building a Case for Investment(http://www.conferenceboard.ca/e-library/abstract.aspx?did=4132), estimates that about $293.8 billion (all figures in 2010 dollars) would be needed between 2010 and 2030 to replace aging facilities and meet demand requirements. This level of investment would be a mix of public and private sector investment, depending on whether the systems in each province are owned by governments or by private industry.

# INDUSTRY NEWS

At least half of the expenditure is expected to be made by private companies, although a large portion of the private investment will be producing power that is under long term contract to a government agency. The remainder of the investment will be made by provincial government corporations or municipal utilities.

The study was funded by the Canadian Electricity Association to review the current state of Canadian electricity infrastructure and analyze future investment requirements.

"The electricity grid that serves us so well was built for a population of about 20 million, but is today servicing around 35 million," said Pierre Guimond, President and CEO of the Canadian Electricity Association. "It is time to make some of the decisions that previous generations also had to make to have reliable and affordable electricity."

Several steps were applied to obtain the estimates. The Conference Board:

- Identified all units that are operational, under construction, planned or proposed;
- Used the National Energy Board's long-term outlook to determine market requirements through 2020, and used its own analysis to project demand to 2030;
- Determined generating capacity requirements by balancing the market requirements against potential retirements or repowering of existing units, and a listing of future projects;
- Applied capital costs to all generation projects,to calculate total generation investments;
- Used long-term plans published by the transmission companies, system operators, and provincial regulators to estimate transmission investments; and
- Based distribution investments on the levels of expenditure required to sustain existing infrastructure and meet growth in demand.

The largest share of the full amount, $195.7 billion, would be for generation. Most of these investments would be in renewable and low carbon emission sources of electricity generation.

The Conference Board estimates that the distribution system will require about $62 billion in investment over 20 years, both to sustain existing infrastructure and to implement new systems.

The Conference Board calculates that transmission systems across the country will require about $36 billion in investment. However, this level of investment is likely underestimated. Transmission investment costs are affected by the amount of power being transmitted and the distance from the source of electricity to the market. As a result, the Conference Board could only assess future transmission needs based on publicly available expansion plans and their cost estimates.

The historical investment in the electricity sector has varied over the years, with periods of high investment in the 1970s and 1980s. There was a significant hiatus in investment in the mid-1990s, but recently, the sector has once again seen growth in the investment levels.

The electricity sector contributed about $24.6 billion to the Canadian economy in 2010 (two per cent of gross domestic product) and it employed 116,000 workers. Canada exports about seven to nine per cent of its electrical generation and is a net electricity exporter. In 2010, exports totaled $2.3 billion.

The report also includes summaries of the electricity systems in each province. It does not address funding sources or pricing options. The report is publicly available at www.e-library.ca.

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## Duke Energy and American Transmission Co. Form Joint Venture to Build Transmission in North America

Charlotte, NC, April 13, 2011 - Duke Energy and American Transmission Co. announced the creation of Duke-American Transmission Co., a joint venture that will build, own and operate new electric transmission infrastructure in North America.

The companies believe Duke-American Transmission Co. (DATC) is well-positioned to help address increasing demand for affordable, reliable transmission capacity in the United States and Canada. DATC has begun identifying opportunities to build, own and operate new transmission projects that meet potential customers' capacity and voltage requirements.

DATC will own all of the transmission assets it builds and operates. Equity ownership of DATC will be split equally between Duke Energy and ATC.

The joint venture will operate as a transmission utility. As a result, it will be subject to the rules and regulations of the Federal Energy Regulatory Commission, MISO, PJM and various other independent system (grid) operators, as well as any states in which DATC develops projects. Per the structure of their new joint venture, Duke Energy and ATC may continue to develop transmission projects independently.

"Thoughtful, well-designed transmission projects afford customers, regulators and other key stakeholders superior flexibility as they determine which energy resources can help meet demand for electricity in the decades to come," said Duke Energy Commercial Businesses Senior Vice President Phil Grigsby. "Duke Energy and ATC share the belief that sound transmission infrastructure can serve as a springboard for next-generation energy technologies."

"This joint venture is an important step in advancing ATC's strategy to grow outside our current service area," said John Flynn, ATC vice president of Strategic Planning and Business Development. "We have been very successful in planning, permitting and building transmission in the Midwest. Through our partnership with Duke Energy, we will take our expertise to other parts of North America to develop transmission solutions that not only deliver reliable electricity, but also economic and public policy benefits.

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## DTE Energy's Energy Efficiency Programs Save Customers $31 Million In 2010

DTE Energy today announced that customers who participated in the energy efficiency programs the company launched in June 2009 saved $31 million last year and can expect the steps they took to result in lifetime savings of $520 million.

"Customer response to our energy efficiency programs has been extraordinary, far exceeding our expectations," said Gerry Anderson, DTE Energy president and CEO. Over a half million of our customers took control of their energy use through these programs and saved millions of dollars as a result."

Comprehensive energy legislation passed in 2008 to assure clean, affordable energy for the future was the catalyst for the company's energy efficiency initiatives. The company's Your Energy Savings programs, designed to help customers save money by saving energy, included appliance recycling, in-home energy audits, low-income weatherization assistance, and rebates and discounts on energy efficient light bulbs, programmable thermostats, clothes washers and more.

2010 results for DTE Energy's Your Energy Savings programs included:

- Nearly 23,000 old refrigerators, freezers, room air conditioners and dehumidifiers were picked up and recycled, taking energy guzzling appliances off the electrical grid.
- Over 3 million compact fluorescent light bulbs (CFLs) were purchased by customers at prices steeply discounted by DTE Energy and sold at participating retail stores throughout southeastern Michigan.
- Close to 38,000 apartments and other multifamily housing units were outfitted with energy-saving measures like CFL bulbs, low-flow showerheads, kitchen and bathroom aerators.
- DTE Energy and local Community Action Agencies worked together to weatherize approximately 2,500 low-income homes. The company also installed energy saving measures in approximately 2,000 low-income residences. Approximately 1,650 customers living in low-income households received new energy efficient refrigerators.
- Over 15,000 customers signed-up for in-home energy consultations and audits to learn how to make their homes more energy efficient.
- More than 7,000 customers received energy efficiency kits containing CFL bulbs, low-flow showerheads, faucet aerators and more.
- Many commercial and industrial customers participated in DTE Energy energy efficiency programs. Customers submitted more than 2,700 applications for investments made in energy efficient equipment and upgrades for their business facilities. More than 5,000 business owners and trade associations participated in presentations about DTE's Energy Optimization program. DTE Energy installed more than 1,100 programmable thermostats free of charge for businesses.

Anderson said DTE Energy hopes this year to expand some of its existing programs and introduce new ones. The company expects to file an updated plan with the Michigan Public Service Commission on September 1.

"Our customers clearly are looking to us to help them manage their energy bills and we want to make sure we have the best possible programs in place to make that happen," Anderson said. Web Site: *http://www.dteenergy.com*

Circle **14** on Reader Service Card

## Dominion Honors 13 Employees as Volunteers of the Year

Richmond, VA, April 7, 2011 - They installed solar panels in Uganda, repaired cars in Mexico, mentored at-risk children, worked to reduce drug use and drunken driving among teens, coordinated free dental help, supported women with cancer and performed other selfless acts of kindness to help others in their communities.

For their efforts and achievements, Dominion has selected 13 employees from six states as Volunteers of the Year.

"They represent Dominion's spirit of volunteerism at its best," said Thomas F. Farrell II, chairman, president and chief executive officer. "The good work they do for Dominion is rewarding. The good works they do for others is inspiring."

This year's winners, selected by a panel of community leaders, join more than 260 previous honorees. Photos of the individual winners are available for download on Dominion's website.

They will be honored April 7 in Richmond and April 20 in Cuyahoga Falls, Ohio, near Akron. This year's winners are:

- Stephen A. Alexander, a customer service representative at Northeast Shop, Wickliffe, Ohio. Since 2005, he has used athletics and academics to mentor at-risk youth through the Euclid Cowboys, a youth football and basketball organization. He works to instill in them the knowledge and desire to become leaders and responsible young men.

• Priscilla Cortney Allen, a business performance analyst with Dominion Virginia Power (DVP) in Richmond. Through Dominion's "Lunch Buddies" program, she has mentored a Blackwell Elementary School student for four years and has worked tirelessly to recruit additional co-workers for the program. In December, she took 50 children from the Lunch Buddies program to the Dominion Christmas Parade and brought hats and gloves for children who may not have been prepared for the cold weather.

• Crystal B. Bright, a projects coordinator for DVP in Virginia Beach. As the volunteer adviser for DVP's Eastern region, she manages volunteers' participation in a host of community service projects year-round. They range from collecting supplies for earthquake victims in Haiti and school children locally to sorting food at the local food bank and making repairs at the Judeo-Christian Outreach Center.

• Paul E. Caldwell Jr., a repair crew leader with Dominion Energy in Leesburg, Va. A talented mechanic, he serves as a "mechanical missionary." He leads semi-annual trips to repair cars, buses and vehicles in Mexico's Baja region, where dusty conditions, a shortage of local mechanics and general poverty make it hard for residents to maintain their vehicles. He also coordinates two days a year at his church to work on cars for anyone in need, regardless of their church membership.

• Sandra C. Christman, a training administrator with Dominion Generation at Kewaunee, Wisc. She has served as secretary of the Kewaunee High School Parent Teacher Organization and has been involved in programs for drug awareness and drunken driving awareness. She also hosts the "Plant for the Public" event to raise funds for a horticulture scholarship program.

• Vicky A. Harte, a nuclear technical specialist with Dominion Generation in Richmond. She has been a lay missionary of Mother Teresa of Calcutta's Missionaries of Charities since 2008. She regularly stays overnight at a hospice in Washington, D.C., where she helps care for patients who have no family support and are not eligible for social services assistance. She organized the first free dental clinic in Louisa County. She also volunteers with Remote Area Medical, which sponsors an annual free medical and dental clinic in southwest Virginia.

• Wendy C. Jones, a maintenance helper with Dominion Generation in Surry, Va. She compassionately supports victims of domestic violence at the Genieve Shelter in Suffolk. She volunteers throughout the year. During the holiday season, she ensures that people staying at the shelter have presents to open Christmas morning. She also fills stockings with toys for the Salvation Army and chairs the Angel Tree Project.

• Richmond B. Phillips, manager of gas operations for Dominion Energy in Cleveland, and Carol M. Zadra, an engineer with Dominion Energy in North Canton, Ohio. They each work tirelessly to raise money for breast cancer research through Cleveland's annual Susan G. Komen 3-Day for the Cure, which entails three days of 20-mile walks. Additionally, Phillips helped organize the Kids for the Cure companion event, which has become the Dominion Kids Dash.

• Phillip W. Powell, director of conservation/load management research and program development for Dominion in Richmond. He is a 25-year volunteer and now board president of Bainbridge Community Ministry, which distributes food to the working poor in Richmond's South Side. As a member of Engineers Without Borders, he has traveled to Uganda with Virginia Tech engineering students to install solar panels to bring electricity to a window-less, rural school. His next planned project in Uganda is to lead students in installing solar panels at an orphanage near the school.

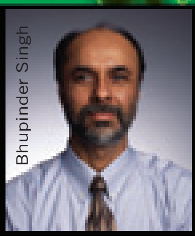
• John E. Ventura, a physical security coordinator with Dominion in Somerset, Mass. He is a retired police officer in Portsmouth, R. I., who organizes an annual ice-skating day there for children with special needs. He also coaches for the Swansea Independent Baseball League and Diman Regional Vocational Technical High School in Fall River, Mass., and volunteers with Massachusetts Special Olympics.

• Robert A. Vince, a senior safety specialist with Dominion Energy in Oakford, Pa. He and his family established Zachary's Mission after the death of his infant son from a congenital heart defect in 2008. The foundation provides "Zach Packs" filled with hope, comfort and basic necessities to families staying overnight at a hospital to be with their sick children. Since its founding, the program has expanded to serve families in western Pennsylvania, West Virginia and Ohio.

• Dustin B. Vincent, an engineer with Dominion Energy in Clarksburg, W. Va. As a volunteer, he oversaw a drainage and paving project for the Harrison County Sheltered Workshop, which provides jobs for individuals with disabilities. He now sits on its board. He also coaches baseball for children with special needs in Bridgeport Little League's Challenger Division.

# 2011 GreenWays Series

## Leadership for a Clean Energy Future



### Bentley Systems, Inc., Exton, Pennsylvania USA

By Malcolm Walter, Chief Operating Officer & Senior Vice President
Bhupinder Singh, Senior Vice President, Bentley Software


On any given day, Bentley colleagues and software users around the world are focused on infrastructure and the lifecycle of infrastructure. So what's Bentley all about these days? Well, maybe more than you think. Having reinvented itself over the last decade from a traditional CAD/GIS company into a global software powerhouse, its stated mission is to support the enterprises and professionals who design, build, and operate the world's infrastructure – sustaining the global economy and environment, for improved quality of life. Learn more about how Bentley sees the future of infrastructure planning, design, and development unfolding in this interesting and insightful interview with two high-profile members of Bentley's leadership team. – ***Ed***.

**EET&D**: First, I want to thank you both for taking time to share your vision of the future for the energy/utility industry with me and with our readers. However, I have to admit that until last fall I was under the impression that Bentley was essentially a CAD/GIS company. Since then, I've had the opportunity to learn more about where the company is headed, and let's just say it's quite a bit different from my earlier impressions. Assuming that I'm not the only one who wasn't 100% up to speed on the latest developments, let's start with a quick overview of where the company is focused today…

**Walter**: Simply stated, Bentley is all about sustaining infrastructure. I'll explain more about what that means in a minute, but I want to start by acknowledging that we all witnessed some fairly major disruptions to the energy/utility business model in the last decade. As a result of those disruptions, we need to figure out how to engineer the 21st century utility. At Bentley, our role is to provide solutions to design, build, and operate that utility infrastructure, along with all of the other types of infrastructure the global community depends on for improved quality of life. On any given day, thousands of our Bentley colleagues and software users around the world are focused on infrastructure and the lifecycle of infrastructure.

**EET&D**: Let's talk a little more about how Bentley is positioned and where you operate…

**Walter**: As you know, our worldwide headquarters is in Exton, Pennsylvania, and then we also have regional headquarters. For Europe, the Middle East, and Africa, our headquarters is located in Dublin, Ireland, and for Asia its in Beijing. Although we're a U.S.-based company, our reach is truly worldwide, as evidenced by the fact that 58% of our business comes from outside North America, and we have nearly 3,000 employees operating in more than 45 countries.

**EET&D**: And from a technology perspective?

**Singh**: Bentley software is being used by 90% of the top engineering firms around the world, and we're the world's leader for providing software for infrastructure design, construction, and operations. Moreover, we're number one in building performance, structural design, water modeling, road and transit design, bridge engineering, and number one in plant operations.

**EET&D**: Can you offer some insights about how you've achieved such a pervasive global presence and position?

**Singh**: Bentley has chosen a very sustainable approach as a company. We've extensively focused on offering robust, flexible subscription services to our users and more recently on 'software as a service.' We go to market in two ways: with individual products – which help our users where there are solution requirements that can be well defined and met with standard, off-the-shelf products – and also through solutions, which are aggregations by industry of capabilities and products across our core product areas. Each is designed to meet the needs of infrastructure lifecycles for specific classes of infrastructure. From a products standpoint, our baseline subscription service provides technical support and on-demand updates to our products as they're developed and enhanced. Just recently we introduced an innovative new "sustainable licensing" business model based on annual Portfolio Balancing. Through Portfolio Balancing, new purchasers of Bentley product licenses, along with existing Bentley SELECT subscribers, can annually exchange underutilized Bentley software for software of equal value that meets existing or upcoming needs. For more complex challenges, we allow our enterprise customers to use any amount of Bentley software for a fixed annual fee, based simply on usage logs. All of this allows us to offer very broad capabilities that support the needs of utilities, from plant to point of service.

**EET&D**: That's a great synopsis of Bentley overall; now let's move to energy and utilities more specifically. Maybe a good beginning would be to explain what you mean by 'engineering the 21st century utility' and perhaps articulate some of the challenges that utilities are currently facing along those lines.

**Walter**: Energy and utilities are a significant focus for Bentley. We've been servicing this area of business for over two decades. In recent years we've made substantial acquisitions to broaden our technology base, and we've also evolved and significantly extended our software offerings for this part of the market, globally.

**EET&D**: You seem to imply that the challenges are different now; how so?

**Walter**: Utilities have been at the center of the global community's quality of life over the last century, but particularly since the 1930s and 1940s, when utilities delivered universal power – even to rural areas. Providing affordable, reliable and abundant energy was the key to that equation for decades. However, we're seeing today that a change is needed. Cheap, reliable energy has been taken for granted, and as a result inefficiencies have developed in the supply chain of energy to end users.

**EET&D**: As most of us in the industry already know, grid architecture hasn't fundamentally changed since the 1930s and '40s. Moreover, a substantial proportion of the grid infrastructure today – whether for generation, transmission or distribution – has either reached or is rapidly approaching its end of life. So, a lot of change is needed for all of those reasons. Will the old energy paradigm sustain energy delivery from fossil fuels and people's expectations of a cleaner, safer, sustainable world?

**Walter**: Bhupinder, I'll let you take the first shot at that one.

**Singh**: First, there's the issue of reducing carbon emissions. Whether the result of public pressure, government mandates, or international agreements, it's something that isn't going to be solved with a simple answer and probably not with a singular answer.

In developing countries – primarily in Asia, the Middle East, and Latin America – population growth, along with the need to expand infrastructure to support it, is also an issue. In addition, developing economies have growing manufacturing and primary industries, which means that their demand for energy is increasing.

Distributed renewable power generation is rapidly becoming more prevalent, and renewable energy resources have to be brought into the grid and delivered efficiently to the places where they are needed. That will mean a fundamental change in the structure of the grid and its ability to respond to changes in the power source. There will also be microgeneration and local storage as technologies emerge to support their development and commercialization on a mass-market basis.

**EET&D**: So then, the bottom line is that utilities need to plan for a sustainable, efficient, reliable, cleaner, and more affordable electric grid?

**Walter**: Yes, we believe massive investments will be required in energy infrastructure around the world. And, notably, there will not be smart power generation or a Smart Grid without smart infrastructure information. This is where we begin to cross over into the 'engineering of the 21st century utility.' Why? Because you simply won't be able to do these things without software infrastructure that delivers smart infrastructure information to the engineers and designers. Those are the people who design and operate the overall infrastructure from generation to point of delivery – and everything else in between.

**Singh**: I'd just like to add that according to the International Energy Agency in its 2008 World Energy Outlook report, much of the world's current infrastructure for supplying oil, gas, coal, and electricity will need to be replaced by 2030. From an aging infrastructure perspective, this is a major turning point for utilities.

**Walter**: I should point out that we are not the only ones delivering this message. There are several books out there that are looking at the changes likely to take place in the 21st century utility. Thomas Freidman, a well-known American author and journalist focused on economics and economic trends, wrote a book called Hot, Flat, and Crowded, which I'm sure most of your readers are probably familiar with and many have likely read. In his book, Freidman focuses on the need for a transformation in the way energy is generated and delivered to end users. Here's a particularly cogent excerpt from that book:
*"The energy internet … has the power to give us more growth with fewer power plants, better energy efficiency and more renewable energy … by smoothing out the peaks and valleys in energy demand."*

But that won't happen without a transformation in the nature of the infrastructure that delivers and generates that energy.

In that same book, Jim Rogers, the high-profile and frequently outspoken CEO of Duke Energy, says:
*I have to take my grid and make it smart and make everyone's home into a smart home and everyone's factory into a smart factory and then optimize them all so that everyone gets the most service for the least money and the least amount of* $CO_2$*."*

**EET&D**: Well, those are indeed some substantial challenges. Do you have an opinion on how all of this relates to the ongoing evolution of the Smart Grid?


**Walter**: The Smart Grid is part of the good news! It will enable better monitoring and management of the grid using a variety of technologies, including software applications that will aid in designing and operating this infrastructure. It will be able to respond in real time to changes in the network and demand patterns over the grid. There will be more self-diagnosis and self-healing in the grid, which will reduce the number of outages.

**Singh**: And the Smart Grid also brings the promise of distributed and microgeneration support, which is difficult to incorporate into our existing delivery systems, which were designed primarily for one-way power distribution. Over time, the intelligent grid will be able to support real-time pricing, with the added benefit of load management – or Demand Response, as it is now widely called. Demand Response has the potential to reduce demand and peak loads by influencing usage patterns using a dynamic pricing model.

**Walter**: And of course there are government incentives to effect change. Besides the stimulus bill, there are many other government-driven incentives for investment in new technologies to help shape the modern utility of the 21st century.

**EET&D**: Okay, we've identified the solution areas that you feel will provide substantial value to utilities as they move forward with reinvestment in infrastructure. But can you perhaps frame the nature of those solutions on a more categorical basis?

**Walter**: Sure. Our solutions encompass three essential areas of interest: engineering/design, team collaboration, and, most recently, asset lifecycle information management (ALIM). These target some of the most important areas of a utility's business. We're talking about providing intelligent 3D infrastructure design of power generation facilities and substations, efficient engineering collaboration across distributed project teams, and ALIM to greatly improve information integrity and operational efficiency while streamlining the business processes associated with sustaining infrastructure assets over their lifecycles. Bentley has the experience and holds a leadership role in these critical areas, and we continue to focus our investments around these challenges, now and into the future.

**EET&D**: Obviously, there are lots of challenges ahead as we transform the grid from what it's been for nearly a century to what it needs to be for this next one, and it's hard to say which of the myriad obstacles will prove to be the most onerous or will take the longest and cost the most to overcome. Where do you feel engineering the 21st century utility fits into the grand scheme of things?

**Walter**: We acknowledge that these challenges may or may not be at the top of the priority list for every utility today. However, we're quite certain that they will be at the forefront of many decisions in the coming years. Changes are always more difficult when the available solutions are not clearly understood. Bentley has the technology and the professional teams around the world to help decompose the larger issues into manageable, high-impact projects. We are truly aligned with the priorities of our utility clients and have been serving the needs of energy and utilities for most of our 27 years as a company. Our commitment to helping engineer or re-engineer the 21st century utility empowers utilities to move their engineering, design, and management projects forward aggressively, and confidently.

# Ideas That Are Shaping the Electric Vehicle Landscape

## From Off-peak Incentives to Buy/Lease Programs to Electro-commerce, Energy Companies are Forming the Future of Electric Transportation

By Michael Garvin, President, RENAIS LLC and Joe Sulentic, Associate Professor, University of Iowa

Americans bought more than 16 million vehicles a year before the recent recession plunged sales to a pace of fewer than 10 million. But a continued rise in oil prices could send demand for electric vehicles (EVs) climbing much faster than expected. And strategies for accelerating the introduction of EVs could drive those numbers significantly higher still. Pike Research[1] predicts that automobile dealerships in the United States will sell 650,000 electric vehicles a year by 2015. The question is, how can energy providers control the rollout of EVs in their service areas through deliberately planned policies – rather than a roll of the dice?

A growing number of utilities are making plans to do just that through incentives on charging, setting controlled public charging stations and even increasing revenues with "buy to lease" and Electro-commerce programs. Utilities are now setting incentives to encourage off-peak charging of EVs. Utilities may also be granted the ability by state utility commissions to buy large numbers of electric cars, light trucks and even local delivery trucks and service vehicles and lease them to their customers thus increasing company's revenues.

### Costs and Employing a New Metric- Miles Per Gallon CARbon Release Equivalent

The major stumbling block standing in the way of the EV revolution is the need for an easy way to explain the benefits to a buying public. The industry needs a new metric in discussing relative carbon release and operating costs. Already, there have been accusations that electric vehicles, powered by grid energy, released about as much carbon as high efficiency gas-powered cars or hybrids. Yet this claim ignores the fact that not all grid energy is generated by carbon-release sources.

*We need to carefully articulate what the capabilities and limitations are with electric transportation.- Utilities want to provide customers with lower cost transportation options, but those options have to be reliable and the customers have to be able to make accurate comparisons between the cost and carbon release data for both electricity and gas-powered vehicles.*

The electric car industry is already setting new terminology for energy use and carbon release. A new computer program called Miles Per Gallon -CARbon Release Equivalent (MPG/CRE) is being released in June of 2011 (sidebar). The program puts gasoline and electricity powered vehicles on a level playing field as to what their operation costs and carbon release are expected, based on actual energy generation sources.

### Turning Challenges into Control and Opportunity

Utilities often express concern that EVs placed in clusters might put too much demand on the energy delivery system. The "nightmare scenario" is described as a hot summer afternoon when a cluster of EV owners coming home for a few critical hours each day to their neighborhood, turn on their air conditioners, microwaves, plasma screen TVs, and plugging in their electric cars all at the same time.
*"We're talking about doubling the load of a conventional home," says Karl Rabago, who leads Austin Energy's EV-readiness program."*

"It's big. The electric transportation opportunity is a classic 'systems' issue, involving traditional utility concerns of reliability, safety, security, and fair allocation of infrastructure costs. It also requires developing a clear view on new services, customer preferences and product development synergies."
*"That's our part; from the customer's side it's as simple as plugging your car into a wall!" says Rabago.*

Yet a number of ideas are emerging that allows the energy provider to control the impact of EV introduction in their service area. Dominion Energy in Northern Virginia has proposed a special rate for EV charging that would translate into fuel costs of less than a penny a mile as compared to nearly 15 cents per mile for cars operating on $4 per gallon gasoline.

*"Based on sales of hybrid cars, we believe many of our customers will purchase EVs and they will recharge them at home. We need to be ready," said Kenneth D. Barker, vice president of Customer Solutions and Energy Efficiency. Dominion supports federal initiatives to lessen our nation's use of petroleum and Governor Bob McDonnell's energy plan to improve the energy efficiency of vehicles in the state and utilization of alternate fuels.*

*"Electric vehicles have the potential to affect the company's infrastructure at all levels – transmission, distribution and generation. This pilot program enables the company to gauge potential impacts from electric vehicles. The pilot offers customers rate options structured with pricing levels to encourage charging outside of the peak demand periods of the day," Barker says.*

[1] Pike Research is a market research and analysis firm and CleanTech forecaster based in Boulder, Colorado

## Utilities joining Forces with Electric Vehicle Dealerships- Electric Vehicle as a Leasable Asset

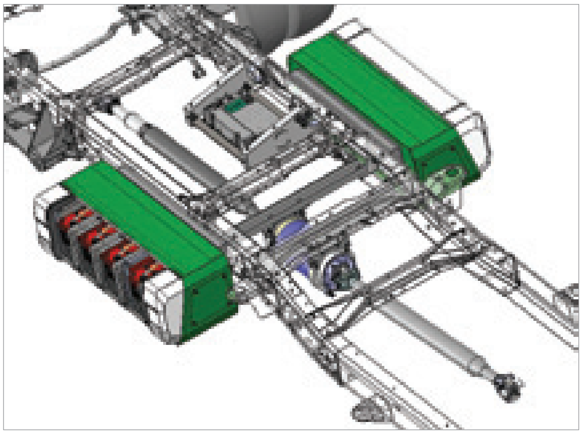
Utilities are now developing ways to provide their customers what they want, controlling EV rollout and company increasing revenues. Electric car companies, led by the advertising budgets of Nissan and General Motors, are announcing the release of the new electric car revolution. Investor-owned utilities are always looking for ways to control their own destiny and generate new revenues by bringing new, high demand services to their electricity customers within the restrictions of the state utility board. It is usually a tricky balance.

With the economy still sluggish, there are few places in a family budget that are available for utilities to tap for more revenues. Yet the introduction of EVs that have fairly impressive range, 100 to 200 miles on a single charge, will provide opportunities to generate far more revenues for utilities than just the fees for using off-peak electricity for charging. Utilities will have the opportunity to gain access to the already set family budget items allocated for transportation, the monthly car payment, gasoline and service. That can add up to as much as $500 per customer per month but the real opportunity is when all revenues sources are calculated.

The Electric Vehicle As Asset (EVAA) Revenue Generation Tool was commissioned from faculty and graduate students from the University of Iowa Tippie College of Business (see sidebar). The EVAA Revenue Generation Tool was designed to assess gross revenue and profitability for a variety of purposes including an EV "bulk buy and lease" program.

The variables involved in the creation of the model include expansion of asset load as it relates to retained earnings if EVs are determined to be classified as assets, leasing fees for leasing EVs to utility customers in conjunction with a local automobile dealership, depreciation on equipment, carbon credits and green tags, increase in electricity usage and service fees on the equipment in conjunction with local automobile dealership.

This model would apply for regular cars but also for the retrofit hybrid conversion kits for class 3-8 service trucks and buses. This new technology runs as low as $25,000 per conversion for service vehicles to reduce fuel consumption by 70%.



New technologies to quickly and cost effectively retrofit a Class 3-8 service truck or bus are coming into the market. This conversion takes just 8 hours and can reduce diesel fuel consumption by as much as 50%.

## Running the Number for the EVAA Model

Taking an example of the purchase of a single electric car which sells for $40,000, the *EVAA Revenue Generation Tool** is able to calculate the following annual revenue sources and return on the utility investment:

### EVAA Revenue Generation Tool

| | |
|---|---|
| Federal subsidy ..... | $7,500 taken off the price of the vehicle |
| State subsidies may be factored in ..... | $0-10,000 |
| Percentage of retained earnings on asset load expansion ..... | $4,810 @ 12.7% asset-based retained earnings level |
| Leasing Fees ..... | $2,250 (@7.5%) |
| Carbon credits or green tags sales ..... | $1,000 at market value |
| Depreciation ..... | $2,000 at a 5 year schedule |
| Service contract revenue sharing with automobile dealership ..... | $500 |
| Increased electricity usage for charging vehicule ..... | $500 |

*These figures are all estimates, but taking into consideration the state and federal subsidies and backing those funds out of the equation, the EVAA Revenue Generation Tool calculates that a utility can generate roughly $13,000 - $20,000+ of additional revenue on a net investment of $40,000. Modeling indicates that the return on investment would range from 33.5% to 50%.

There are automobile retailers networks that are preparing to reach out to utility companies around a buy and lease program for their long range, highway capable car and light truck and service vehicle conversion lines. Gabus Automotive Group (Des Moines, Iowa) is planning to set up 100 electric car/truck dealerships by the end of 2011. Many of these dealerships will be offering fleet sales of the electric cars and trucks to customers through utility companies.

*"We sell over one half of a billion dollars of vehicles every year and we use a lot of electricity as well so we know a little about both industries." says Gene Gabus, President of Gabus Automotive Group. Our network of dealerships are excited about supporting utilities as they look to provide their customers with a cost effective way to drive a new electric car and save around $150 per month over a gas-powered vehicle. Basically the saving pays for most of the lease payment. All this, plus the utility realizes a solid return on its investment, making this a real win-win situation."*

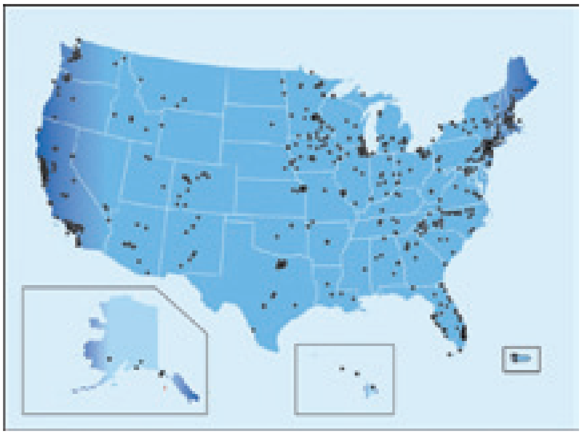
Some smaller auto-makers, such as Envision Motor Company, are rapidly bringing all-electric vehicles to market by simply converting proven platforms. (Pictured: Envision Motor Company vehicles with American-manufactured electric motor and robust battery delivering 150-200 miles per charge.)

A legal advisor for a Midwest utility board pointed out that the two questions to be answered are is the EVAA program beneficial for the rate payer who buys the EV and is the EVAA program beneficial for all rate payers associated with that regulated utility. The answer was provided by the Consumers Advocate Office in that same state – a solid "yes" to both questions. The customer leasing the EV gets as much as $2,000 less cost in transportation each year. The utility is able to realize solid returns for its investment and an ability to shift demand in a positive direction. The ratepayers who did not buy an EV should realize more stable rates as the utility received income from other sources than electricity rates.

## Utilities Can Control the Rollout of Automobile and Service Vehicles in Their Service Areas

As the new reliable highway-capable EVs and Class 3-7 local service trucks/buses begin to appear on the market, investor-owned utilities are likely to become a major driving force in their introduction. The *EVAA Revenue Generation Assessment Tool* simply assists in setting the roadmap for the introduction. Utilities can better estimate their returns on investment and control where the vehicles are charged and when as they promote electric cars and trucks. The opportunities look very promising. The industry is already setting demonstration projects using the state of the art EVs and service truck conversions.

Roger Christianson, from the Omaha Public Power District, thinks that non-profit driven energy companies can also benefit from the EVAA program. "We need to influence our customers to help us shift the energy demand more evenly from peak to off-peak times of the day. The EVAA program gives the customer a huge financial benefit so that it probably would not be a big inconvenience if we put in as a condition of the lease the requirement that we be able to remotely turn on and off his EV charging station. We can do that remotely and that could, as the EV numbers grow, help us control the peak, off-peak balance of energy supply."

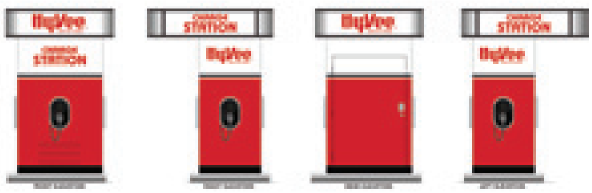


Over a thousand U.S. communities have signed the Council of Mayors Agreement for Climate Change. Utilities can help these cities meet their goal for reducing carbon release by 30% within 30 years.

## Electro-commerce and Utility-controlled Public Charging Stations

The establishment of utility-controlled public charging stations, such as the network being developed in Austin, can have a much greater commerce potential than just realizing revenues from electricity sales. Spending money takes time. Mall owners can tell how much a buyer will spend if that buyer spends a certain amount of time in the mall. Businesses will want that buyer to spend time in their establishment while their EV is being charged.

Many businesses will want a charging station on-site and pay for the vehicle charge just to get the customer in the door. Motels, hotels, cinemas, restaurants, hair salons, grocery stores and almost any business that has something to sell will want the electric car owner to come and get a free or reduced rate charge. Electro-commerce will be a strong consideration of where the charging stations are located.



Utilities may soon work with local businesses and Google to help EV owners decide what route to drive and what purchases will be made along that route. (Rendering courtesy of Heritage Industries.)

Discussions are underway to have the charging station serve as information centers and Electro-commerce navigation stations. With MapQuest, Google and Garmin already setting the stage, Intelligent Charging Stations could be asked to plot a "trip map" that includes stopping by the dry cleaners, buying some groceries, picking up the kids at school and ordering Chinese take-out for supper.

With cities already supplying charging station locations to the Internet map companies, hotels, motels, cinemas and restaurants will be able to communicate with the charging station and with the consenting EV owner. All of these communications have revenue potential back to the utility that owns that charging station through Electro-commerce programs.

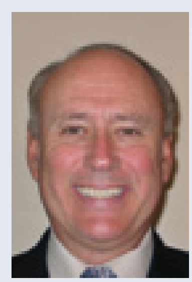
## Conclusion

*"Electric vehicles are making consumers think in a new way – about the economic, environmental, and lifestyle impacts of gasoline versus electric fuel – and utilities and automakers share the education responsibilities of our shared customer," says Steve Powell, the Manager for the Southern California Edison's Program for Plug-in Vehicle Readiness.*

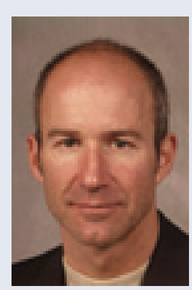
*"In addition to customer outreach, utilities have an important role to play, starting by making sure that we can provide smooth customer service and our grids can accommodate these new vehicles. At this nascent stage, Southern California Edison is also offering time-of-use rates that help customers manage the cost of fueling and encourage off-peak charging."*

Electric vehicles are most certainly going to play a role in the transportation scenario for the future. Electric utilities can shape that future with innovative strategies that integrate these vehicles into their energy supply network. The utility can have much greater control of the electric vehicle roll-out by exploring and implementing such innovative programs as charging time and location incentives, *Electric Vehicle as Asset* program involving local auto dealerships can establish Electro-commerce programs with local and regional businesses. Utilities are already deciding that they want to shape the electric vehicle landscape instead of responding to an uncertain future. ■

## ABOUT THE AUTHORS



**Michael Garvin** is a former Technology Transfer Specialist for the University of Iowa, where he designed entrepreneurial studies courses and has developed seven start-up companies in the states of Iowa, Wisconsin and Texas. Garvin founded his current company, RENAIS (Renewable Energy Network for Aggregating and Integrating Services, LLC), in 2009 to set economic models that allow electric and plug-in hybrid vehicles to become viable commodities in the mainstream automotive market. He is one of the founding members of the Iowa Northern Energy Corridor (INEC), which pairs the most advanced non-oil energy production technologies in the context of a major short-haul railroad corridor stretching from Cedar Rapids, through Waterloo to Manly, Iowa. Garvin earned his BA from Benedictine College (Atchison, KS) and graduated with a MHA (Master of Hospital Administration) from St. Louis (MO) University in 1973. Before becoming an Iowa State University Project Director in 2008, Garvin served as a Program Development Specialist at the University of Texas-Houston (2002-2004) and at Texas A & M University (2003-2008).



**Joe Sulentic** has taught at the University of Iowa's John Pappajohn Entrepreneurial Center since 1998 and started his first business while an undergraduate at UCLA. A USASBE nominee for Entrepreneurial Instructor of the Year in 2005, Sulentic's approach to instruction includes real world sales activities to give students pragmatic lessons as would-be entrepreneurs. After receiving his undergraduate degree in economics, he spent two years in Italy as a Formula 3 racecar driver in Italy. Later, while completing his MBA, Sulentic worked for the USF&G Arrows Formula 1 racing team. He is currently working with Porsche Engineering of Weissach, Germany on the next generation of small-scale wind turbines for residential and commercial use. Sulentic holds a Bachelor of Arts in Economics (1984) from the University of California-Los Angeles and earned his Master of Business Administration degree from the University of Iowa (1987).

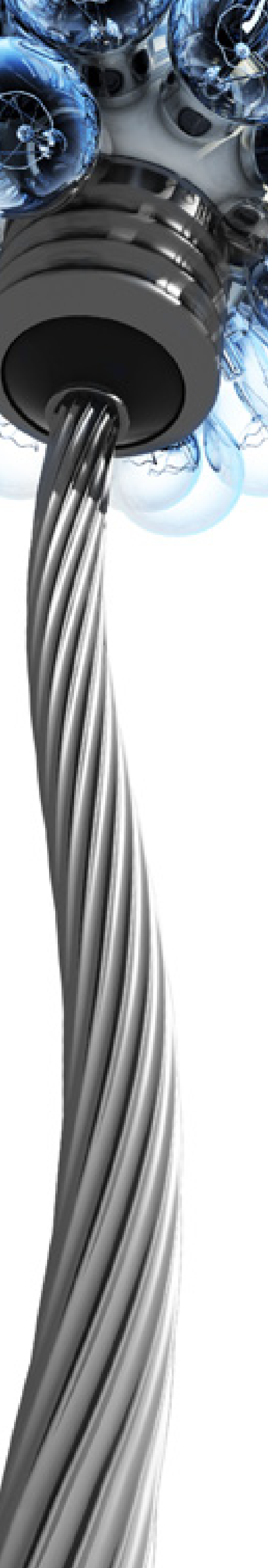
### The MPG-CRE Metric: Evening the Playing Field with Gasoline

The war of words has been ongoing for some time between those who support electric transportation and those who think that the answer is making more efficient gasoline-powered vehicles. True, it is a matter of carbon release, but mostly it is a matter of operating expense. Supporters of oil-based transportation have already put forth the notion that electric vehicles can release as much carbon as a gasoline-powered one. They cite the fact that the electricity that is used to power that car comes from power plants that release carbon into the environment, so people who are thinking of buying an EV for the purpose of having their vehicle release less carbon in the environment are misguided.

A new computer program – planned for release in June of 2011 – will strive to put the electricity/gas carbon and expense discussion on an even playing field. The program will track miles traveled as well as how much electricity was used, the cost of that electricity, and even where the energy was generated. The opening discussion from the oil industry assumed that all electricity is produced from coal-fired power plants, which, of course, is not the case. In reality, nearly every utility has a growing component of renewable energy available in the mix that they offer customers.

The *Miles Per Gallon-CARbon Release Equivalent (MPG-CRE)* will be able to calculate the relative statistic for a given electric car in relation to the amount of carbon released by that car travelling a certain number of miles. It will translate the statistic to a metric that is well known in the gasoline-power vehicle industry: miles per gallon (mpg). Thus, a conventional gasoline car could be rated at 35 miles per hour; a hybrid could be rated at 50 miles per hour; and an all-electric vehicle might be rated at 125 miles "per hour-CARbon Release Equivalent". However, for an EV that is powered by an energy supply that has a wind or solar panel offset program, that car could experience up to a 270 MPG-CRE.

This new metric can provide an indication of the relative release of carbon and can also track the relative operating expenses. For example, Dominion Energy is requesting a new rate for off-peak electric vehicle charging that could see the energy costs of transportation settle in at around 0.7 cents per miles as compared to nearly 15 cents per miles with $4 per gallon gasoline. Electric car service departments want to use the program to track performance and indicators of how the vehicles are performing so that maintenance appointments can be set based on the data, reported via the Internet.



# LightsOn

## Energy Efficiency: The Most Sensible Way to Go Green

By C. Brandon Fletcher, CFA;
Co-Founder & CEO
Green Analytics, Inc.
Bentonville, Arkansas

As politicians, companies, and citizens are pushing for a "greener" environment, meaning one that is environmentally sustainable and emits fewer greenhouse gases, numerous studies have been conducted to determine the best way to go "green." Should we have solar panels, geothermal energy, windmills, or energy efficiency? This is the question that all members of society are faced with from power providers; the CEOs, CFOs, and corporate sustainability officers in the corporate world; and individuals.

### Current Economy and Benefits to going Green

One cannot object to the fact that the current economy is proving to be a difficult time for manufactures to weigh the costs of going green and waiting for the long-term return on investment. This leads to a number of executives "doing business as usual" and waiting to go "green." However, the company is still acquiring higher utility costs and emitting more greenhouse gases including carbon dioxide ($CO_2$) emissions. The transition to going "green" should be financially harmless and profit maximizing for the company. In a perfect economy, everyone would be willing to renovate using more energy efficient measures or renewable energy.

There are many benefits to being environmentally sustainable. First, the company is emitting less greenhouse gases and $CO_2$. Second, with the reduction in emissions there is less harm to the environment. Third, as the company is emitting less greenhouse gases, it is also decreasing its energy usage, which in turn reduces its electric power costs. And last, but also increasingly important, the company is benefiting by being recognized as an environmentally conscious business entity.

### Energy Efficiency Versus Renewable Energy Sources

Renewable energy sources include solar, wind, hydrogen, biomass, water, and geothermal. All of these reduce carbon emissions but have an expensive cost and a long-term return on investment, averaging 10 years or more. Granted, the renewable energy sector is making progress in combating greenhouse gases; however, it is at a slow pace and meanwhile, people around the world are using products that are emitting more poisonous gases into the atmosphere. It turns into a vicious cycle where the gases become the winner and the earth and society are on the losing side.

## A Perfect Solution?

On the other hand, energy efficiency could be the perfect solution in reducing emissions and a way for the United States and other countries to become compliant with the Kyoto Protocol. Energy efficiency is often dismissed as a solution that is still adding to the current greenhouse gas emissions and not a viable solution when compared to solar, wind, and other renewable energies. Non-profit organizations, such as the Carbon War Room, and Energy Efficiency Standards, a division of the Lawrence Berkeley National Laboratory, have illustrated the large reduction potential of energy use – as much as 50% in the building sector alone – with energy efficiency measures. With this large reduction potential, the return on investment is much shorter, averaging just three to four years. Moreover, this solution offers a path toward solving our environmental emissions problems and thus, helping to combat climate change.

Several attractive incentives that are necessary for these initiatives to be successful include:

- Rapid return on investment (ROI) for implementing energy efficiency measures
- Zero up-front cost to install renovations and retrofits
- Tangible monetary savings for the company
- Measurable energy savings
- Improved work environment (e.g., better lighting, cleaner air, etc.)
- Material reductions in greenhouse gases

While some might think that this solution sounds almost too easy, the fact is that it already exists, Indeed, energy efficiency improvements can often be financed with no up front costs and a guarantee to pay back the investments within three years with a guarantee of having at least a 30 percent reduction in energy usage. Thus, the financial constraints and other impediments that generally cause business owners and managers to balk when looking at becoming more energy efficient and implementing environmentally sustainable improvements are essentially eliminated.

With zero out-of-pocket expenses for the client, the client must still have faith in the financial strength and stability of the project's financing partner. Asking a building owner or manager with limited knowledge about the engineering and science behind energy efficiency to buy on blind faith is a poor business model and one that rarely (if ever) succeeds. Instead, Green Analytics makes sure that its financial partners understand the engineering and science behind each energy efficiency measure and works with several national leasing and financing companies (or the client's own bank) to finance these projects.

## Case Studies with Manufacturing Companies

The majority of energy usage for buildings comes from cooling it. But there are substantial advantages to taking a wider approach to energy conservation than just the common appliance and lighting renovations. For example, viewing a data center with thermal imaging, one can see that there are heat pockets through the ceiling and cool pockets of air coming from the floor. Using thermal imaging, you can literally see the money seeping out through the ceiling. Anyone can understand that. One way to correct this problem is by using with Air Movers, an air circulation system that works alongside the current HVAC system to achieve a stable temperature at all heights and areas in a room, which corrects the airflow patterns and reduces energy consumption by 25-50 percent (dependent upon the nature of the facility).

RDS Manufacturing in Broken Arrow, Oklahoma utilized Green Analytics' services and saw an immediate reduction in its energy usage, which then yielded immense savings in energy costs. The project included a renovation of the lighting system and the installation of Air Movers. The savings for the energy efficiency lighting alone is 38 percent, and the entire project will be paid back in a little over two years.

Midwest Tool, Inc. located in Joplin, Missouri also completed a portion of their energy efficiency client specific solution with Green Analytics. Currently, they have installed a lighting renovation, the Air Mover system, and IceCold – a HVAC catalyst for improving heat transfer. With this portion of the solution, Midwest Tool is saving 25 percent of their energy costs amounting to $11,500 annually. In addition, Midwest Tool is looking to install a power factor correction system allowing all of its manufacturing equipment to run more efficiently. The savings for the power factor correction system is 10 percent; therefore, the total energy savings for Midwest Tool is 35 percent.

## Energy Efficiency and the Power Sector

Efficiency of power generation is widely varied ranging for example in a traditional coal plant at 25 percent to an integrated combined cycle (IGCC) at levels greater than 60 percent. However, even with the IGCC generator there is still a large amount of energy that is being lost in the energy generation process. Seeing this loss, there is a necessity to find a better method to achieving greater efficiency.

As transmission constraints and congestion are plaguing the current power sector, there is a high need to implement better practice. Consumers are continually demanding more energy than the power supplier can handle at any given time which is causing the congestion among the grid. In today's market, the high rates of congestion yield higher energy prices.

According to William Hogan, a Harvard University Professor of Global Energy Policy, "Transmission congestion costs can easily exceed generation costs at the margin." Furthermore, there is not a set manner in which to account for allocating the higher prices, whether it is a zonal pricing system or a nodal pricing system. The power industry must find a solution because consumers are becoming agitated with the rate hikes in one location but not another due to the amount of congestion.

## Power Industry Energy Efficiency Solutions

There are a variety of solutions that the power industry can take in order to achieve better energy efficiency. First, the industry can utilize Flexible AC Transmission Systems (FACTs), which can increase transmission capacity on average from 20-40 percent. "Smart " technology can be used in the grid sector and load management; for example smart metering. Also, the supplier can create voltage optimization by replacing equipment on schedule and by reactive power compensation. Lastly, energy storage devices and enhanced methods for distributing generation – including micro-grids, underground distribution lines, and ground wire loss reduction techniques – will increase efficiency.

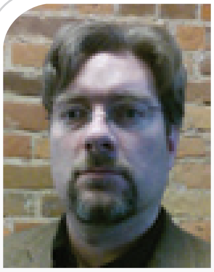
## A Better Environment for All

The environment is the tying connection between the power supplier industry and the consumer. As the United States Department of Energy and the United States Environmental Protection Agency define the standards for both sectors on energy efficiency requirements, each sector must do their part so that every member of society will live in a sustainable environment. Every party will benefit from being energy efficient.

The power supplier will see greater efficiency in the amount of coal, fossil fuel, or other renewable energy source that it uses. This leads to a reduction of lost energy, and specifically in coal and other fossil fuels, there are less greenhouse gasses and $CO_2$ emissions polluting the air. Also, there are fewer non-renewable sources being used. Therefore creating a more sustainable environment for society; however, this is only one piece of the energy efficiency jigsaw puzzle.

Energy consumers are the second vital piece to solving the sustainable environment puzzle. By completing energy efficiency renovations through lighting, appliances, HVAC systems, et cetera, not only is the consumer saving money by the reduction in energy usage but he is also emitting less greenhouse gases into the atmosphere. For instance, if a consumer uses Green Analytics' client specific solution with an energy reduction of 30 percent, and knowing that 39 percent of total U.S. $CO_2$ emissions are from residential and commercial buildings, then Green Analytics' solution in all of these buildings can save 11.7 percent of all U.S. $CO_2$ emissions. With this high $CO_2$ reduction, the U.S. would have achieved compliance with the Kyoto Protocol. Each and every individual can make a difference, which leads to individuals collectively taking a serious stand at combating climate change.

So what exactly happens when both the power supplier and the consumer work together and make a valid stand at combating climate change and creating a "greener," more sustainable environment? Worldwide, we, as a society, will begin to see a dramatic reduction in greenhouse gas emissions across the board. If the United States takes an active position and becomes one of the leading countries to make energy efficiency a top priority, other countries including China, the second highest emitter of $CO_2$ behind the United States, the European Union, and other countries will begin to follow suit and see that energy efficiency is an active manner at combating $CO_2$ and other greenhouse gas emissions.



**Brandon Fletcher** has directed multiple hundred million dollar return projects for large retailers including Wal-Mart, where he served as the head of US Strategy reporting to the CMO for Wal-Mart-US, and has managed projects in health care, pricing, logistics, and sustainability. Brandon worked on the officer team of A.T. Kearney in Eastern Europe and developed merchant strategies in multiple countries. He returned home in 2009 to form Green Analytics, LLC. Brandon holds an MBA from the University of Chicago and a BA in Political Science and Economics from Northwestern University.

# Smart Grids Need Smart Design

## How utilities benefit from model-based design

By Alan Saunders, Senior Industry Manager – Utilities
Autodesk Inc.

Many utilities are in the midst of planning and deploying smart grid programs and related technologies. In principle, the Smart Grid is a simple upgrade of 20th century power grids, which generally "broadcast" power from a few central power generators to a large number of users. The new grid will be capable of routing power in more optimal ways to respond to a very wide range of conditions, such as intermittent wind or solar generation or concentrations of plug-in electric vehicles. These Smart Grid programs will enable fundamental changes in the efficiency of electric transmission and distribution operations. They will also allow consumers to control their demand and usage patterns from a price-signal enabled smart phone rather than a manual on/off switch.

## The Smart Grid

Expectations of the Smart Grid vary by region and utility, but a few common capabilities include outage prediction and response or self-healing grids; improved reliability and power quality; improved asset utilization, operations and maintenance; accommodation of distributed and renewable generation; and increased demand response.

At the same time – and as more and more utilities initiate smart grid programs – the range of projects that fit under the Smart Grid umbrella continues to grow. Advanced metering infrastructure, substation automation, superconductive transmission lines, new communications networks to manage device interoperability, and integration of renewable energy sources are just a few examples of the types of technologies being deployed. Not only do these projects require detailed planning and design work, they need to be designed to the utility's standards and incorporated into the utility's records management system to form the basis of the network model that will drive smart operations.

The numbers associated with some of these projects are staggering. For example, in order to deliver solar and wind generation to market, one estimate calls for 19,000 new miles of transmission lines to be built in North America. Another example is substations in North America. As many as a third of them are near the end of their useful lives and due for major upgrades. Projects of this scope involve multiple firms – the utility, their engineering and construction contractors, data collection vendors, and various equipment suppliers. The complexity of this work and the need to coordinate closely with local and regional constituents is driving many utilities to take a closer look at their planning and design processes and technologies.

Image courtesy of Üz Lülsfeld, Germany

## Smart Planning and Design

While the impact that these new Smart Grid programs will have on operations, customer engagement, billing, and demand response have all been well debated, less has been documented about how they will affect the process that utilities and engineering firms must undergo to design the new network.

## Building Information Modeling

These basic utility design challenges are similar to those faced in the building and transportation industries, where Building Information Modeling (BIM) is being widely adopted as a process to create smarter designs and make better, more informed decisions. With BIM, changes to one component are reflected in the model and inform the design of other components. This integrated process vastly improves project understanding and enables engineers to validate design ideas very early in the design process – long before construction begins – and achieve more predictable outcomes. With BIM processes in place, all project team members can stay coordinated, improving accuracy, reducing waste, and making informed decisions earlier in the process – helping to ensure a project's success.

"Using information in a model-based geospatial context has become an essential element for performing work at electrical utilities," says Marshall Hibnes, GIS Manager in the Asset Management Division, Seattle City Light. "It provides an intuitive framework for understanding complex engineering tasks and leveraging the tremendous amount of data becoming available through modern, enterprise technologies such as smart grid. Utilities have an opportunity to work more efficiently integrating GIS, engineering design, system analysis and asset management - resulting in higher quality service to customers."

Distributed generation

For every transmission and distribution project, utilities must adhere to rigorous design and engineering standards. Many have pre-defined workflows and business processes in place that help ensure quality and accuracy, as well as cost controls. Smart Grid projects, with their greater emphasis on planning and delivering initiatives and projects faster and more economically, also often include ambitious new environmental mandates and call for more sustainable design.

In this context, a new set of questions faces utilities as they review their design processes and standards. What if designs could be validated sooner in order to have less impact on the actual construction? What if coordinated and consistent information could improve planning and assessing innovative and sustainable alternatives? What if it were possible to visualize and simulate real-world infrastructure and performance versus cost? What if more design alternatives could help to improve the accuracy and sustainability of the designs?

The process continues when the design goes to construction. For the utility owner-operator, it is important that the model-based design process also informs planning, maintenance and operations decisions across the lifecycle of assets. Once the new systems are in place, utilities must manage the as-built information in a system of record that has the following ideal characteristics: it is spatially enabled; is kept in a database environment; and is linked with other operational systems. Such a system of record helps to form the basis of the network model that lists each asset's attributes, location, design documentation, maintenance history, connectivity and topology—all of which utilities can use to drive smarter operations.

## A Day in the Life

To accommodate distributed renewable energy generation, smart buildings, smart appliances, and plug-in electric vehicles, utilities will need to be keenly aware of how they design their networks, analyzing multiple "what if" scenarios before selecting the appropriate transformers, breakers, and other grid devices for a circuit. For example, consider a street on which half of the residents will purchase plug-in electric vehicles within five years or a new commercial building that will include rooftop solar on a feed-in tariff. The best way to optimize design decisions in scenarios like these – involving tremendous amounts of dynamic information – is to employ a model-based design process. And, the best way to understand how these changes impact the design and management workflow is to examine a typical utility planning and design process.

## Planning

The process begins with a request for new service or internal planning that requires upgrades to the network. In the case of a smart grid upgrade project, the process may start with a service order generated by the smart grid project manager. In either case, the planner brings together relevant data to create a project base-map. Data might include the existing utility network model from GIS or circuit mapping records; land base and parcel information from a local agency's GIS; survey and LiDAR data; and aerial photography imagery to provide real-world context.

With this integrated information in a model, the planner can make critical decisions, such as the optimal route or corridor, impact on local stakeholders, and right of way information. Building and sharing compelling visualization based on this model allows designers and developers to not only accelerate the public acceptance of a project, but also allows the planner to incorporate changes much more quickly.

## Design

Once the project planning is complete, more detailed design starts with a designer creating a layout of the network, calculating material estimates, and creating construction work orders and bills of material. In order to engineer the project, the designer relies on the base-map information as well as the utility's design standards to size network elements – transformers, cables, poles and towers. Typically this process involves estimates or default values for commercial, industrial, and residential loads. These default estimates are based on building type and square footage, climate information, and the designer's own experience. Often, a designer chooses one size larger than needed to cover any variances in estimates.

With model-based design, the designer can add greater value since the commercial office park, residential subdivision, or industrial facility most likely is no longer just a 'load'. Instead, this location is likely to be a very dynamic grid participant, with renewable generation (e.g., rooftop solar), a building energy model created with BIM, and managed appliances and devices (e.g., plug-in electric vehicles) within the facility.

Although much more useful, such a system is more complex than a traditional, static load-based design – and also much more challenging to create. To complete the new dynamic model, the designers need to factor in many additional data sources before making final design and sizing decisions. Engineers developing the design standards for the utility need to consider questions like these:

- What are the demographics of the neighborhood? (e.g., are the residents likely to be early adopters of plug in electric vehicles?)
- What is the existing and planned distributed generation in the neighborhood or office park?
- What does weather and other geographical data tell me about seasonal peaks, protection and environmental conditions?
- What does the building load model tell me about expected peak and coincident loads?
- What are the corresponding telecommunication requirements?
- What are the transmission interconnection impacts on protection schemes and substation design?
- Will the utility have direct control over any appliances or equipment in the facility?

According to Paul Joseph, IT & Business Integration Manager for TDBU/Non-Energy, at Southern California Edison… "The designers will need to design to these new standards. The key is having the ability to configure these evolving standards within the design tools being used so that the data collected and the results produced are both standardized. Model based standards allow engineers to quickly assess evolving field conditions, environmental impacts, and regulatory mandates and modify standards that can be immediately analyzed, approved and implemented."

Once detailed information is available and aggregated, the designer can make much more informed layout and sizing decisions. With model-based design, the designer can quickly compare alternative designs and adjust results as new data comes in, without having to redraft or start from scratch. These more informed decisions help the utility optimize materials and devices on the grid, creating a truly "smart" grid and more sustainable design practices.

## Managing more assets means more complexity

Smart grids also introduce more complexity to the utility's network model. There are more devices to track – ranging from smart meters and communications networks to sensors and switches, and even appliances and other devices beyond the meter. Each has attributes originally created in the design process. Some need to be considered part of asset management (e.g., accounting for network assets, depreciation, reporting, etc.); all have associated location and connectivity attributes. Accurate and complete engineering information becomes an increasingly important part of the model for operations and future planning.


A more complex grid

Once new facilities are in service, there are often significant backlogs in making network data available to operational systems. Before the updated data reaches the outage management or the distribution management system, operators may be working from older data, potentially compromising quality and safety.

A model-based design process provides a more complete network model, helping the utility maintain the integrity and currency of this engineering data. Better data makes better information possible because precision design does not get discarded once the project is complete. By integrating design models into utility workflows and systems as they are created, operators can work from more accurate and current as-built data and can manage information about the planned project along with their existing records. With integrated model-based design, utilities are able to reduce and, in some instances, eliminate the backlog between the asset being operational and fully in sync with GIS, engineering, inventory, and operations.

Reducing backlogs is important to the utility in any case, but with Smart Grid programs, it is even more important.

According to SCE's Paul Joseph, "The need for data to be available to multiple business disciplines simultaneously – public affairs, planning, engineering, grid operators – makes modeling and data restriction based on role paramount."

## Summary

Smart Grid programs are transforming the way utilities are looking at operations. They are also beginning to drive changes in business processes covering the planning, design, and management of the grid. Model-based design provides the context for utilities to make significant process improvements and deliver a smarter, more sustainable grid. ■

## ABOUT THE AUTHOR

**Alan Saunders** is the industry manager for the Autodesk utilities vertical. He is responsible for Autodesk's global utility product direction, alliances, and business development. Alan has over 25 years experience in the international energy and utilities business leading successful initiatives in distribution design and planning, network operations, customer service, energy trading and marketing, business development, and solution strategy and delivery.

# Connectivity: Key to the Smart Grid

By Leo McCloskey, Vice President
Airbiquity

It is an exciting and unprecedented time for the energy and utilities industry. The rapid adoption of new technologies, particularly communications-based technologies, has provided a platform for the industry to meet multiple demands ranging from energy efficiency to improved reliability. Whether we are talking about the adoption of wireless technologies to read new meters or network monitoring devices, there is no dispute that connectivity is key to Smart Grid.

## The Electric Vehicles ARE Coming!

There is also no disputing the buzz around the availability of electric vehicles in the United States. According to transportation expert, Antonio Benecchi of Roland Berger, plug-in hybrids and electric vehicles will capture 10 to 20 percent of the auto market by 2030.[1] For argument's sake, assume total vehicle parc (i.e., the total number of vehicles on the world's roadways) will remain relatively static at roughly 500 million in North America and Europe. This equates to nearly 100 million vehicles whose primary or sole means of locomotion is electric power. If each vehicle averages 30kwhr capacity, we may redefine the old car expression – "that's a lot of power!"

The market is indeed stirring. Nissan delivered the first all-electric LEAF vehicles to Japanese and North American markets in late 2010 and has aggressive targets for both vehicles and markets, adding multiple European countries through 2011 and into 2012. Riding the wave of EV excitement, Ford followed suit with the announcement of its fully-electric Focus at this year's Consumer Electronics Show in January. While the Focus is set to be available to customers by the end of the year, Ford has discussed a strategy of electrifying the entire fleet of Ford vehicles.

Electric Vehicles MUST be Connected Vehicles.
(Photo Courtesy of Airbiquity)

It is worth noting that both Ford and Nissan are top brands in vehicle markets, characterized by high quality vehicles and an enthusiastic customer base. Other automotive brands have announced plans for introducing alternatively powered vehicles, primarily electrically powered. The target markets are not just consumer-centric either, with significant production plans focused on local and municipal fleets. Large fleet owners, such as Coca-Cola, FedEx and DHL, are experimenting with electric power within their vehicle mix as well. This is not just a ploy from automakers and fleet operators looking to harness a public conversation for their own publicity. Rather, these initiatives, both announced and yet to come, are central to a vision of supplying the market with vehicles that owners and drivers want. The promise of electrical power within the vehicle fleet holds great value to both consumers and business enterprises alike.

Let's face it; the days of dependably inexpensive gasoline are behind us. In 2010, roughly half of all U.S. fuel consumption came from domestic sources, and that portion is growing. Meanwhile, the price of gasoline in February and March of 2011 is rising quickly because of events in the Middle East. No matter how much petroleum is produced in the U.S., it is a global commodity where price is determined by gyrations well beyond the control of a single country's sourcing strategy – even a consumer as large as the U.S. Inexpensive fuel will find a new floor at $3.00/gal, and even that is likely to prove a rare occurrence. Electric power – even expensive electric power – is a fraction of that operating cost.

This is all well and fine, until some tens of thousands of electric vehicles in a mid-sized metropolitan market arrive back at the home, shop or warehouse and plug in to the electric grid. Or, even in a more realistic and near-term scenario, several dozen electric vehicles in a typical suburban neighborhood each plug in at 7 p.m. on a warm evening, when the grid is already struggling to carry load for the air conditioning demand.

[1] "Intelligent Electric Vehicles and Smart Grid," John Addison, Clean Fleet Report, August 20, 2009.

## EV vs. AC

Someone remarked that electric vehicles represent the single largest step function change in demand since the air conditioner. It's likely that buying an air conditioner did not require notifying the local utility that summertime demand at a specific address would increase. Maybe that's because there was sufficient headroom in the grid at that time, or because it was concurrent with infrastructure investment in the post-WWII years. Regardless, it is worth discussing both whether and how such notification should occur now. Markets tend to cluster geographically, so early adopter markets are likely to exacerbate load planning and management challenges.

Indeed, it is worth pausing to consider that this new technology product – electric vehicles – will generate new ecosystems of supplier and service companies. Unlike other new technology products, these new ecosystems will need to wrestle some very big and thorny topics that revolve around product lifecycles.

And social issues abound. For example, how are consumer hyper-personalization, geographic specificity, and privacy combined into an ecosystem that doesn't transgress legislation or market sensibilities while enabling utilities to participate in an apparently simple event like overnight charging? Or, what about a more complex event, such as rationalizing feed-in-tariffs for tapping stationary power sources in urban garages to smooth mid-afternoon peak urban summer demand?

So with this new found excitement around electric vehicles, there comes an immediate question: How do we plan for these new electric vehicles, what is their role in the "Smart Grid" – and how do we get there from here?

The urgency of understanding the impact of EVs on the grid is real. As utilities across America roll out rate programs, such as Time of Use and Dynamic Pricing, planning for the "how to control the charge-the-vehicle event" and "how to plan for FITs for stationary EVs" are just a couple of the emerging issues that will need to be resolved.

## The Electric Vehicle is Connected

Electric Vehicles MUST be Connected Vehicles. (Photo Courtesy of Airbiquity)

Electric vehicles are built with an impressive blend of technologies – integrating the best of automotive, battery and communications innovation. It is the latter – communications – that creates the opportunity to act smartly in planning for both owner/driver satisfaction and automotive/utility preparedness.

The EV is a different kind of vehicle. Until battery breakthroughs enable similar distance capability when compared with a gasoline-powered vehicle, the EV will require the driver to consider range quite differently than ever before. Not only is aggregate distance less, but traffic, weather, terrain, slope and driver behavior each factor into the vehicle range calculation. The only way to assist the driver with a range of dynamic inputs is to connect the vehicle to information stores, controlled by the automaker.

This offers the option for a range of services. Instead of just route navigation, EV drivers can reach their destination via the quickest route or through an eco-route, which uses the least amount of energy.[2] This calculation is dynamic and considers real-time and predictive traffic modeling, weather conditions and temperature.

Coincidentally, the automotive industry is already planning to use communications technology to connect vehicles across their entire manufacturing line. Electric vehicles, because of their connected requirement, are the first vehicles to be always connected. Automakers are also adapting to a constantly-informed, hyper-personalized consumer. They are building customer relationship management (CRM) capabilities into smart-device apps for phones and tablets and into self-service web portals. Similarly, owners/drivers are being empowered with tools and information that enables a highly personalized vehicle experience.

The future of the automotive industry will include a great deal of connectivity. Consumers will be able to select services and suppliers that are tailored to their unique needs and are dynamically presented within the vehicle each time and based on that specific individual. Automakers will use these platforms to create sustainable communication with the owner across the lifecycle of the vehicle, even changing for subsequent vehicle owners. Insurance companies will use the driving information to reduce actuarial risk and tailor policies to individuals in a way that not only matches risk, but that also provides financial incentives to improve driving behavior. And given the real-time connected nature, these policies can also consider GPS coordinates to ensure that fleet vehicles are within the insured geography.

Nissan LEAF interior, showcasing the vehicle's advanced ICT system.
(Photo Courtesy of Nissan)

[2] "Intelligent Electric Vehicles and Smart Grid," John Addison, Clean Fleet Report, August 20, 2009.

All of this makes the vehicle much different than the air conditioner. The vehicle is connected and location aware. Many automakers have adopted open and flexible service delivery platforms that can easily integrate service and 'infotainment' suppliers into the information ecosystem. This creates an opportunity to create an information architecture that helps the supplier, the consumer and all of the parties involved in the transaction, to meet stringent security and privacy requirements.

## New and Dynamic Ecosystems

As we know well, the energy grid is a complex and dynamic act of production, transmission and distribution – and, of course, consumption. Utilities across the country are at different stages of implementing programs for energy efficiency and time of use pricing to encourage consumers and enterprises to make informed energy consumption decisions. But adding a new product, like the electric vehicle, is not simple. Because of market clustering noted earlier, demand in neighborhoods could easily and quickly exceed distribution capabilities. Location-aware systems that enable consumers to identify their local utility and incorporate that entity into a hyper-personalized service environment would seem both sensible and practical.

Furthermore, some industry experts suggest that utilities could use EVs for "spinning reserves and peak power using vehicle-to-grid (V2G)."[3] Dr. Jasna Tomic with CALSTART estimates that the national grid would only need seven percent additional capacity to off-peak charge 100 million electric vehicles. Those same vehicles could provide 70 percent of the grid's peak power requirements. Smart grid upgrades, customer price signals and subscription agreements could enable growing use of V2G in this and other capacities during the coming decade.[4]

## Questions Remain

Many questions about EV integration still remain, of course. For example, would a request for using an individual vehicle as temporary power source be required each time? Could a consumer opt-in to a system that enables the utility to tap the source dynamically? If the consumer is not a customer of the requesting utility (think commuter), how is the transaction recorded in both power and financial systems? How is the consumer informed? Is this a regulated transaction? How is it governed? And the list goes on…

Moreover, this still does not consider a world of emissions management based on financial credits. So, under such a scenario, even more pressing questions loom. Which is the certifying agency for a transaction that uses the consumer vehicle as power source when the vehicle is from a market where electricity is largely hydro, and therefore clean, versus a market where the vehicle tapped has been powered by a dirtier energy source?

All of these scenarios require open, flexible service delivery platforms that can dynamically adjust to consumer or enterprise personalization as well as supply and distribution variations. And, they all require a collaborative approach to build an informed ecosystem.

## Forging the Path

The salient point is that, although there is sufficient evidence that electric vehicles may have a significant role in both consumption and supply, the collaboration has only just begun to evolve.

At last year's Homeland Security for Networked Industries Conference, the CTO of the Department of Transportation, Mr. Tim Schmidt, keynoted the Smart Grid Executive Conference with news of the Intellidrive program. In this speech he spoke candidly about the Department's intelligent vehicle programs and agenda, and the importance of industry collaboration.[5]

There is ample opportunity for collaboration at both the national and state level. Some state PUC - like California, Oregon and Maine - have acknowledged the relationship between electric vehicles and the Smart Grid; many others offer minimal legislation and only scant education information or guidelines have been put forward.

As we strive together to build a reliable Smart Grid, we must think of the larger ecosystem that manages the transmission and distribution of energy AND… how that is now woven into the consumer market conversation with another long-established, mature industry: Automotive. Moreover, we must start to think about the grid in terms of the way we live and the way different parts of our lives interact across industry and from the perspective of the consumer, be they household or enterprise. Whether we are adjusting a smart thermostat at home or plugging in our electric cars at the end of the workday, this integration of technologies and behavior is what will make the grid truly smart. It will be based on open and flexible communications systems, and much like many of the other technological dimensions of our lives, these too will evolve over time.

## ABOUT THE AUTHOR

**Leo McCloskey** brings nearly two decades of experience in networked-services to the company. His expertise in services and networks has been honed in North America and Europe, and he has also lived in Japan. He was most recently vice president of marketing for IntelliTax, a provider of software and services for tax professionals, and has held senior leadership positions at Nexagent, Ebone and Terabeam. While at EDS, he defined a novel method for connecting customers to the EDS global service delivery infrastructure. Mr. McCloskey holds a B.A. in Russian studies and language from Dickinson College.

[3-4] "Intelligent Electric Vehicles and Smart Grid," John Addison, Clean Fleet Report, August 20, 2009.
[5] "Homeland Security for Networked Industries Conference, September 2010, Park Hyatt Hotel, Washington, DC.

# New Options for Streamlining Field Paperwork:

## Digital Pen & Paper Technology Speeds Substation Inspections, Tracking and As-Built Updates at Burbank Water & Power

By Pietro Parravicini, President/CEO, Anoto, Inc.

Electric utilities are facing increasing pressure to provide superior quality and reliable service to their customers while also seeking higher efficiency in their work forces and processes. As a result, key trends in electric utilities best practices are improving facilities and infrastructure visibility, as well as implementing preventive maintenance programs. Improving operational visibility helps teams identify and address issues before they become service, safety, or compliance issues. As part of that operational visibility, many electric utilities are working to improve inspection and reporting processes for lines, substations, poles, and vegetation management. Immediate access to this data on conditions can improve preventive maintenance and streamline operations.

### The Electric Vehicles ARE Coming!

A recent Tennessee Valley Authority (TVA) report demonstrated how timely preventive maintenance can save millions of dollars in repairs and replacements. Over a single 6-month time period, TVA calculated savings of $4.3 million by performing preventive maintenance in a sample of 106 substations. After assembling the right team for inspections and surveys, TVA concludes that, "thorough documentation is the next key ingredient."

Many of these workflows have resisted data collection with laptops and PDAs, due to the highly mobile nature of the work, and challenge of complex equipment, training, and support. In many cases, data collected to track these processes is still written by hand on printed forms, maps, and CAD designs, which slows the process.

### The Challenge: Getting Data off Paper for Timely Analysis and Reporting

All that documentation means a lot of paperwork process; many highly mobile teams collect inspection data directly on paper forms, CAD designs, and maps. Pen and paper survives for a variety of familiar reasons:

- There is no training required – anyone can fill out forms or markup plans and maps.
- Paper can be used in any environment – indoors, outdoors, rain, or direct sunlight.
- Large format paper maps and CAD prints enable a wide field of view – important for understanding and marking up extensive maps or complex plans.

Writing notes on paper is easy, of course. The challenge is getting data off paper in a timely way, so that important information can be quickly tracked and shared. In many cases, data collected on paper creates an administrative burden.

Completed forms, marked-up maps, and CAD designs usually need to be scanned or sent back to central operations. Depending on the workflow, there is often manual data entry required back at the central office, where data is entered into the central IT system for analysis and sharing. In the case of inspection forms, data can be tracked in custom systems or even simply in Microsoft Office. In the case of maps, data on poles and lines is often stored in a GIS system. In the case of substations, marked up data often needs to be entered into computerized drawing systems as the master record of facilities and their as-built conditions.

### New Options for Utilities: Digital Pen Technology

Many utilities are exploring the use of digital pen and paper technology and software to help streamline data collection and reporting for line, pole, and substation inspections, and vegetation management. Digital pens enable mobile teams to collect data on paper as they always have, while also instantly scanning and digitizing the data, which gets stored on the pen. Such software enables utilities to print their own maps, CAD drawings, and forms and then use digital pens to automatically collect data directly into various files and file formats from CAD systems. After data is collected, it can be shared with central offices either immediately through a cell phone connection or physically, when the pen is returned to the office.

## Burbank Water and Power

Burbank Water and Power, for example, is using digital pen technology to automate data collection to keep their substation plans current and manage preventative maintenance. The utility – located just outside Los Angeles – serves 45,000 households and 6,000 businesses in Burbank, California, with power and water through an extensive network of poles, lines, substations, and water infrastructure. BWP substations undergo frequent inspections, repairs, and preventive maintenance in order to provide customers with high service levels and uptime. The frequent changes result in as-built drawings being out-of-date and as much as years of paper-based updates backlogged for CAD operators. BWP is currently working with Capturx Software for digital pens to instantly capture substation as-built mark-ups to improve infrastructure visibility, while reducing data collection and entry costs and risks from missing documentation.

## Keeping Substation Plans Current w/ Frequent Maintenance Changes

Like many utilities, BWP has skilled maintenance and service teams, which inspect critical infrastructure, perform preventive maintenance, and quickly respond to issues to keep service levels high. As teams plan and perform maintenance on substations, for example, they work with as-built drawings which reflect the original plans along with the cumulative changes. Armed with the current drawings, service teams can bring the right parts and tools and avoid surprises.

The challenge is that the plans are often out of date. With ongoing maintenance, parts and configurations frequently change. Changes are noted on the paper drawings in real time, but it can take as months, or even years, for those changes to be reflected in the master as-built drawings. Marked up paper plans can be misplaced, left on site, or left in trucks. When the markups do make it back to the office, the CAD operator adds them to the stack of marked-up drawings awaiting updates.

Such delays can be costly in time and money as well as in other ways. Out-of-date substation plans make it difficult to plan preventive maintenance and react proactively to issues. Out-of-date plans can also result in surprises onsite when teams respond to issues with equipment and staff that don't match the actual substation conditions.

## Mobile Computers: Too Cumbersome for Substation Inspections & Service

To get the as-built markups back to the CAD operators faster and reduce the risk of missing documents, the team had explored using mobile computers. Laptops and tablets did not end up being a viable alternative for a variety of reasons.

For one thing, the teams are highly mobile and work in demanding environments – industrial, outdoors, or bright sunlight. In addition to requiring extra cost for equipment, training, and support, mobile computers typically only offer a keyhole view on CAD plans. This makes it difficult to work with and mark up bigger and more complex CAD design drawings. The teams also weren't necessarily trained on CAD systems, which can be complex, so the easiest process is the current process; that is, simply redlining large paper prints with a pen.

With the new software, field workers can simply print CAD drawings of the substation plans, which are published directly out of the CAD system (in this case, AutoCAD). The designs are printed on ordinary paper and markups to specific drawings can be tracked easily with digital pens. Redlines are scanned as they are written with the digital pens, which record the ink strokes and automatically associate them with the correct files published from AutoCAD. When field teams return to the office, they simply connect the digital pens to their PCs over a USB port. The redline markups are then automatically integrated into the correct design files.

## Faster Substation Inspection Reporting and Plan Updates

Substation inspection and service teams can now digitize their markups on site as they write them on paper. The data can be instantly sent to the back office using the pen's built-in Bluetooth with cell phones or stored on the pen during the day, or even a week, for uploading into the original files through a standard PC and USB connection. With faster access to digital data, CAD operators can get files in digital formats immediately, resulting in faster updates.

## Reduced Risk with Real-Time Data Access and Better Visibility

With better and faster access to data, teams can more quickly spot issues, better plan preventive maintenance, and avoid risks from unidentified issues. Should the paper get lost or destroyed, the pen records all information. Likewise, if the pen is lost or damaged before data is downloaded, the inspector still has the original paper forms.

## Works the Way They Do

BWP was able to automate the substation inspection and as-built updating process without any complex or expensive computers, training, support, or distractions. The teams in the field simply continue the easy and reliable process of writing and redlining paper substation plans. Engineers can focus on their core tasks – inspecting, reporting, identifying, and addressing issues – without the costs, risks and delays of the paper trail.

Utilities such as Burbank Water and Power are looking to digital pen technology because it frees up time and improves access to data. Typically inspectors and technicians do the data entry, which takes time away from inspecting and analysis and simply collecting data. Software that enables data from digital pens to be automatically integrated into native Microsoft Office, ESRI ArcGIS, and PDF files can save a great deal of data entry time. Teams can focus on their core tasks – inspecting, reporting, identifying, and addressing issues.

Since data is instantly digitized and can be immediately sent to central offices from the field, teams can also speed up access to data collected in the field with digital pens. The speed can improve dealing with simple one-off issues that are noted in the field for immediate attention. On a larger scale, it can also result in more efficient maintenance scheduling. For teams managing a range of facilities, immediate visibility to facilities issues enables more efficient deployment of service personnel to address the issues.

Faster data access and eliminating data entry can reduce a range of risks from delayed issue reporting to data entry errors, leading to unaddressed problems, as described above. In many cases, utility teams face a great deal of risk simply from missing paper. Data on paper frequently never makes it back to central offices – having been left at facilities, the truck, or lost in transition from the truck to the scanner or data entry clerk. Missing paper can range from a simple inconvenience to a large liability in the case of key regulatory inspections, adherence to safety procedures, or interactions with stakeholders and private and public property owners.

## Conclusion

Many electric utilities are working with digital pen and paper technology to help streamline a range of field processes that have resisted automation with PCs in the past. In addition to the examples above for inspections and facilities tracking, many teams are also automating other paper form processes, including safety reports and time sheets. The common thread is that teams working with paper but needing digital access to either scanned paper, structured data tables, or immediate access to sketches and signatures. For many utilities like BWP, pen computing might be just the answer they've been looking for!


## ABOUT THE AUTHOR

**Pietro Parravicini** started his career in the Logistics and Transportation sector in Zurich, Switzerland in 1984. He subsequently held financial and operational management positions with Siemens, Alusuisse and ProData Treuhand, exposing him to a variety of other industries and international businesses. In 1995, he joined Siemens-Nixdorf AG as Director of Finance and Operations and became a member of the Management Group, overseeing IT solution business units within Public Sector, Telecom and Banking & Insurance.

After relocating to the U.S. in 1997, Parravicini was appointed Vice President and CFO at Siemens Nixdorf Retail & Banking Systems Inc. and Wincor Nixdorf Inc., and served as member of the board. He gained experience in corporate management, acquisitions, spin-offs and re-organizations. Parravicini holds a degree in business administration from the Swiss Business School, Zurich (Switzerland) and earned subsequent degrees in corporate financial management. He joined Anoto Inc. in April 2001.

# Beyond Earth-friendly: How renewables will impact the grid

By Alan Mantooth, IEEE Fellow

Thanks in large part to innovative technologies, environmental awareness and government incentives, renewable energy generation will contribute a significant portion of the total power consumed in the U.S. sometime in the next decade. This raises an important question: How does today's grid have to evolve to accommodate an operational scenario in which a significant percentage – from 25% to perhaps as high as 50% – of the power being pumped into it depends on how hard and where the wind is blowing and the sun is shining?

Solar panels, wind farms and other renewable energy sources can play an important role in managing power flow on the Smart Grid.

The short answer is that the grid has to become more intelligent and evolve toward a more accommodating structure. It has to be capable of managing energy flow dynamically. It has to forecast both load *and* energy availability simultaneously and deploy the resources to bring them quickly and accurately into balance. It has to move energy back and forth in the distribution system as well as in the transmission system. It will also have to add large-scale energy storage to its list of dependable resources.

The argument for renewables has always been compelling from an ecological perspective, but it has taken decades to make the economic argument and – because of the formidable logistics involved – some utilities still aren't embracing it. Utilities are onboard with many aspects of the Smart Grid concept, however, and although many challenges must be met that fact will strengthen the case for renewable energy in some interesting ways.

The same sensing, monitoring, analysis and control technologies that utilities find attractive in the Smart Grid will make it possible to handle the challenges of safely and efficiently integrating renewable generation, which is often distributed, has limited capacity, and is weather dependent.

There are three areas in which this "creative tension" between the grid and renewables can be beneficial: A stronger grid, a smarter grid, and a more efficient grid.

## Strength in diversity

Distributed generation is a term that is typically applied to power generation resources that are geographically distributed and offer modest or even small contributions to the total power supply. Distributed generation need not come from renewable sources. A diesel backup generator, for example, falls into the distributed category, but is not renewable. Large wind turbine or solar farms that generate hundreds of megawatts are renewable, but not distributed.

The nature of renewable technologies combined with the development path of renewable systems (e.g., rooftop installations), however, puts them in the distributed category. Historically, one concern facing utilities has been implementing bi-directional energy flow in the distribution (69 kV or less) system.

Although bi-directional flow is commonplace on the transmission grid – especially since deregulation made a business out of moving large chunks of power hundreds or thousands of miles – the distribution system in the U.S. is still thought of as being characterized largely by radial, one-way power flow.

What happens when distribution systems go bi-directional? A distributed grid resembles a network similar to the Internet. Power is routed in much the same way that information is routed and controlled. When done on a large scale, this requires new equipment to ensure safety, routing algorithms, distributed – even granularly distributed – monitoring equipment to collect the information, and a communications system overlay to deliver the operations data.

It all sounds impressively difficult. But the truth is that many utilities are already on that road. In order to help ensure uninterrupted power to homes, businesses and factories, many distribution feeders today are "loop-fed", which means that the customer can receive power from two different substations. It also means that utilities are already dealing successfully with some degree of bidirectional power flow in their distribution systems. Their reasons for implementing loop-fed systems are remarkably similar to the benefits that are expected to accrue from the Smart Grid: more robust and resilient systems that can resist cyber attack, route around outages caused by accidents or acts of nature, and even gracefully accommodate outages due to scheduled maintenance.

Many utilities are already becoming familiar with managing bidirectional power flow in the power distribution system at the substation level.

Viewed from this perspective, the addition of renewables tends, if anything, to strengthen the grid rather than make it more vulnerable. Distributed resources give the routing algorithms more options. It could also be argued that distributed resources make the algorithms' job a bit easier because they are local to the outage.

A staple argument against renewables has been their intermittent nature. Clearly, energy storage solutions are a reasonable answer and energy storage is likely to be an important contributor to the renewable generation solution. But even this is not an absolute requirement because the existence of renewables on the grid simply establishes the first option (or, level of redundancy) for an alternate power source. If the sun is not shining the routing algorithms can look elsewhere for backup power in the case of emergencies.

## Data + Intelligence = Knowledge

Most everyone is familiar with the observation that data is not knowledge and its corollary: Intelligence acting on data produces knowledge. Implementing the Smart Grid envisioned by most utilities will require collecting data to measure a number of parameters that basically monitor the grid's vital signs. Distributed, renewable energy resources are likely to measure a lot of the same parameters just to operate efficiently. That makes them a natural source of reliable, granular and local information. It certainly beats the alternative of installing equipment just to measure the grid's vital signs.

Another perspective is that *fuel diversity* sets off a chain of events that makes the grid intrinsically smarter. Start with the fact that utilities want to utilize the least expensive source of energy available to them. Harvested energy – as opposed to that generated with fossil fuels – is increasingly likely to gain the upper hand in the cost per kWh competition, particularly at specific times and places. It already has a clear environmental advantage, which is less and less likely to be dismissed.

It takes a bit of out-of-the-box thinking, but perhaps wind and solar should be perceived as the first source of power instead of an *alternative* source. Use it when it is available; not just because it can reduce the average cost per kWh once installed and available, but also because it mitigates the need for more power from fossil fuels, which in turn, reduces capital equipment costs.

It is not so much that renewables make for a smarter grid per se, but that including them in the power production mix forces the change in thinking for optimization of grid assets. Fuel diversity also leads to greater grid security and resilience. DoE has defined resilience as the Four R's, consisting of robustness, redundancy, resourcefulness, and rapidity. The robustness is the inherent strength of the grid; redundancy is having a system with alternate possibilities; resourcefulness is the grid's ability to mobilize alternatives; and rapidity refers to the speed of recovery. In each of the Four R's of resilience, renewables can contribute positively to an improved grid when complementary technologies are in play, such as communications and storage.

## Grid efficiency

The synergy between what the Smart Grid needs and what renewable sources offer changes the cost/benefit analysis of renewable energy dramatically. By adding a few megawatts in small increments around its grid, a utility could collect valuable information about what's happening in its distribution network.

In some cases, the information could be very granular. In a 40 MW project now underway in New Jersey, for example, Petra Solar will install 200 W solar panels on utility poles. The project will allow the utility to address its Renewable Portfolio Standard (RPS) requirements while simultaneously investing in Smart Grid technology.

Operational efficiency is not invariably associated with renewable generation. But putting 200 W solar panels on power poles and equipping them with Smart Energy Modules that include micro-inverters so that they can provide real and reactive power for power quality improvement, and communicate with Zigbee wireless technology, provides two new levels of operational efficiency.

The first is real and reactive power that can be controlled and managed through utility-based computers to optimize power efficiency and quality. The second is an ability to have sensors on the network monitoring many aspects of the health of the system (i.e., voltage, frequency, fault current, temperature, and outages), so that the system can be operated more efficiently.

Outage management is another benefit of collecting information from many points on the grid in real time. With information collected at a substation level, utilities can act quickly to stop a local problem – such as a voltage collapse or spike from a small factory – from cascading through a wider part of the system. In other instances, localized renewable energy sources can be brought online to condition power or as an alternative to firing up a 10 MW emergency generating station.

## The challenges of diversity

The value of a diverse network may be manifest in theory, but bringing the concept to reality will require hard work and innovative thinking. Some of the salient challenges involve scalability and network topology.

Planning transmission systems is likely to be driven by the location, type of generation, and routing of transmission lines instead of just the needs of the transmission system. In other words, traditional transmission planning was driven by load forecasting, but Smart Grid planning is more likely driven by generation needs. In fact, the advent of deregulation has already put the power industry on that path.

Any future transmission and distribution network with a high percentage of renewables is very likely to have more generation sources than existing networks and this will make scalability a significant factor.

Planners will have to determine (1) the network topology best suited for this new scenario and (2) the effects on system performance and reliability of having a large number of spatially distributed generation sources. It should also be noted that there is no "one-size-fits-all" network topology. What works for East Coast cities with high population density may not be appropriate for areas in western states that have very low population density. Some systems will need substantial energy storage capability while others that have a good deal of spinning reserve will need less energy storage.

Network topology will significantly impact total transmission losses, as well as the performance of the overall network when subjected to disturbances. If the network has a very large number of power sources, the range of possible power-flow configurations will be enormous.

Although all of this will make the performance and reliability problems much more challenging, it will also provide opportunities for designing networks that can outperform traditional networks while also presenting Earth-friendly solutions.

### ABOUT THE AUTHOR

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THE BIGGER PICTURE

VOL 3 NO. 2

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# U.S. Renewable Transmission and Interconnection Reform: Can't Get There from Here?

Given the current turmoil in the Middle East and Japan, commodity market volatility, and remaining concerns regarding climate change, the conversation again has returned to renewable power development to diversify the United States generation fleet and create jobs. Existing high voltage transmission lines, however, do not yet connect effectively the regions where wind, solar, and geothermal power are most abundant.

To date, efforts to incentivize and build a grid that accommodates a greater share of renewables have been slow. Renewable power developers cannot obtain financing and sign long-term contracts unless they know transmission is secured for their project, while utilities and other transmission developers will not invest in transmission unless they are assured of cost-recovery and a reasonable return. Furthermore, inefficient interconnection procedures have created a backlog of renewables projects that are unable to proceed while waiting in the transmission queue. Some states are even considering a roll back of their renewable portfolio standard ("RPS") requirements due to high compliance costs.

As described below, the effort continues to improve renewable transmission access. Indeed, with this in mind, the Federal Energy Regulatory Commission (FERC) conducted a technical conference on March 15, 2011, to consider issues related to generator lead lines and the ownership of and priority access rights to new transmission projects.

Through Order Nos. 888 and 890, the FERC addressed deficiencies in the transmission planning process and implemented open access reforms, including the adoption of a pro forma open access transmission tariff ("OATT") and planning and interconnection obligations. On June 17, 2010, FERC issued a Notice of Proposed Rulemaking ("NOPR") aimed at further improving the effectiveness of regional transmission planning and the efficiency of resulting transmission development by establishing a closer link between transmission planning and cost allocation processes.

Under the NOPR, FERC proposed a variety of reforms including a focus on regional planning, consideration of public policy (including state RPS), rights of non-incumbent utilities to construct and own facilities, and cost allocation. At the same time, FERC issued two orders – Southwest Power Pool ("SPP") "Highway/Byway" and Central Transmission v. PJM complaint – further clarifying permissible cost allocation and, in turn, the rights of non-incumbent utilities to own, operate and seek cost-of-service rates for regional expansion plan projects.

Furthermore, in terms of incentive-based rate treatments for transmission projects, the Energy Policy Act of 2005 added a new section (§ 219) to the Federal Power Act ("FPA"), directing FERC to develop incentive-based rate treatments for transmission of electric energy in interstate commerce. In response, FERC issued Order No. 679 and identified specific permissible incentives, to be approved by FERC on a case-by-case analysis, including but not limited to: (1) incentive rates of return on equity; (2) full recovery of prudently incurred construction work in progress, pre-operations costs, and costs of abandoned facilities; and (3) use of hypothetical capital structures, accelerated depreciation and accumulated deferred income taxes.

To be eligible for these incentives, facilities must either ensure reliability or reduce the cost of delivered power by reducing transmission congestion, with a presumption that this requirement is satisfied if the project has been included in a RTO's regional transmission expansion plans or if the project's host state has a formal siting process considered Section 219 requirements.Facilities also must demonstrate a nexus between the risks and challenges to develop the project and the requested incentives looking at the total package of incentives and whether the project is routine. FERC has, at times, interpreted this broadly, granting incentives to a project developed "in order to provide the infrastructure to meet state renewable energy standards" and to ensure reliable service to growing regional load.

FERC has also indicated that it is willing to consider innovative structures that spur large-scale renewable transmission investment, if the project addresses open access and affiliate issues. Indeed, FERC has issued several declaratory orders on innovative structures, most notably in regards to merchant transmission lines with negotiated rates, where an anchor tenant is selected pre-open season to demonstrate project financial viability. In the *Chinook* Order, for example, FERC established a test for approving future merchant transmission lines, under which it considers: (1) the reasonableness of rates; (2) the potential for undue discrimination and affiliate preference; and (3) regional reliability and operational efficiency requirements.

On January 21, 2010, moreover, FERC issued a Notice of Inquiry ("NOI") and comments have been received regarding barriers to the integration of variable energy resources ("VERs") into wholesale power grid. FERC recognized the existence of problems related to the inability of VERs to store and control electrical output and ramp, noting that the output from VERs is often negatively correlated to demand curve. FERC stated its objective to eliminate unnecessary barriers to transmission service and access to wholesale power markets for VERs and to increase efficiency. In the NOI, FERC sought comments on a number of issues, including data and forecasting; scheduling incentives and flexibility (such as intra-hour scheduling and balancing considerations), capacity market barriers, and curtailment issues.

In terms of interconnection queue reform, FERC has attempted to address some of the perceived shortcomings of Order No. 2003, which established standardized interconnection procedures based on a "first come, first serve" allocation. This method has increasingly led to developers holding queue positions for projects that may not be commercially viable causing interconnection request backlogs. In response, several RTOs/ISOs have instituted "queue reforms", including studying projects in "clusters" and increasing deposit and milestone requirements, to implement more efficient interconnection procedures and eliminate potentially non-viable projects.

In the SPP, for example, as a customer progresses through the queues, deposit levels increase and the milestone requirements become more detailed. Once a project progresses to the final "facility study" stage, the relevant customer provides a letter of credit for its network upgrade costs share. "Interim" interconnection service is also provided for "ready to go" project; provided that there is sufficient stability and reliability margin.

Emphasizing the critical importance of these transmission issues, on March 15, 2011, FERC held a notice of technical conference regarding lead lines and the ownership of and priority access rights to new transmission projects – independent, merchant and utility-sponsored – and new business models for developing, owning, and operating electric transmission infrastructure including project owners seeking priority access to the transmission capacity it develops. FERC received a variety of presentations, including how the economics of a proposed project are affected by the Commission's current affiliate rules and pricing structures (e.g., cost-based or negotiated rates) and the need for and appropriate application of priority access mechanisms, such as open seasons and anchor shipper/tenant arrangements, balanced with FERC's open access and affiliate rules. Panelists included representatives from transmission developers, renewable power developers, utilities and other market participants.

Panelists described the difficulties in "right-sizing" or "up-sizing" new transmission. Because independent transmission developers design projects to suit the needs of customers that are both creditworthy and willing to commit to a service agreement, the capacity on the line may not be as great as system planners would otherwise desire. Discussion included the notion that independent transmission developers must carefully size projects in order to obtain financing and do not have captive customers from which to recover the costs of excess capacity. Certain participants also remarked that "first movers" – those who conceive of and obtain customers for new transmission projects – should receive benefits associated with shouldering these unique risks, including incentives and priority rights to the transmission they sponsor.

Concerns were expressed regarding right-sizing and single-use of new lines, which may not be optimal for system planning overall or in keeping with open access principles. FERC staff questioned participants about the tension between approving priority rights for certain customers on independent transmission projects and the FERC's long-standing open access and non-discrimination requirements. Questions were raised as to whether open seasons were the appropriate method to "right size" transmission lines and avoid allocation disputes. Several participants remarked that FERC's existing rules, including open access requirements and the availability of the FPA Section 206 compliant process, are sufficient protections and thus obviate the need to add regulatory layers to govern emerging business models necessary to develop needed transmission infrastructure.

An important topic included whether FERC should allow developers to have exclusive priority rights to the generator lead line for a period of time. This issue is of particular concern for wind developers because they may phase construction of several wind farms over a period of years and connect all of the facilities to the same lead line to the grid. If a third party (i.e., a competitor) can demand access to the lead line before all of the developer's wind farms are complete, then the third party can effectively bump the developer's planned wind generation off the line if there is insufficient capacity. Again, these issues were weighed against FERC's open access polices and whether exceptions are required in certain circumstances. With this in mind, certain participants suggested that, rather than granting waivers, the FERC should consider a "slimmed down" radial line OATT or other lightened forms of regulation to accommodate tight construction and financing requirements typical of new generation development.

Participants also discussed the regulatory structure and its impact on potential partnerships between incumbent utilities and independent transmission developers to coordinate and construct transmission assets that serve both the interest of generation developers and broader regional planning needs. When utilities develop transmission, they also need alternative structures to meet different demands, including RPS requirements, and rate recovery for their outlay of capital.

FERC has issued a notice and will accept written comments until May 5, 2011, on the issues addressed in the technical conference issues. FERC may, thereafter, issue further guidance on the regulatory treatment of these transmission facilities. Although the issues are complex and interrelated, FERC and other market participants are focusing on these critical initiatives to encourage and streamline transmission infrastructure development and generator interconnection in order to meet national, regional and state requirements and goals.

## ABOUT THE AUTHOR

**Gregory K. Lawrence** is a partner in the Energy and Commodities group of the law firm Cadwalader, Wickersham & Taft LLP. Mr. Lawrence focuses his practice on regulatory proceedings, projects, negotiations, enforcement and agency litigation relating to the wholesale and retail electricity and natural gas industries. Mr. Lawrence thanks Joseph Williams, special counsel, and Dolly Donnelly, associate, with the Energy & Commodities group for their significant contribution to this article. The views expressed herein are solely those of the authors.

# Smart Grid Calling: Do You Know Where Your Outages Are Tonight?

By Charles H. (Chuck) Drinnan
President & Principal Consultant
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> Its midnight and several meters are experiencing power interruptions and have sent last gasp messages over your new Advanced Metering Infrastructure (AMI) communications network. You promised you would improve outage response times for your customers who invested in Smart Meters. So now it is midnight... do you know where your assets are – and how to repair them?

Advanced Metering Infrastructure (AMI) offers utilities new measuring devices – Smart Meters – that revolutionize outage identification and response, reduce system Customer Average Interruption Duration Index (CAIDI) and eliminate unnecessary (and expensive) truck rolls to verify outages. If you know where your facilities are located and how they are connected using an accurate network model maintained by your Geographic Information System (GIS) and are willing to integrate AMI and GIS with your Outage Management System (OMS) and Interactive Voice Response (IVR), you can reduce costs and improve customer service and become a leader in the Smart Grid revolution.

## Determining Outage Validity and Primary Outages

Utilities typically implement AMI-assisted capabilities in stages so that each stage demonstrates improvements and leads to the confidence to implement the next stage. The first stage uses AMI pinging capability to determine if power has really been interrupted. That is, when a customer calls in reporting a suspected outage, the AMI is used to ping the customer to see if the power has actually been interrupted. This eliminates expensive truck rolls to determine whether an outage has occurred.

The next stage automates this process and supports batch pinging operations. So, if a number of outages are reported, the OMS predicts the control device that has been tripped, pings all of the customers that should be affected by the outage, defines the outage as a primary outage, and dispatches the appropriate crew with the right equipment to the suspected trouble location. During normal hours, the IVR contacts the customers who are out of power and tells them the utility knows they are without power and is doing its best to restore power as soon as possible.

## Automatically Reporting Outages

The steps described above use AMI to validate outage situations. The next stage uses the Smart Meters themselves to report an outage. When a Smart Meter senses that it is losing power it sends a “last gasp” message back to the central office. This message is interpreted as a new outage in the OMS even though the customer probably hasn’t called yet. Typically the IVR tries to communicate with the customer advising the status and expected repair times. In many cases, the system may identify outages and dispatch crews to repair them before the customer even knows that power has been interrupted.

## Managing Multiple Masked Outages

The next stage uses the Smart Meter capability to sense that power has been restored. During a storm there can be – and often are – multiple outages situations affecting a given customer. Some of these outages are masked by outages further up the line. If the first outage occurs ‘down-line’ (i.e., logically near the meter), the system may be able to identify the outage as an individual outage even if subsequent outages occur up-line. This wasn’t practical when customers haphazardly reported outages and there was no real ability to pinpoint outage locations easily.

However, if an up-line outage occurs first, the down-line outage is masked from the outage system. But then, when power is restored, each Smart Meter sends a message that power has been restored. This process is used to determine if there are masked multiple outages without the crews having to inspect the entire circuit, end to end. An alternative approach yielding essentially the same result uses the pinging process (described above) to determine if the power has been restored at a specific meter.

# Smart Grid Calling: Do You Know Where Your Outages Are Tonight?

By Charles H. (Chuck) Drinnan, President & Principal Consultant eWAM Associates

GUEST EDITORIAL

## Recording and Keeping Track of Outages

Most outage systems record the initial report of an outage and then each operation required and performed to correct it. They record outage duration, equipment repair and replacement, switching operations, necessary follow up, and other activities that affect customer service. Among other things, this information is then used to compute CAIDI and other reliability indices.

## Improving the Network

Many utilities either have an electric network model or may be planning to develop one. However, these models are notoriously inaccurate at the specific meter connection level. Some utilities do not model the individual phases down to the customer level, and others don't have an explicit connection between the customer and the transformer. The costs to define a new network model or repair an existing model through a field inventory are often prohibitive. This is usually because existing map records are poor and field verification is very expensive.

If your network model needs work but has the basic connectivity, you can improve the model using AMI technology and outage events. Every time an outage event occurs a record of the affected facility and expected effect it has on the down stream meters is stored. For example, if a tree causes the failure of a conductor the outage/AMI system can determine and record every meter affected. Thus, the system knows every down line meter on that circuit and can automatically identify connectivity errors quickly, easily and at minimum cost.

The system can also compare the affected meters to the expected outages. If there are meters that recorded failures but were not part of the logical network, you can change the network so that they are included. Typically that is changing the setting of a tie switch. If two circuits are near each other and one circuit fails, move the unaffected meters to the neighboring circuit. If the occurrences and exceptions are automated so that the changes are presented to the user in a well-defined manner, the changes in the network can be accomplished quickly.

Does your network become a reliable network model using this approach? Clearly, if there are many misconnected meters, this process will not produce a good model quickly. A concerted effort results in an increasingly more accurate network model. Some utilities record confidence levels to indicate which portions of the network are accurate and current. But even an inaccurate model will provide the crews with a starting point. When an outage occurs in a low confidence area, the crews are tasked with additional field verification of the connectivity, and the back offce makes a special effort to record the network connectivity determined by the crews. In areas where the network model is totally unacceptable, a field inventory is warranted.

## But We Don't Even Know Where Our Assets Are!

Some utilities still don't have any digital network models. Instead, they still do their work by paper-based maps and map books. Or, they may have a series of digital maps, but nothing is connected in any type of documented network architecture. In this latter situation, the utility should implement a plan to develop a digital network model as a fundamental starting point. An incremental approach is advised, and starts with finding a reliable base map to work from. If nothing else is available, start from a Google map.

Next, locate all the meters on the digital map – street address models using service addresses are a good start. Maintain these maps as new meters are added. Determine the growth areas and develop a digital network model placed on top of the land base. High growth areas can often easily justify the cost of defining a digital model. It is generally advisable to complete one circuit – or better yet one substation – at a time. Slow growth areas can be filled in gradually as the opportunity arises.

# Smart Grid Calling: Do You Know Where Your Outages Are Tonight?

By Charles H. (Chuck) Drinnan, President & Principal Consultant eWAM Associates

GUEST EDITORIAL

Assuming the utility has an AMI, when an outage is reported (by telephone) check it using the pinging process and record it on the meter map. If there are multiple outages you will get a good idea where to start looking for the primary outage. Record all the down line facilities, but recognize that they are only a start to a comprehensive circuit connectivity model.

## What Are Those Smart Meters Really Doing?

Most utilities implementing AMI are still in the process of installing their Smart Meters. Many of the utilities have plans or contracts to implement AMI-enabled outage management systems after they complete all, or at least a large portion of their AMI installations. Many of these utilities have justified their Smart Grid projects at least in part on improved network reliability and reduced outage durations.

Several utilities have already achieved reduced truck rolls and improved CAIDI results, primarily from incorporating pinging processes into their existing outage procedures. These utilities and the others that have contractual obligations to do so are adding this integration across AMI, OMS, and IVR. They are confident that they will achieve more benefits as they incorporate automatic outage recording from AMI ‘last gasp’ messages. There is still much to do before AMI systems are completed and integration between AMI and OMS is all in place. However, when they do, this new level of integration will become utility best practice – wait and see.

## ABOUT THE AUTHOR

**Chuck Drinnan** is an independent market consultant, analyst and advisor. As President and Principal Consultant for eWAM Associates, he brings more than 35 years of utility Transmission & Distribution systems experience and provides consulting and project management work of the highest quality and integrity based on industry best practices. He has experience in all phases of information systems design, from developing and managing one of the first commercially successful GIS databases for the utility industry to specifying, designing and managing the implementation of one of the industry's most comprehensive enterprise gas and electric systems. Chuck is a co-author of the international Spatial Data Transfer Standard, has organized and presented the GITA (Geospatial Information Technology Association) Work & Asset Management Seminar, has authored over 30 technical papers and serves on the Editorial Board of GeoWorld magazine. Chuck can be reached in Houston, Texas via email: chuck.drinnan@ewam-associates.com or by phone: +1.713.461.2606.

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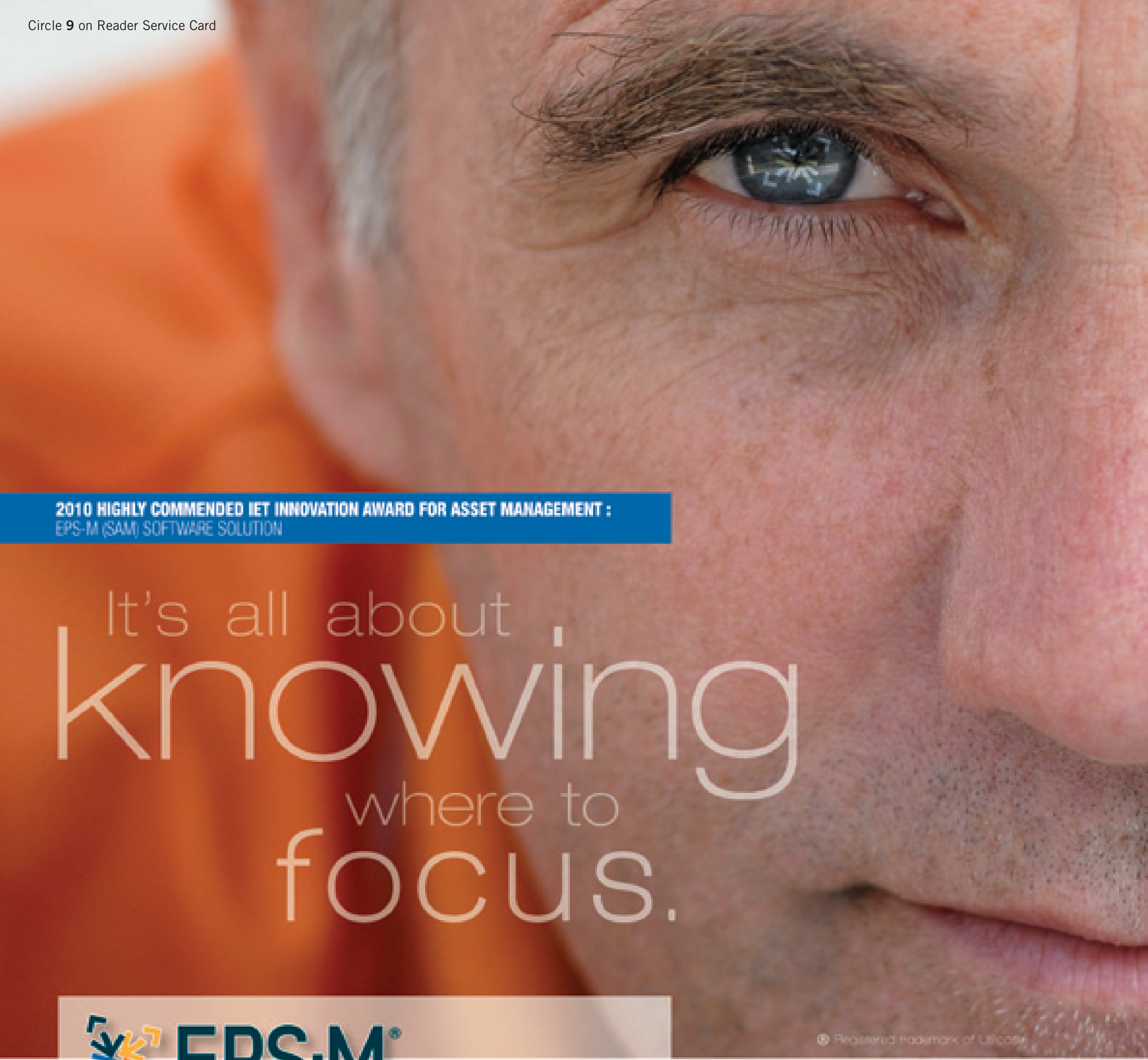


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