Section Three: Recommendations on NIST Smart Grid Research Activities

Introduction

This section of the report represents the work of SGFAC Subcommittee Four focused on the various research challenges and recommendations. Specifically, this section summarizes the perspectives based on fifteen interviews of stakeholders across the Smart Grid regarding NIST Smart Grid research activities. Specific recommendations on research areas are included.

Overview

The following are the overarching themes that emerged from the interviews.

- *Generally, the private sector should be the primary vehicle for applied smart grid research. Universities, research institutes and national laboratories do the basic research. NIST smart grid research and development should focus on areas where the organization has core competency and expertise, namely: standards development, metrology, cybersecurity, testing and certification.*

- *NIST should be selective in the areas that it tries to address, and focus on things that require a common, continuing, unbiased oversight and will result in a common set of standards for the community. In short, it was felt that this activity is good and should continue, but that the resources given to it should not be increased.*

- *Development of cybersecurity standards and other related research needs to be a coordinated effort between SGIP, utilities, vendors and regulators so as to reduce the confusion and complexity about implementing standards.*

- *There is a need to sort out the large amount of research sponsored and/or done by various federal agencies (e.g., NIST, DOE, DHS) to remove duplicative work, and to get the useful results of the research to utilities and vendors for further development and commercialization.*

- *Rigorous and transparent processes and techniques for interoperability testing and certification of individual smart grid products as well as integrated systems are important.*

- *NIST technical experts in different smart grid domains should interact more with their counterparts at utilities to better understand how the standards affect or could affect utility operations in terms of grid reliability, security, and business processes.*

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.

- *Utilities need metrics to support the deployment of smart grid. There is a need for a systemic view of the benefit to the customer from smart grid improvements to the grid. The industry as a whole has to quantify the financial benefits in a way that is convincing to the customers, regulators, and utility leaders. Without clear metrics to the customer and the business, people cannot judge the benefits of the various programs.*

Research-related Gaps, Activities and NIST's Role

Collaboration on Cybersecurity

There needs to more collaboration on different research efforts being conducted. The role of NIST as a keeper of security standards for unclassified work for the U.S. government could somehow be exploited. NIST cybersecurity experts should get more connected with the smart grid security work. NIST has a great opportunity to drive our security program.

Smart Grid Metrics

Utilities need metrics to support the deployment of smart grid. For example, metrics for control of the power system considering the two-way flow of energy are needed. While this may not yet be a major issue for utilities, interviewees anticipate that it will. Another key question is how to characterize and quantify the operational risks in the smart grid in terms of reliability, interoperability and cybersecurity? There is growing interest for a systemic view of the benefit to the customer from smart grid improvements to the grid. The industry as a whole has to be able to quantify both operational risks and financial benefits in a way that is convincing to the customers, regulators, and utility leaders. Without clear metrics to the customer, it will be difficult to evaluate the benefits of the various programs. For example, what metrics can be used to measure the impact of items like PHEV and distributed generation and demand reduction that are both understandable and believable to all the stakeholders from the regulators to the customers? Methods must be developed to take the benefits from pilot projects (e.g. feeder reliability improvements) and translate them in a meaningful way to the systemwide deployment. The regulators are having a difficult time judging the benefits of the smart grid. Research to improve the metrics for operational performance of the smart grid could address this issue. In addition, due to potential vulnerabilities facing the smart grid from cyber attacks, security metrics will also be needed.

Facilitator of Research around Standards Development, Security and Metrology

NIST should focus its smart grid research priorities around the subjects related to standards development, cybersecurity and metrology. NIST should avoid duplicating the research activities in the domains of the smart grid already being conducted by EPRI, national laboratories, universities as well as the private sector. However, NIST should facilitate greater collaboration in smart grid research. In such a role NIST could provide input to the research priorities of these organizations to ensure that adequate emphasis is put on the topics that are relevant for standards developments, interoperability and cybersecurity.

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.

Modeling and Metrology

There is a strong relationship between modeling, calibration, and measurement. Accurately modeling the smart grid at both the system and device levels is an important aspect of achieving interoperability. Analytical models must describe physical phenomena which occur in the smart grid. The models also determine the data and information that are exchanged between systems, devices, etc., for both real-time operations and planning. While there are various modeling efforts in the industry, more research is needed to validate and enhance these existing models as well as develop newer models. This will be all the more necessary as the smart grid continues to grow and evolve. New kinds of devices will be constantly added and different operational procedures, implemented by utilities, to create this "system-of-systems" will become even more complex.

Testing, Calibration and Certification

NIST could be involved beneficially in issues related to the testing, calibration and certification of smart grid components. NIST has already demonstrated this capability as part of its efforts on PMU testing. However, for those cases where NIST may not want to be involved in testing itself, it could certify or recommend testing requirements related to cybersecurity, functionality, interoperability and other issues. NIST's role could be to coordinate these activities that may take place at other labs. Another related role would be to develop test processes for the actual testing itself, or for NIST to physically test the equipment that is used by others in the test process. In this way, NIST could insure that tests connected at different test facilities would be comparable to one another.

Key Recommendations

NIST Research Activities

The key research areas for NIST should be interoperability, cybersecurity, testing and certification, metrics for interoperability, vulnerability, resilience and other properties of complex systems such as the emerging smart grid.

Facilitator of Multi-Stakeholder Smart Grid Research Collaboration

NIST should take advantage of the multi-stakeholder SGIP and play the role as the convener of workshops on smart grid research in order to ensure that the focus of these entities' research agenda supports the activities to develop interoperability and other smart grid standards.

Accreditation of Testing and Certification Laboratories

NIST should conduct research into the development of processes and procedures to provide accreditation to independent laboratories that will be authorized to test and certify that products and systems comply with the smart grid interoperability and cybersecurity standards. NIST should also conduct research about the lessons learned from other industries that have developed certification and compliance regimes, and should research how the findings can be adapted for smart grid. As both smart grid and interoperability and cybersecurity standards are constantly evolving, NIST should conduct research to continuously improve the accreditation

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.

processes for the independent laboratories. NIST research activities in this area should be funded in part by fees paid by laboratories and by the Federal government.

Collaboration with Utilities and Private Sector

NIST should invite and promote strong collaboration with utilities and private sector on research into metrics for interoperability, cybersecurity and other properties of the smart grid. Such collaboration could lead to more jointly funded R&D efforts, and also improve the support for NIST activities by Congress.

Continue Research in Electric Power Metrology

NIST should conduct research to determine the metrology requirements for smart grid devices; research that aims to reduce the number of interfaces between different devices. NIST should build upon the work it has already started on electric power metrology for the smart grid. Over the coming decades, as smart grid continues to evolve and new sensors and actuators are developed, there will be a need to ensure that the measurements are accurate and that the controls are acting, and at the same time satisfying, the standards for interoperability. NIST should continue to conduct power grid metrology research to also include identification of new kinds of quantities that characterize the system level behavior of the smart grid.

Smart Grid Modeling

NIST should conduct research to create a framework for determining the requirements for modeling the smart grid at the system level. In the coming decades as the smart grid continues to evolve with more advanced devices, with embedded sensors being added, and more interconnectivity between systems as well as devices, accurate modeling will be key to achieving interoperability. As demand response and intelligent buildings are expected to play bigger roles in the smart grid, modeling and develop appropriate standards for communication to support these new resources connected to the grid will be critical. NIST should continue its research and development in intelligent building integration with the smart grid.