Appendices

Appendix A: Smart Grid 2015 – A Baseline Narrative

By 2015, it's expected that the pilots and demonstrations that were initiated and funded as part of the American Recovery and Reinvestment Act of 2009 (ARRA, or The Stimulus Bill) will be complete. As the fifth year of the national smart grid effort begins, a significant amount of deployment based on the results of those demonstrations will have taken place. As a result, electrical grid operators will have a substantial deployment of smart gear, largely centered on those applications that will most directly benefit the utility company. That is to say that items that don't necessarily have a consumer component, such as substation automation, outage management, and supervisory control systems, will progress more rapidly and consistently than the technologies on the consumer side of the meter.

Suburban Areas Will Have More Smart Grid Technology

Suburban areas will contain significantly more Smart Grid technology than either rural or urban areas because they will have been "built smart" as population growth causes the number of residents in the suburbs to continue to expand. Deployment of smart technologies was more necessary in suburbia to support the electrical vehicle market. In the period between 2010 and 2015, electric vehicles (EVs) tended to thrive in the suburbs because the residents not only have the disposable income to purchase the vehicles, but their lifestyle is also able to accommodate the vehicles' limitations in terms of range-between-charge requirements.

Urban Areas Will Lag; Rural Electric Cooperatives Will Be A "Mixed Bag"

In 2015 deployment of Smart Grid technology lags in the urban areas because much of the existing legacy gear still has usable life and has not been fully depreciated. At the same time, rural areas and electric cooperatives offer a mixed bag of Smart Grid capabilities. Some of these utilities lag because there is little new construction and the revenue base simply isn't there to fund the wholesale replacement of their existing operational gear. Other co-ops have a much more advanced implementation because they realized early on that Smart Grid was critical to their business case in terms of sustaining their operations.

Smart Grid Standards 80% Complete

In 2015 we expect the Smart Grid landscape to be fairly well-developed in terms of standards, somewhere in the 80% complete range. It's impossible to know how many standards it will take, but by saying the task is 80% complete you would expect that the list will only grow by another 20%. By this time the conceptual architectures (and corresponding standards) for Smart Grid will be fairly well-baked and accepted by a consensus of the electrical supply chain. The majority of the standards work beyond 2015 will center on the home market and corresponding grid-side ancillary services in order to support higher functionality inside the

Note: The content of this report is premised on industry interviews that were conducted prior to September 2011 and do not reflect discussions, initiatives, activities, or developments that are subsequently taking place within the SGIP or other stakeholder forums.

home. International standardization is also fairly stable as the important issues relative to Smart Grid operations are harmonized between the Americas, Europe, and Asia.

No Major Legislation; Focus on Security and Privacy

The legislative front is similarly quiet in 2015. As cited earlier, most of the major federal legislative initiatives for Smart Grid will have been completed, funded, etc. However, there may be some loose ends that need to be cleaned up as part of the ongoing energy policy process, but there are no major Smart Grid standalone initiatives (like EPAct-2005, EISA 2007, or ARRA 2008) on the horizon. Of all of the issues being addressed, security and privacy continue to be relatively thorny, which is where the majority of the legislative effort will be focused.

In contrast, the regulatory environment of 2015 is likely to remain somewhat unsettled. Policy conflicts between federal and state authorities continue to bristle and be challenged in terms of the separation of authority. Lingering effects from regulatory activities related to energy efficiency, emission standards, renewable electricity standards (RES), and carbon production and offsets earlier in the decade will continue to produce concerns for the industry. A variety of lawsuits will have been initiated as state utility commissions seek broader jurisdiction.

Appendix B: Market Drivers

When you consider the adoption of Smart Grid, the overall assumption is that the United States and the other developed nations of the world are on the path to making it a reality. Therefore, the role of the market drivers in this scenario will either be to accelerate or inhibit the arrival of individual components associated with Smart Grid. This paper makes no assumption about the status of these drivers, other than to comment on their possible impact for the deployment of smart technologies.

The impact of the global economy will continue to be a significant driver for Smart Grid deployment in 2015. Whereas the seeds for deployment of the technologies in the United States were sewn as a result of the $4.5 billion Smart Grid Investment Grant program in the American Reinvestment and Recovery Act, the speed of propagation in 2015 and beyond will benefit from a robust U.S. and global economy. Because every aspect of Smart Grid comes with a price tag, utilities will rely on Public Utility Commission approval of rate cases in order to deploy smart equipment. Changes in utility rates are obviously more palatable under favorable economic conditions. Similarly, intelligent endpoint applications for Smart Grid (demand response, energy efficiency, renewables, storage, etc.) require an investment by the commercial, industrial, and residential consumer. These too are made more willingly during periods of prosperity.

Security and Privacy have the potential to become a major pacing item for Smart Grid, and the current state of these issues in 2015 will be a factor. As Smart Grid deployments progress between 2010 and 2015, electric power providers across the globe will have established some history in the effectiveness of their cybersecurity measures. The key question will center on whether any aspects of the geopolitical climate have affected grid operations, and whether any nation launched a successful cyber attack on another country's electric grid. A close second to this is the hacker issue within the U.S. borders. As with the Internet and the financial services industries, hackers—some looking for financial gains and others seeking fame based on their computer skills—will continue to probe the vulnerabilities of digitally-controlled grid systems. Any headlines citing an interruption of services related to hacker activity will make regulators nervous and send legislators scrambling to the microphones, touting their latest plan to improve security of the grid. Such an event would have a detrimental effect on the rate of deployment.

The characteristics of the concerns over privacy will be somewhat different. There is no argument that the customer's identity must be protected. And, as expressed by the group "Privacy by Design," privacy must be the default – which is to say that if the customer takes no action, their data is protected. The real battle, however, is over the ownership of that data. If it's determined that it is utility company data, there is already talk about ways to "monetize" its

Note: The content of this report is premised on industry interviews that were conducted prior to September 2011 and do not reflect discussions, initiatives, activities, or developments that are subsequently taking place within the SGIP or other stakeholder forums.

value. Possible applications of monetized data means that a utility company could possibly place targeted advertising inserts in the customer's bill, permit service providers to send advertisements to the customer's home energy management system, or the utility could let third-party providers market energy savings or specialized rate plans to those customers. In contrast, customer-owned data means that these kinds of programs would become the exception rather than the rule – their data could not be used for these purposes unless the customer signs up for some kind of marketing service.

Related to the state of the global and U.S. economies, the cost-effectiveness of Smart Grid solutions will continue to have an impact on the rate of adoption. Quite frankly, if consumers don't see the value, either in terms of the solutions available for their home or in terms of the rates they are paying for electricity, they will resist the expansion of Smart Grid services. To date, the state of California has been a case study in terms of the variety and depth of the opposition to Smart Grid, where accusations of faulty meters, environmental impact of transmission lines, and now health concerns over wireless technologies have all presented obstacles to the progress of Smart Grid deployments.

Adoption rates for electric vehicles, including the accommodations that retailers make for charging them will be an indicator of consumer acceptance, as will the variety of Smart Grid solutions that are available via retail outlets such as Lowes, Home Depot, Wal-Mart, Sears, and Dollar General. Other indicators include the variety of Smart Grid programs that are available from utility companies such as demand response, dynamic pricing, and energy efficiency, as is the willingness of the financial industry to provide capital for Smart Grid projects.

Whereas the progress on the utility side of the meter may be seen as a series of fairly steady gains in operational efficiency, there is bound to be a high level of variability on the customer side of the meter, particularly in the residential market. Homeowners that embrace technology and are comfortable with it will represent an entirely different picture than those of the disadvantaged and elderly, meaning that the continuum of consumer acceptance will be somewhat broad. Just as the VHS versus Beta and HD DVD versus Blu-Ray market forces took two-to-three years to declare a winner, so too will the competing interests for the providers of home energy management systems (HEMS). By the year 2015, it's likely that the consumer technology preferences will finally be sorted out.

As stated earlier in the cybersecurity example, the regulatory environment will continue to have an impact on Smart Grid deployments. Beyond security, feed-in and net-metering tariffs will affect the rates of adoption for consumer-owned renewables and have a major impact on the classification of other distributed energy resources. Issues surrounding transmission corridors—siting, cost allocation, and the notions of federal pre-emption and/or backstop authority—will also be major factors. Questions over the enforcement of cybersecurity requirements between federal and state authorities will be played out in the regulatory arena.
One of the lessons learned about the impact of the cost for a barrel of crude oil that played out between 2006 and 2010 is that the price for a gallon of gasoline has a major impact on the

Note: The content of this report is premised on industry interviews that were conducted prior to September 2011 and do not reflect discussions, initiatives, activities, or developments that are subsequently taking place within the SGIP or other stakeholder forums.

public's appetite for Smart Grid components such as electric vehicles. Similar instability in the cost of doing business for coal, natural gas, and nuclear-generated power will also impact the desire for other Smart Grid features such as demand response, distributed generation, and renewables.

Also, changes in consumer economics could fuel an appetite for Smart Grid services independent of what the utility companies are doing. Just as the utility companies will pursue the applications that are in their best interests, so too will the consumer. It's very likely that under this scenario, technology vendors will respond by delivering services wherein benefits are not contingent on a corresponding change or deployment by the utility company.

Beyond the regulatory issues associated with the normal channels in the electrical supply chain, new complications brought about by regulations implemented by federal agencies such as the Environmental Protection Agency will have an impact on the popularity of Smart Grid. This not only includes the concerns over carbon emissions and air quality, but also the estimations about the amount of water necessary to sustain the growth in global energy requirements. Actions taken by the 112th, 113th, and 114th Congress in response to federal agency regulations leading into 2015 could either accelerate or decelerate the Smart Grid adoption process.

Appendix C: SGIP-2015

The assumption driving the SGIP vision for 2015 and beyond is based on the implementation of Smart Grid being a 20-to-30 year effort. As such, there is a need for an industry body under which vendors of all kinds and electric power providers can organize to tackle important issues. Because of its origins, the SGIP is a possible candidate that could evolve into this role. However, because of its current legal standing (the SGIP is not a registered entity), beyond the Smart Grid technology framework and roadmap published by NIST, there needs to be an evolutionary path established for the SGIP. As with the organizational changes recommended for NIST, it is necessary to decompose the expected functionality of the SGIP in 2015 and beyond.

Functions & Activities

As with many technological endeavors in the latter years of the 20th Century (telecommunications, the Internet, etc.), industry will continue to push the performance frontier in terms of smart grid for decades to come. As such, it will be as important in 2015 as it is today that there remains a common technology and vendor-neutral forum for industry leaders to discuss their common challenges and potential solutions. Ideally this will also involve the features of the ANSI essential requirements such as Openness, Balance, Lack of Dominance, and Due Process.

If innovation for the grid will continue to be driven in industry, deep pockets of subject matter expertise in each of the functional domains (generation, transmission, distribution, and consumer) will continue to evolve. Having them organized under a continually functioning SGIP-like body will make this individual subject matter expertise readily accessible by both government and industry implementers of smart grid.

Another interesting feature of the government-industry dynamic in the United States is that unlike a lot of countries, we don't have a centralized government effort to write standards. Although we have a "National Institute of Standards and Technologies," the process of standards writing in the U.S. rolls up under the American National Standards Institute, or ANSI – an industry body that doesn't actually write the standards, but accredits the processes for those who do. It should also be noted that the work of ANSI doesn't stop at the U.S. borders as they also administer the U.S. National Committee for the International Electrotechnical Commission (IEC).

However, while ANSI performs a vital administration function in the standards writing process, they have no responsibility to identify gaps or defects in the content of existing standards, or to suggest possible areas for new standardization, either in the U.S. or abroad. Again, this type of function would be best placed with a neutral, industry-based body such as the SGIP, which could very readily examine any combination of ANSI or non-ANSI standards and specifications within the U.S. as well as international candidates from a variety of sources including the IEC.

Note: The content of this report is premised on industry interviews that were conducted prior to September 2011 and do not reflect discussions, initiatives, activities, or developments that are subsequently taking place within the SGIP or other stakeholder forums.

This would create a global catalog of standards that any industry or government official anywhere in the world could cite.

Combined with the pockets of subject matter expertise as described earlier, the SGIP can remain the coordination point between stakeholders in the standards, manufacturing, and utility industries. It can produce educational materials for federal and state government staffs, regulators, and legislators; provide a common forum for public-private workgroups and committees; and effectively manage the industry semantics so that the concepts behind the conversations are consistent. Further, it would provide input to the Dept. of Energy Clearinghouse and administer industry ballots to achieve consensus on a broad range of industry concerns.

Staffing & Structure

The structure of the SGIP in 2015 is a major question which centers on whether it becomes its own legal entity. Currently, the SGIP is merely a public-private partnership organized under NIST and is not a registered entity in the U.S. However, SGIP does have a logo (See Figure 3) which includes a trademark symbol: this begs the question: Who really "owns" this trademark?

Figure 3. Version of Smart Grid Interoperability Panel (SGIP) Logo

It should also be noted that the application of the trademark "™" symbol is somewhat inconsistent between the various SGIP newsletters, flyers, PowerPoint slides, etc.

The reason this is important is because in 2010, the SGIP was already producing documents with essentially no ownership, if in fact the SGIP has no legal standing as an organization. A select few of the SGIP work products may become government documents, such as the NIST Interagency Report (NISTIR) 7628, *Guidelines for Smart Grid Cyber Security*. However, a vast majority of the documents produced by the membership of the SGIP will not be destined for U.S. Government Printing Office (USGPO) document number and will need to be owned and maintained by some legal U.S. entity. Other concerns would be the fact that you cannot sign a memorandum of understanding or agreement (MOU or MOA) with the SGIP; further, they cannot provide any form of endorsement. For example, in January 2011, the Testing and Certification Committee of the SGIP, the SGTCC, produced an *Interoperability Process Reference Manual (IPRM)* encouraging companies to become testing and certification authorities for various smart grid standards. In exchange for their diligence, any company that goes through the process of developing a testing and certification plan will be rewarded by being "listed" as an approved Interoperability Testing and Certification Authority, or ITCA by the SGTCC.

Note: The content of this report is premised on industry interviews that were conducted prior to September 2011 and do not reflect discussions, initiatives, activities, or developments that are subsequently taking place within the SGIP or other stakeholder forums.

In light of these concerns, it seems obvious that in order to preserve the value of the work being done today by the SGIP members, and to maintain the integrity of the vendor and technology neutral forum for the industry that the SGIP should become its own legal entity. Possible models for this include the North American Electric Reliability Corporation (NERC), the American National Standards Institute (ANSI), or an "Industry Council" model, such as the Utilities Telecom Council (UTC), or the Sustainable Buildings Industry Council. This would permit the SGIP to charge reasonable dues for its members to enable the federal government to cease funding the administration of the panel, and thereby allow the SGIP to continue to maintain its own agenda, governing board, charter, and bylaws.

Note: The content of this report is premised on industry interviews that were conducted prior to September 2011 and do not reflect discussions, initiatives, activities, or developments that are subsequently taking place within the SGIP or other stakeholder forums.