

## WILL WE MERELY SURVIVE... OR THRIVE? ANTICIPATING THE SUCCESS ESSENTIALS FOR SMART GRID'S FUTURE

The Smart Grid is poised to create great change for operators and consumers alike. How well we anticipate and prepare for these changes will determine whether we merely survive or thrive in the new reality.



The most significant impact we will see is the integration of energy into our cultural values as we become increasingly aware of energy challenges and their impact on our lives. As a result we are transitioning from “consumers” to “customers” – a culture that wants to be more aware and in control on “how” and “how much” and “from where” we are consuming energy through exciting and powerful new applications.

Electric vehicles and thousands of renewable generation sources throughout the grid will add great management complexity while greatly helping to mitigate peak demand issues, fluctuating energy prices and political instability. Coalitions and partnerships enabled by open standards and IP/MPLS architectures will increasingly

bring higher value to both energy consumers and operators. Advanced technologies and regional regulatory environments create new high-potential business models for all stakeholders as long as they understand and effectively address the key drivers for success.

The Smart Grid will fuel and support these profound transformations as long as it offers scalability, the ability to include millions of consumers as active participants; simplicity, an elegance and functional of design; and security for the immense amount of usage data that will be generated.

The opportunity is all there. The trick is to anticipate and be prepared.

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# MANAGING CHANGE FOR THE SMART GRID

WITH: CHRISTINE HERTZOG, CONSULTANT, AUTHOR AND MANAGING DIRECTOR, SMART GRID LIBRARY

## HIGHLIGHTS

- **Policy makers, utilities, regulators and vendors must focus on change management as a core social acceptance strategy.**
- **The Smart Grid's largest social impact will be seen in developing nations.**
- **Smart Grid designs should incorporate social and cultural behaviors in order to fully enable the benefits of the Smart Grid going forward.**

The Smart Grid of the future will change our lives. It will impact our business landscape, the energy marketplace and the ways in which we interact socially and culturally. It also will enhance control and convenience in the industrialized world while enabling positive social progress in developing nations.

When and how well these benefits gain traction will depend on how skillfully energy providers manage change. "You can count on unmanaged or poorly managed change to instill fear, uncertainty, and doubt - the FUD factor - into those who are impacted, and that leads to resistance," says Christine Hertzog, Managing Director of the Smart Grid Library. "That makes it critical that policy makers, utilities, regulators and vendors focus on change management as a core strategy to rollout Smart Grid-related technologies and programs."

## ENHANCING CONTROL AND CONVENIENCE

For the developed world the Smart Grid will enhance the reliability of electricity, along with opportunities to minimize operational cost and avoid rate increases and the ability to incorporate new forms of electricity generation and storage to all parts of the supply chain.

Wireless will be very much the enabling technology for all of the interfaces at the point of consumer interaction and communication. Mobile devices will increasingly keep homeowners in control of their home systems governing energy use, security and more, while location-based services relying on GPS can use the same network to provide additional consumer amenities that will significantly change lifestyles.

"Smart Grid can also mean water and natural gas as well," Hertzog notes "Right now our most expensive asset, our homes, are much dumber than our cars, which have a fraction of their value. I'd like to see something like a home dashboard, an app that is on your iPad, for example, to allow consumers to easily monitor and control utility usage, from electricity use to a water or gas leak. This type of monitoring would no doubt be attractive to insurance companies, which now give discounts based on sprinkler systems, smoke detectors and alarm systems in homes."

Wireless support of the Smart Grid will also better protect society against large-scale losses of property and services. "The San Bruno, California gas pipeline explosion

in 2010 killed eight people and created a raging fire that destroyed or damaged many homes, yet once it was reported, it took an hour and a half for a technician to travel from the company headquarters from the other side of the bay in rush hour traffic to manually turn a valve to shut off the gas," Hertzog says. "In the future, remote fault sensors and control powered by wireless communications will minimize that kind of damage."

## NEW TOOLS FOR THE DEVELOPING WORLD

The Smart Grid's largest social impact will be seen in developing nations. Hertzog notes that approximately 2.4 billion people of the world live in energy poverty - what she terms a permanent blackout. "The technologies in Smart Grid can make a huge difference in delivering electricity to these people," she says. "Whereas we will see incremental improvements in our lives, for them this will be the difference between night and day."

One powerful application is micro grids - highly local, renewably produced electricity that has selected destinations "Ideally what the generated electricity is used for would be a community decision," Hertzog says. "One use could be, for example, to power a well, alleviating the necessity to yank girls out of school in order to hike miles to get water."

Data generated by micro grids in the developing world could be used by NGOs to assure that systems installed to help local populations are functioning well,

with replacement parts distributed more readily. “You may bring prosperity to a small village that is 25 miles from anything else,” Hertzog says. “This prosperity could be engendered by the fact that villagers now can, for example, operate sewing machines day or night, producing clothing, which brings more commerce.” She adds that thanks to the scalability of smart architectures eventually these installations could easily grow into expanded grids that provide even more services.

### CREATING A NEW ENERGY MARKETPLACE

Renewables will make the social equation more complex. Hertzog points out that the social responsibility mechanisms of policy and regulation must continue to support all of the new models for generation, storage and distribution being made possible by Smart Grid architecture. For example:

- **The Energy “Farmer’s Market”:** This model could be a significant factor in those communities where abundant,

“For consumers to rapidly adopt any devices or management solutions for collection devices, they’re going to want it to be plug and play.”

renewable sources of energy are readily available and can be tapped in a cost-effective manner. “People who have solar panels, for example, will generate local business to support them, and entire local ecosystems could develop,” Hertzog says. “Regulators need to be careful in designing policies that will encourage rather than discourage the conditions for establishing this ‘locavore’ type of movement for electricity generation.”

- **Electric Vehicles (EVs):** “The roles that regulators allow for utilities in building the charging infrastructure and financing mechanisms for end users of EVs could have a profound impact on both demand response efforts and the speed of transition to an electrified transportation system,” says Hertzog. “For example, I could lease an EV from my power

supplier, agreeing to a very attractive rate in return for keeping it plugged in during peak hours so that the utility can discharge the battery.” Utilities would essentially take ownership of the vehicle’s battery, repurposing it as community energy storage, as well as other uses.

“Intelligently designed policy, including useful feed-in tariffs (FITs) can address all of those different constituencies’ concerns, allowing consumers who will actually become power providers to have as much control as they want over their own generation in those parts of the world where it makes sense,” Hertzog notes.

### ENABLING SOCIAL ADOPTION WITH GOOD DESIGN

Smart Grid designs should incorporate social and cultural behaviors and viewpoints in order to fully enable the benefits of the Smart Grid going forward. “Although the underlying technology

may be the same, how information is presented could have some very localized distinctions,” Hertzog notes. “In one part of the world, electricity may be cheap, but gas or water may be expensive, so those types of indicators would be more prominent on the device. Also, in a typical home you don’t have just one consumer – you have

“What is often overlooked is how a Smart Grid capable of supporting electrified transportation can boost a nation’s energy security.”

a family unit, typically with a couple of adult consumers and some juvenile consumers. You need to make sure that your interfaces are appropriate for all of those consumers.”

Flexibility of architecture and services also is critical to social adoption. A smart home’s energy consumption systems need to be automatic and seamless, non-proprietary and modular. “For consumers to rapidly adopt any devices or management solutions for collection devices, they’re going to want it to be plug and play,” Hertzog notes.

She adds that many of the same principles are applicable to generation, transmission, and distribution, recognizing that we have very profound security concerns whenever we’re talking about infrastructure. “Too many closed systems that are difficult to use or upgrade may cause operators to look for the easiest workaround, which could compromise security,” she says.

### CRAFTING THE RIGHT MESSAGE

According to Hertzog, social acceptance and satisfaction is dependent upon three categories of messaging to consumers. “We all talk about environmental benefits. That is very important, but what is often overlooked is how a Smart Grid capable of supporting electrified transportation can boost a nation’s energy security. That message needs to be more strongly communicated. This can help eliminate wars and massive environmental cleanups based on our continuing reliance on oil,” she says.

“A second area is for consumers to be aware of the rewards and the risks inherent in new types of energy consumption data that will be made available to them, utilities and third parties. That behavior data must be protected, and consumers need to feel secure in order to encourage adoption,”

Hertzog notes. “Consumers also need to be made aware and secure in the new kinds of relationships between various companies that are being forged in the Smart Grid ecosystem – for example, where a company

other than the main energy provider may own the consumer relationship.”

### FOCUSING ON HUMAN NATURE TO ENSURE SUCCESS

“Change, whether it’s in the form of new technologies, new processes, or new services, should not be assumed to be a foregone conclusion,” says Hertzog. “Utilities

“Everyone involved in promoting the Smart Grid will need to increasingly concentrate on human nature.”

should plan to assimilate new ways of thinking, operating, planning, and interacting with their customers.”

Hertzog says that “gamification,” which incorporates achievements, points, status, and behavioral momentum into existing

communication channels, can build knowledge and support for Smart Grid initiatives such as smart meter deployments, introduction of time of use (TOU) pricing, or enrollment in demand response (DR) programs. “Using websites and social media platforms such as Facebook, utilities can reward consumers and motivate them to actively seek information and recruit

others,” she says. She adds that power providers could use the same approach to work out agreements with local businesses that are willing to redeem game points towards the purchase of approved merchandise or services such as energy efficiency upgrades, HVAC maintenance

and other actions that deliver long-term benefits to utilities in reduced energy use.

Resistance to change will also be evident within utilities as employees are expected to develop different orientations to consumers, and develop mindsets that are modeled on competing for customer walletshare and energy awareness mindshare. “The convergence of a customer service orientation with a focus on reducing consumption would be a fabulous change in utilities,” she states.

“Ultimately, everyone involved in promoting the Smart Grid will need to increasingly concentrate on human nature,” says Hertzog. “We must identify and explain the benefits of the changes that need to be made to avoid resistance from all impacted populations – utilities, regulators, vendors, and consumers.”



# ANTICIPATING THE FUTURE'S SMART GRID ECONOMY

WITH: RAVI KRISHNASWAMY, VICE PRESIDENT, ENERGY PRACTICE, FROST & SULLIVAN

## HIGHLIGHTS

- Emerging economies will make up 93 percent of the demand growth between now and 2020.
- Renewable energy market will start taking a significant share of the power source in many countries.
- Smart Grid adoption will vary from community to community based on markets being served, regulatory environment, and other factors.

The world's overall energy demand expected to rise by nearly 40 percent between now and 2035 according to the International Energy Agency (IEA). Power providers need to be prepared with the right communications and service platform for the future's Smart Grid economy, but what will that look like and how much will it cost? Is there an ultimate business model?

The optimal Smart Grid value proposition depends on numerous factors related to regional needs, national priorities, technology development and regulatory environment, according to Ravi Krishnaswamy, Vice President, Energy Practice, Frost & Sullivan. "It's not a one size fits all situation," he says. "Each utility will have to weigh these factors, then arrive at elements of Smart Grid that works for them."

## DRIVERS, CHALLENGES AND INVESTMENT

Drivers for the Smart Grid future are environmental policy and renewable energy development, greater demand for energy

efficiency, growing energy demand and economic development. Challenges that restrain development include lengthy decision-making process, the high cost of investment, a lack of standards and data security concerns.

While energy demand in Europe and North America will continue to grow, emerging economies will make up 93 percent of the demand growth, with China and India accounting for 36 percent and 18 percent of the rise, respectively, according to IEA. Renewable energy will be a large part of that mix, increasing substantially across Asia, and especially in China and India.

Focusing on all of these opportunities and challenges, forward-looking global players and governments in the Smart Grid ecosystem already are making major investments. China is the world's largest investor in renewable energy, and is aiming for a 16 percent renewable share by 2020. The European Union (EU) also has taken a global lead through its 2020 target, which includes reduction of greenhouse gas emissions by at least 20 percent compared to 1990 levels, and increasing the share of renewable energy in final energy consumption to 20 percent, with a 20 percent increase in overall energy efficiency.

"We require a Grid that is more intelligent than it is today, obviously because conventional resources are limited while new elements need to be effectively integrated," says Krishnaswamy. "That brings us to the next stage of evolution, which basically is having large utilities gain storage - capturing and storing that renewable energy so that it can be used whenever you need it."

## CONSUMER DEMAND

The consumer interface, as embodied in demand management initiatives (DMI) and smart meters, is shaping up as the leading edge of deployment. "Reaching the full promise of the Smart Grid will take several stages or steps," says Krishnaswamy. "The rollout of smart meters, is the first."

Just consider the following total investments in smart metering technology that Frost & Sullivan has projected for the period between 2009 and 2017:

- **United States:** \$4.3 billion, with a 52.4 percent Compound Annual Growth Rate (CAGR)
- **Europe:** \$9 billion, 13.5 percent CAGR
- **Japan:** \$4.6 billion, 85 percent CAGR
- **Asia Pacific:** \$12.5 billion, 69 percent CAGR

"The Smart Grid gives the consumer more choice, he or she can better control consumption, and eventually will be able to manage home energy right down to home appliances," Krishnaswamy notes. "Some of the most promising edge applications will be the in-home displays through which consumers will be able to measure and proactively control power consumption by appliance. Many also will have solar or other alternative generating capacity in their homes, which they can sell back to the Grid. These are realities if we have a Smart Grid, and they will provide an attractive value proposition."

## THE IMPACT OF RENEWABLES

Frost & Sullivan estimates that by 2020 renewable energy should account for 20 percent of the European Union's final energy consumption, in line with EU targets. China invested more than \$10 billion in new renewable energy



capacity last year, second only to Germany, according to the Worldwatch Institute, and is aiming to double its renewable share by 2020, based on its own government's target. In the U.S. 22 states have renewable targets of between 10 percent and 20 percent for the same period, while renewable power in Africa is expected to reach \$57 billion in 2020, up from \$3.6 billion in 2010.

Krishnaswamy notes that the Smart Grid is essential for utilities and nations that want to grow their renewable generation base, which itself is a key element in the equation for meeting future demand. "Many countries have significantly added capacity in the recent past. Still these are intermittent sources, and in some instances, especially in China's case, they not able to connect that new capacity for lack of transmission technologies," he states.

"Predominantly renewable energy is growing, especially the solar market, and it's growing on the strength of feed in tariff (FIT) support from the governments," Krishnaswamy notes. "This has led to economies of scale which in turn has resulted in lower cost of production. So I would say that the renewable energy market will start taking a significant share of the power source in many of these countries."

### SMART CITIES AND MORE

One of the more fascinating outlooks for the Smart Grid is its role in supporting smart cities. "We believe that the infrastructure created by utilities will in several cases have the potential to serve as a backbone for all the communications that happens in a smart city, whether created from an existing city or a planned new urban development," says Krishnaswamy. "This is basically a convergence of multiple sectors, such as transportation planning, healthcare delivery, water and waste management and so forth."

These smart cities will be highly efficient, competitive and sustainable, fully capitalizing on the convergence of utilities'

infrastructure so that a broad range of public services can be delivered more efficiently. This scenario presents a myriad of enhanced business opportunities for power providers working in this space. "These value-added service opportunities provide a strong business justification for the Smart Grid - especially on a pilot scale at this point," Krishnaswamy notes.

### THE EVOLVING BUSINESS CASE

Smart Grid technologies are fundamentally changing the business models for power providers in several ways, including deferred investment in expensive power plants, reduced maintenance and service costs, more efficient and reliable load management and that expected proliferation in potentially lucrative smart services using the Grid's communications infrastructure.

Yet those factors alone are only part of the equation. Krishnaswamy points out that most utilities will need some kind of government support, especially in emerging markets where the industries themselves do not have very strong financials and are not able to adequately support the initiatives.

"The Smart Grid is especially important in places such as India, Indonesia and China, where they will be able to avoid billions of dollars that would have been spent on new power plants," he says. "It also translates into lower carbon emissions, so there is a definite incentive to having these intelligent Grids in many of these markets. It's a strong business case long term, but for some of them it's going to be very tough initially. For a time we will see utilities struggling to come up with a business case, and that's why they need some element of

support, or even approval from regulators in a given market for passing through the costs.

"You see that playing out in many countries. It's kind of a chicken and egg situation," he notes. "The Smart Grid is not just one project; it's an architecture and a schematic that needs to be developed over a five-to ten-year time frame, depending on the individual needs and realities of the utilities."

### THE SMART GRID TIPPING POINT

When will we see the tipping point, when the technical, policy and business factors all converge to supercharge ubiquitous Smart Grid adoption? Krishnaswamy believes that it probably is not going to be coming from one source or one direction, but from multiple facets of the Smart Grid.

"Take the communications infrastructure," he suggests. "Is the tipping point is going to be the whole cost of the infrastructure, or is it going to be the consumer demand for more choice and control - the moment when consumers recognize that they need to have the Grid to support the money-saving smart devices and other killer apps that they crave? At this point it's tough to say that one particular event or aspect will do it."

Krishnaswamy says that overall smart adoption and the precise form it takes will vary from community to community based on markets being served, regulatory environment, and other factors. "You can list 20 or 30 Smart Grid benefits, but what are the two or three key objectives for a particular utility? Is it going to be renewable energy integration? Is it going

"We believe that the infrastructure created by utilities will in several cases have the potential to serve as a backbone for all the communications that happens in a smart city, whether created from an existing city or a planned new urban development."



to be fault identification & rectification, is it going to be smarter distribution management? Once utilities and the communities they serve consider that and determine their own cost-benefit landscape, then that determines their initial architecture and tipping point.”

Then they can add on elements as needed. “That’s the beauty of today’s Smart Grid - it’s not just one big animal, but an

aggregation of smaller projects. Utilities can start with something that is more manageable and meaningful for them in the context of their particular needs. They may start at different points, but eventually the whole system will be done up in 15 to 20 years’ time frame,” Krishnaswamy states.

“In the end we are striving for efficient operation of the whole utility Grid, because today the utility industry is loaded with

inefficiency. For many years generation has been taken care of, but there’s not so much that has been done on the distribution and transmission side. That is the new focus for the years ahead.”



# EPB CHATTANOOGA: CUSTOMERS AT THE CENTER OF THE SMART GRID'S FUTURE

WITH: HAROLD DEPRIEST, PRESIDENT AND CEO, ELECTRIC POWER BOARD OF CHATTANOOGA (EPB)

## HIGHLIGHTS

- **Smart Grid technology will give customers unprecedented levels of convenience and control, while also providing their communities with advanced communications services.**
- **Wireless technology will be a great enabler for the Smart Grid's customers, providing more instant access and greater convenience.**
- **Customer education and addressing privacy issues should be priorities for utilities going forward.**

As the Smart Grid revolution plays out over the next 15 to 20 years, customers are likely to be the driving force and chief beneficiaries of new energy-centric applications that will fundamentally change their lifestyles.

"These days we're used to instant information, to quick response, and to having control over a lot more things in our homes and our lives, but that hasn't been true for electricity, says Harold DePriest, President and CEO, Electric Power Board of Chattanooga (EPB). "The Smart Grid is changing that reality, bringing electric systems into the 21st Century."

DePriest should know. EPB has been rolling out a gigabit passive optical fiber-to-the-home (FTTH) network to its entire service area of more than 170,000 customers, with 90,000 smart meters already installed.

A model for what much of the world can expect in the years to come, it is the fastest fiber-based Smart Grid in North America that manages electrical usage information in real time, giving customers unprecedented levels of convenience and control. It also offers the community additional advanced communications services such as virtual local area networks for businesses and schools, and "triple play" services that include Internet, phone and television.

"Whether it's providing advanced services or dealing with outages, we're going to be able to do it quicker, with customers communicating interactively with the electric system through mobile devices and other platforms," says DePriest. "It's going to make us a more relevant and convenient part of people's lives."

## ANTICIPATING THE FUTURE

DePriest believes that enhanced customer communication and convenience made possible by wireless technology, mobile platforms, rich media, interactive apps and well-thought-out interfaces will be essential to ensuring Smart Grid success in the future.

"We see the Smart Grid as integrating utilities like ours much more into the lives of our residential customers and businesses. The communications network overlaid on top of the Smart Grid will provide people with options they haven't had before," he says.

"We are working on customer interfaces – web and IPTV – and we're getting ready to do a 5,000-home pilot where people will be able to see their usage, choose rates and learn to control their use of energy better,"

he notes. "With IPTV, you will basically be able to punch a button on your TV remote control and see your usage in dollars and cents on a real-time basis, along with a way to predict what your monthly bill is going to be at the current rate of use."

Wireless technology will be another great enabler for the Smart Grid's customers. "Wireless means more instant access, more convenience," says DePriest, "so customers are going to expect to control consumption, communicate with the utility, view bills and more wirelessly. They're going to be interacting with appliances in their homes wirelessly, which should reduce energy use. We're already using Facebook and Twitter, and in a few months we should start turning our smartphone apps loose."

DePriest also notes that the Smart Grid can become a strategic tool for cities looking to increase their standing and attractiveness in an increasingly competitive world. "Our deployment has had a big impact on community pride, and we're showcasing Chattanooga as a place for high-tech industries. It is very much a part of how the community sees its future," he notes.

## CREATING MORE VALUE FOR CUSTOMERS

In the next decade Smart Grid technology combined with fast, high-bandwidth fiber will allow the world's leading utilities to follow EPB's lead – enhancing energy management and reliability to keep costs down, while diversifying their conventional energy supply business to offer advanced communication services and other innovations to their customers.



This integrated approach will create competitive advantages and create more business value for all stakeholders, as indicated by EPB's own results:

- **More Efficiency:** "The amount we pay for our wholesale power from the Tennessee Valley Authority has been \$30 million to \$40 million each month, but thanks to Smart Grid technology, we're already seeing savings of \$200,000 to \$400,000 for that same time period," DePriest notes. "We probably can take that to the neighborhood of \$1 million per month, which means we'll be able to curb rate increases for our customers."
- **Better Reliability:** DePriest notes that Department of Energy and TVA algorithms show that outages caused by storms have recently cost EPB business customers \$100 million a year. "With smart technology we've already reduced those costly outages by a third, and we think we can get that to over 40 percent," he says.
- **Additional Services:** Further leveraging the grid's fiber infrastructure, EPB's advanced voice, video, data and interactive communications services are generating new revenue that pays for the FTTH deployment. "In an era of rising energy costs it was clear that we simply couldn't afford to not build a Smart Grid based on a fiber optic network," DePriest states. "We needed it for the Smart Grid, but we figured that it also would provide superior services that people would buy in quantity sufficient to pay for

the investment. That has proven to be the case."

Overall, the Electric Power Research Institute has estimated the value to EPB's customers in the form of reduced outages, energy conservation and other efficiencies at roughly \$300 million over 10 years, while several economists at the University of Tennessee at Chattanooga have projected the service area's total economic and social benefits from the fiber project at \$600 million during the same period - results that will help drive the customer-based value proposition for utilities in the years ahead.

### EDUCATION A MAJOR CHALLENGE

DePriest believes that customer education will be among the foremost challenges facing utilities in the next 10 to 15 years. "We're headed for a much more complicated rate structure," he notes. "Making full use of the interactive tools becoming available to us, we're going to have to teach residential customers how to understand and respond to that. Our business customers are already in that world of time-of-use rates, including several large industries that are able to change their operations to take advantage of that for pretty large savings."

Ensuring customers' privacy is another major challenge. "With all of the deep, unprecedented usage data that will be collected, customers will have to feel secure that their privacy is being protected,"

DePriest says. He also notes that a lack of understanding can create laws or regulations that amount to hurdles for the system, such as legislation in some states that cast smart meters as privacy threats, allowing people to opt out. "We're going to have to do a better job as utilities earning the trust of our customers," he states.

### COMFORT AND CONVENIENCE WILL DRIVE ACCEPTANCE

"Twenty years ago when everybody started putting PCs on their desks, they knew it was going to lead to big changes, but nobody really understood the depth of the change," DePriest states. "You need to 'future proof' your technology decisions, and that's why we chose the fiber for our network. Once you put in that super-fast communications, all of the other things begin to come together - allowing all of your smart devices to interact with one another that much easier."

DePriest sees information technology and new approaches to managing customer relationships as the key to managing energy costs and environmental impacts in the future. "In the end, how this rolls out is going to be like everything else we do - it's going to be driven by our customers," he states. "People everywhere typically are looking for more comfort or more convenience in every product they buy. I don't see that changing. The Smart Grid gives us the ability to interact with our customers in a way that addresses those goals."



# DEALING WITH THE SMART GRID'S KEY DRIVERS AND CHALLENGES

WITH: KAMAL BALLOUT, VICE PRESIDENT - ENERGY SYSTEM INTEGRATION DIVISION, ALCATEL-LUCENT

## HIGHLIGHTS

- **Building the right foundation for future success is dependent on flexibility, security and understanding the enhanced expectations of consumers and society.**
- **Electrical Vehicles (EVs) are poised to radically change models for both electricity production and consumer behavior.**
- **Dealing with the massive amounts of data generated by Smart Grid applications will be a critical element of success.**
- **Education and smart, compelling eco-friendly consumer applications will support adoption and responsible use.**

The Internet we depend on every day for an amazing diversity of business, recreation, social and entertainment activities has changed unimaginably from the few static websites that appeared on our browsers in 1995 or even 2000. As we now try to look forward to the full realization of the Smart Grid in the years ahead, we can take at least one very important lesson from our Internet experience: build in flexibility, both commercial and technical, and ideas around the Smart Grid will flourish and blossom. The key to this is recognizing and addressing the key drivers that will shape the Smart Grid's development.

## FROM CONSUMERS TO CUSTOMERS

"First and foremost, the largest driver for Smart Grid success is the transformation of today's energy 'consumer' to tomorrow's energy 'customer.' We have to see

ourselves as customers in order to understand how that transformation will drive the industry, then build the right communications and service foundation to support it," states Kamal Ballout, Vice President of Alcatel-Lucent's Energy System Integration Division.

"Look at where we are today. As customers we now demand more choice, convenience and control over nearly everything, including the expectation of real-time information. The convergence of communications innovations – always-on connectivity through wi-fi and other technologies, ever more powerful mobile devices and multi-media platforms – have both increased our appetite for these benefits while raising our dependence on them," he says. "They have become an integral part of our life."

Ballout says that when it comes to energy, we're going to witness a very similar transformation in the next decade. "If you look at how most of us use energy today as consumers, you recognize that we tend to buy it in bulk for the household and we get a flat bill at the end of the month – very much the same as the way the telephone service used to bill us," he notes. "But now things are changing. We will want to understand how we are using that energy. We will want to be able to choose and control the cost, and we also will want to be able to choose the source – whether it's renewable or standard."

## ELECTRICAL VEHICLES POISED TO SHAKE UP CURRENT ENERGY MODELS

Electrical Vehicles (EVs) are poised to radically change models for both electricity production and consumption. On the generation side, millions of vehicles plugged

into residential and business garage terminals will provide significant power reserves that can be tapped by utilities during peak demand periods—all while increasing the complexity of power management.

Control points in the network and consumer power agreements will become particularly important with the increasing popularity of EVs, when thousands of people may show up for work at 8am and plug in, causing a huge peak in demand. Using demand management incentives (DMIs), power suppliers will be able to mitigate those surges, allowing EV owners who need immediate recharges to get them, while power for others will be deferred until later in the day.

Ballout notes that power for EVs could account for more than 50 percent of a monthly bill, and that will be a huge motivator for consumers to embrace demand-based pricing models. "Overall, consumers will want to understand how they're spending this energy and how to optimize it, whether for the EV, heat and air conditioning, appliances and other uses," he says.

## "GREEN" ENERGY CREATING BOTH RISKS AND REWARDS

In the next decade energy consumers will increasingly generate their own electricity, allowing them to be more "green" and socially responsible while creating additional highly distributed generating capacity. In this area as in all of the others, power providers will need to recognize trends and opportunities, developing the service applications to support them.

"Everyone is moving toward green energy, but sources like the wind and the sun are variable and unpredictable," says Ballout.



“The U.K. now has an objective of 50 percent renewables by 2020. Now that’s outstanding, but think about the impact. You are increasing the vulnerability of your network significantly, becoming 50 percent dependent on a variable source of electricity. Storage is part of the solution, but we also have to plan for renewable energy introduction with education and the smart, compelling consumer applications that will support responsible use. We need consumers to be socially responsible and engaged when it comes to green energy.”

### POWER RELIABILITY EVOLVING FROM “CONVENIENCE” TO “CRITICAL”

Smart Grid development in the decade ahead will also demand an increasingly strong focus on the reliability of the network, with a major challenge in satisfying demand from an ever increasing, distributed, uncoordinated and diverse range of energy generation resources. The proliferation of smaller scale renewable generation will create conflict with the legal requirements on utilities to deliver quality energy, since it will increase instability and “noisy” loads within a grid. Exaggerated energy usage profiles and seasonal energy demand will compound this problem further.

Outages are becoming much more critical than ever before Ballout notes. “If you go back 10 or 15 years ago, if we lost our electricity we would lose the television and the refrigerator, along with the lights, but the phone was still on. Now if we lose electricity we can no longer work from your home, we cannot send email, we can’t get our scanners to work. We’ve become much

more dependent on electricity in more aspects of our lives, so outages will be a much more costly situation for everybody.”

Again, it’s consumers who will be at the center of the success equation, since persuading them to cut down on consumption during peak periods will help the overall reliability and quality of the grid. “Using DMI’s enabled by Smart Grid technology, power suppliers will be able to better manage that load while keeping the costs down for everyone,” says Ballout. “Being able to shave some of that peak load also will reduce the frequency of outages, guaranteeing the ability to continue to deliver power to those with essential services.”

### DEALING WITH MASSIVE AMOUNTS OF DATA

In the next few years a large number of utilities will be implementing thousands of sensitive controls throughout their energy networks, along with smart meters in millions of homes. By 2020 this trend will create nine times the Smart Grid data we have today, according to Lux Research, driving telecommunications and information technology investment in the grid from \$12.8 billion today to \$32.4 billion by 2020.

“We will face the very brutal reality that we will have to deal with exponentially more information than ever before,” says Ballout. “Therefore, research and innovations around data analytics based on statistical signal processing, pattern recognition and intelligent controls will be extremely important. The ability to sort through this data to allow us to be more proactive and productive – educating customers while planning better for the years ahead.”

This flood of new data also will make security more important than ever, because the more distributed and intelligent the system becomes, the more it will attract hackers. “What you and I see as convenience, hackers see as an opportunity to learn about us and our behavior and plan harm around that. This is why we have to pair that intelligence with the right innovation for security,” says Ballout. “Enhanced security and privacy protection will be essential to making customers comfortable with the behavioral information generated by smart metering.”

### CREATING ESSENTIAL FLEXIBILITY FOR THE FUTURE

This multitude of complex drivers and challenges means that the Smart Grid’s future will depend upon building a highly capable service foundation based on open standards and interoperability –platforms that will help grow the inter-industry ecosystem essential for success. Networks based on open IP/MPLS technology will ensure both robustness and flexibility for all of the variable conditions and market players – enabling those essential, game-changing new applications that we haven’t even thought about.

And ultimately, energy awareness and engagement by those energy consumers-turned-customers will be the catalyst that drives new development and sparks the greatest success for the Smart Grid. “The Smart Grid concept is poised to become hugely successful,” Ballout states, “but we need their active participation to make it happen.”

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