APEC Smart Grid Initiative (ASGI)

Cary Bloyd

EGNRET-36

Washington D.C., USA

February 28-March 2, 2011

Pacific Northwest
NATIONAL LABORATORY

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Instructions from Energy Ministers at EMM-9

- The Fukui Declaration from the Ninth Energy Ministers Meeting (EMM-9), June 2010, states that "**smart grid technologies**, including advanced battery technologies for highly-efficient and cost-effective energy storage, can help to integrate intermittent renewable power sources and building control systems that let businesses and consumers use energy more efficiently, and they can also help to enhance the reliability of electricity supply, extend the useful life of power system components, and reduce system operating costs."
- EMM-9 instructed EWG "to start an **APEC Smart Grid Initiative (ASGI)** to evaluate the potential of smart grids to support the integration of intermittent renewable energies and energy management approaches in buildings and industry."

Suggested Elements of the Smart Grid Initiative

- Phase 1 – Survey of Smart Grid Status and Potential
- Phase 2 – Smart Grid Road Map
- Phase 3 – Smart Grid Test Beds
- Phase 4 – Development of Smart Grid Interoperability Standards

Phase 1 – Survey of Smart Grid Status and Potential

- An ongoing project, EWG 01/2009S, is evaluating the potential of smart grid technologies in APEC economies to enhance the use of renewable energy and energy efficient buildings, appliances and equipment
- A related project, EWG 02/2009, focuses on addressing grid-interconnection issues to maximize the utilization of new and renewable energy resources

Possible Timeline: Phase 1 – Survey of Smart Grid Status and Potential

- Ongoing projects should be completed by early 2011
- Interested economies may consider a follow-up project on best practices for 2011

Phase 2 – Smart Grid Road Map

- Organize workshops to elaborate a road map for advancing smart grid technologies in APEC
- Due to the wide range of electric grids in place, APEC members can work together to learn from others and develop suggested procedures that will be useful in developing economy specific road maps
- The road map process would be developed in coordination with the International Smart Grid Action Network (ISGAN)

Possible Timeline: Phase 2 – Smart Grid Road Map

- APEC project concept note or self-funded project proposal to be prepared for endorsement at EWG-41 in early 2011
- Economies that wish to contribute ideas to the road map identify themselves at EWG-41
- First workshop to support APEC smart grid development including road mapping is planned to be held in conjunction with EGNRET-37
- Road map should be ready to report to EWG-43 in early 2012

Two projects related to different aspects of road mapping are being put forward for APEC funding in 2011

- Chinese Taipei has proposed a project on “Addressing Challenges of AMI Deployment in APEC” which is to be implemented from April 1, 2011 to April 1, 2012
- China and Hong Kong, China have proposed an “APEC Workshop on Energy and Green Transport Benefits of Electric Vehicles” to be held in late 2011

Phase 3 – Smart Grid Test Beds

- Establish a network of test beds to provide operational data on emerging smart grid technologies
- Economies may also wish to offer smart grid test beds for use by grid operators, electric power suppliers, and manufacturers of energy efficient building systems and equipment
- APEC test beds would become part of a Smart Grid International Research Facility Network (SIRFN) to be coordinated by the International Smart Grid Action Network (ISGAN)

Possible Timeline: Smart Grid Test Beds

- Initial test beds made available by Korea and the United States in 2011
- Further test beds made available by other APEC economies in 2012 and 2013
- Interested parties make use of the smart grid test bed network through 2020 or beyond

Phase 4 – Smart Grid Interoperability Standards

- Discuss interoperability standards for Smart Grid technologies under the APEC Regulatory Cooperation Advancement Mechanism on Trade-Related Standards and Technical Regulations (ARCAM) in 2011
- Based on the discussions, consider follow-up steps to develop interoperability standards across the APEC region and globally through ISGAN

Possible Timeline: Phase 4 – Smart Grid Interoperability Standards

- Highlight smart grids in ARCAM in 2011
- Follow up pursuant to ARCAM recommendations

Comments are welcome!

EWG-41 Agenda Item 10(c)
New and Renewable Energy – APEC Smart Grid Initiative

CONCEPT PAPER FOR THE APEC SMART GRID INITIATIVE (ASGI)
Revised Draft 16 February 2011

Instructions from Energy Ministers at EMM-9

The Fukui Declaration from the Ninth Energy Ministers Meeting (EMM-9), June 2010, states that "**smart grid technologies**, including advanced battery technologies for highly-efficient and cost-effective energy storage, can help to integrate intermittent renewable power sources and building control systems that let businesses and consumers use energy more efficiently, and they can also help to enhance the reliability of electricity supply, extend the useful life of power system components, and reduce system operating costs." EMM-9 instructed EWG "to start an **APEC Smart Grid Initiative (ASGI)** to evaluate the potential of smart grids to support the integration of intermittent renewable energies and energy management approaches in buildings and industry."

Elements of the Smart Grid Initiative

Four different phases of activity on smart grids can be envisaged:

Phase 1 – Survey of Smart Grid Status and Potential

An ongoing project, EWG 01/2009S, is evaluating the potential of smart grid technologies in APEC economies to enhance the use of renewable energy and energy efficient buildings, appliances and equipment. Included in the project scope are grid management technologies, energy efficiency and renewable energy technologies "behind the customer meter" (including "smart buildings"), and intelligent controls to link the grid with customers in a more efficient and seamless fashion. The project report will include a survey of how smart grid technologies and practices have been used to enable new products and services, optimize the use of power grids, allow greater use of renewable energy options, and encourage greater demand-side efficiency response in APEC economies. A follow on workshop will take place to examine findings of the study and lay a path forward for future progress in these areas. The project, which is self-funded by the United States and endorsed by EWG, began in May 2009 and will finish in early 2011.

A related project, EWG 02/2009, focuses on addressing grid-interconnection issues to maximize the utilization of new and renewable energy resources. A workshop on this topic was hosted by Japan, the project sponsor, on 12 October 2010 as part of the 35th meeting Expert Group on New and Renewable Energy Technologies (EGNRET). A workshop report will be made available.

Based upon the results of these projects, interested economies may wish to consider a follow-on projects on best practices to maximize smart grid potential, based upon experience recorded.

Phase 2 – Smart Grid Road Map

Organize workshops to elaborate a road map for advancing smart grid technologies in APEC. Although it is unlikely that there can be a single smart grid road map across all APEC economies due to the wide range of electric grids in place, APEC members can work together to learn from others and develop suggested procedures that be useful in developing economy specific road maps. Key elements of will include understanding the smart grid value streams of capacity, power quality & reliability, energy efficiency, operational efficiency and clean technology as well key area of engagement including smart grid policy, regulation and finance; standards policy; research, development, and demonstration; workforce skills and knowledge; and engagement of smart grid users and consumers at all levels. The road map process would be developed in coordination with the International Smart Grid Action Network (ISGAN).

Phase 3 – Smart Grid Test Beds

Establish a network of test beds to provide operational data on emerging smart grid technologies. Two initial test beds would be made available by Korea and the United States in 2011, which interested parties in APEC economies would be invited to use to test their smart grid components. Other economies may also wish to offer smart grid test beds for use by grid operators, electric power suppliers, and manufacturers of energy efficient building systems and equipment. The APEC test beds would become part of a Smart Grid International Research Facility Network (SIRFN) to be coordinated by the International Smart Grid Action Network (ISGAN).

Phase 4 – Development of Smart Grid Interoperability Standards

Discuss interoperability standards for Smart Grid technologies under the APEC Regulatory Cooperation Advancement Mechanism on Trade-Related Standards and Technical Regulations (ARCAM) in 2011. Based on the discussions, consider follow-up steps to develop interoperability standards across the APEC region and globally through ISGAN.

Possible Timeline for the APEC Smart Grid Initiative

Phase 1 – Survey of Smart Grid Status and Potential

- Ongoing projects should be completed by early 2011.
- Interested economies may consider a follow-up project on best practices for 2011.

Phase 2 – Smart Grid Road Map

- APEC project concept note or self-funded project proposal to be prepared for endorsement at EWG-41 in early 2011.
- Economies that wish to contribute ideas to the road map identify themselves at EWG-41.
- First workshop to support APEC smart grid development including road mapping is planned to be held in conjunction with a meeting of the Expert Group on New and Renewable Energy Technology in 2011.

- Road map should be ready to report to EWG-43 in early 2012.

Phase 3 – Smart Grid Test Beds

- Initial test beds made available by Korea and the United States in 2011.
- Further test beds made available by other APEC economies in 2012 and 2013.
- Interested parties make use of the smart grid test bed network through 2020 or beyond.

Phase 4 – Smart Grid Interoperability Standards

- Highlight smart grids in ARCAM in 2011.
- Follow up pursuant to ARCAM recommendations.

Detailed Discussion of AGSI Components

Smart Grid Status and Potential

At the core of the "smart grid" is the transformation of the electric supply industry from a centralized, producer-controlled network to one that is less centralized and more consumer-interactive. With their wide range of size and level of development, APEC economies can act as an important test bed for smart grid technologies and practices. It has been estimated that between $5.98 and $7.55 trillion in total investment is needed by the APEC energy sector through the year 2030, with 60% of this going to the electric utility sector as it expands from 2,138 TW (2002) to 4,207 TW in 2030. There is an opportunity to guide this expansion using the full range of smart grid enabling technologies and practices that furthers the transition to less centralized electricity production while creating a more efficient and reliable electricity production/consumption system.

An initial APEC smart grid survey project was undertaken to address APEC's expressed desire to minimize the learning time to understand the implications of smart grid concepts so that members can advance their thinking in a timely manner and advance strategies regarding smart approaches that can help meet their environmental sustainability and energy efficiency policy goals. As significant investments are needed to grow and maintain the electricity infrastructure, consideration needs to be given how information and communications technology can be applied to electricity infrastructure decisions that not only meet traditional needs for basic service and reliability, but also provide the flexibility for a changing mix of generation sources with sensitivity to environmental and societal impacts.

The application of smart grid technology promises to provide benefit to electricity consumers and our economies by better utilizing electric system assets to securely satisfy consumer energy demands at a lower monetary and environmental cost. The project report reviews the status of the deployment of smart grid technologies within APEC economies, and in particular, discusses

the potential application of smart grid technology to enhance the integration of renewable energy and to advance greater levels of energy efficiency.

Smart grid technology uses digital technology and communication to coordinate the actions of intelligent devices and systems throughout the electricity system: from large scale generation networked with transmission infrastructure, to the distribution of power to consumers (factories, commercial buildings, and residences), and down into the equipment and systems that use electricity in these facilities. Through automation, better information, and coordination, smart grid technology can provide the flexibility needed to integrate variable generation that is a characteristic of some renewable resources such as wind and solar generators. Smart grid technology can also enhance efficiencies in the transmission and distribution delivery infrastructure, generation, and end-use systems by optimizing system performance and increasing asset utilization.

The environment surrounding smart grid is characterized by continual, rapid developments in technology, regulations, and institutions. From early visionary concepts, smart grid actions are now emerging into an early growth phase consisting of demonstrations and technology deployments.

The picture of electrification across the APEC economies is complex. APEC members are in various states of smart grid development, ranging from no activity to conducting demonstrations, and joint projects with other economies. Each member economy has unique attributes that influence the benefits of smart grid capabilities and affect the priorities given to deployment strategies. To help provide insight into this complex topic, the APEC smart grid status report surveys APEC economies and characterizes the status of smart grid activities. It also identifies APEC economies that are actively pursuing smart grid capabilities to address environmental and economic sustainability goals. Lastly, the report explores the potential application of smart grid capabilities to resolve renewable integration and energy efficiency concerns so that future directions or roadmaps in this area can be developed by interested economies.

Smart Grid Road Map

As APEC economies modernize their electric power grids they share the goals of increasing energy efficiency, transitioning to renewable sources of energy, reducing greenhouse gas emissions, and building sustainably economies. Road maps are useful in linking such desired future goals to current situations and identifying necessary steps in order to realize desired targets. When applied to smart grid, road maps may look at the overall grid system or may look in detail at a specific component such as the Advanced Metering Infrastructure (AMI), the increased penetration of renewable sources of energy or the integration of distributed generation into the overall electric grid. They can also define strategies which focus on new construction or concentrate incremental updating of legacy equipment. Although operational roadmaps will no doubt need to be tailored to each APEC economy, APEC members can draw inspiration and ideas from sharing approaches, as well as successes and failures.

A number of APEC economies have already begun the process of road mapping various aspects of smart grid implementation. Examples from current smart grid road maps in the US, Korea, and Chinese Taipei illustrate the type of targets, scale, and coverage of current APEC smart grid road maps.

The US report, *NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 1.0*, provides the output of the first phase of the NIST smart grid plan. It describes a high-level conceptual reference model for the smart grid, identifies 75 existing standards that are applicable (or likely to be applicable) to the ongoing development of the smart grid, specifies 15 high-priority gaps and harmonization issues (in addition to cyber security) for which new or revised standards and requirements are needed, documents action plans with aggressive timelines by which designated standards-setting organizations (SSOs) will address these gaps, and describes the strategy to establish requirements and standards to help ensure smart grid cyber security.

Korea has defined a smart grid road map as a function of five sectors:

1) Smart Power Grid
Open power grids will be built to allow various kinds of interconnections between consumption and supply sources. The roll-out of such networks will pave the way for new business models, and the building of a power grid malfunction and automatic recovery system that will ensure a reliable and high quality power supply.

2) Smart Consumer
It aims to encourage consumers to save energy by using real-time information and producing smart home appliances that operate in response to electric utility rates.

3) Smart Transportation
It aims to build a nationwide charging infrastructure that will allow electric vehicles to be charge anywhere. It also establishes a V2G (Vehicle to Grid) system where the batteries of electric vehicles are charged during off-peak times while the resale of surplus electricity takes place during peak times.

4) Smart Renewable
It aims to build a smart renewable energy power generation complex across the nation by rolling out microgrids. This will ultimately lead to the emergence of houses, buildings, and villages which can achieve energy self-sufficiency through the deployment of small-scale renewable energy generation units in every end-user premise.

5) Smart Electricity Service
With the launch of a variety of energy-saving electricity rate plans, this service aims to improve consumers' right-to-choose by satisfying their different needs. In addition, it wants to deliver a wide array of added electricity services through the marriage of electricity and ICT, and to put in place real-time electricity trading system for the transactions of electricity and derivatives.

Chinese Taipei has developed an AMI road map that identifies specific benefits which they expect to receive from the AMI phase of smart grid implementation. Their goal is to complete AMI installation for 23,000 high voltage users and 5,000,000 low voltage users by 2020 with the expected benefits of reducing peak load by 650 MW, saving 5% of electricity consumption (9.8 TWh), and reducing 4.39 million tonnes of CO_2 emissions.

Two projects related to different aspects of road mapping or defining the directions of key smart grid technologies are being put forward for APEC funding in 2011:

- Chinese Taipei has proposed a project on "Addressing Challenges of AMI Deployment in APEC" which is to be implemented from April 1, 2011 to April 1, 2012 and
- China and Hong Kong, China have proposed an "APEC Workshop on Energy and Green Transport Benefits of Electric Vehicles" to be held in late 2011.

Smart Grid Test Beds

Smart grid test beds are an important element for demonstrating the multiple benefits smart grid can bring to APEC economies. APEC economies are encouraged to cooperate in the development of regional test beds as well as to develop economy specific test beds which can incorporate local grid operating conditions, environmental factors, and social considerations. Islands are often useful for smart grid test beds since they offer the ability to test smart grid technologies when the local electric grid is naturally isolated from external influences. An example of such an activity in the APEC region is the Jeju Island smart grid test bed in Korea. The Korean Government selected Jeju as a smart grid test bed in 2009 with a goal of it becoming the world's largest smart grid community that allows the testing of advanced smart grid technologies and R&D results, as well as the development of smart grid business models. Korea expects to invest approximated US$200 million (US$50 million public funds, US$150 million private investment) from December 2009 to Mary 2013 in the Jeju Island smart grid test bed.

Smart Grid Interoperability

The compatibility of the Smart Grid technologies across APEC economies will be largely determined by the degree of the interoperability in the underlying technical standards deployed by each economy, and this, in turn, will impact trade and investment flows in a wide range of sectors. Early cooperation on the development of those standards can help prevent non-tariff barriers to trade before they emerge. Interoperability standards for Smart Grid technologies are therefore expected to be discussed under the APEC Regulatory Cooperation Advancement Mechanism on Trade-Related Standards and Technical Regulations (ARCAM) in 2011.

Interoperability refers to the capacity of two more networks, systems, devices, applications, or components to exchange information at the point of interface and to readily use that information securely, effectively and with little inconveniences to the user. ARCAM work on Smart Grid interoperability standards will be undertaken with a view to identifying the specific interfaces that involve heavily traded products and equipment, and to understanding the relevant choices in standardizing activities associated with those sectors and products. The goal of this discussion is to enable policy makers in APEC economies to better understand the close relationship between decisions on interoperability standards and trade and investment in key sectors in the Asia-

Pacific. The discussions would not delve into technical details of the specific interoperability requirements, but seek to impart a higher-level, more conceptual understanding of the issues. This discussion will provide input for the CTI, in close consultation with the SCSC, to make concrete recommendations for cooperation on interoperability standards for Smart Grid technology.

Both in the region and globally, the trade and investment implications of Smart Grid technologies are enormous. The deployment of Smart Grid technologies by APEC economies will impact trade and investment in an array of sectors. To develop Smart Grid infrastructure and use it effectively, economies will need to buy, replace or upgrade bulk generation and electrical distribution and transmission equipment, renewable energy technologies, communications equipment, software applications, as well as electric vehicles and the entire range of smart consumer and workplace electronics and appliances. One recent forecast projects that the global market for Smart Grid related equipment will increase to over $171 billion by 2014 – an increase of nearly 150 percent from 2009.

Broadly speaking, interoperability standards will enable economies of scale and scope that help create markets in which vendors compete on the basis of price and quality. Interoperability standards also provide a common platform upon which vendors can innovate and provide consumer choice while ensuring product performance. For example, interoperability is the basis of "plug and play" technologies –enabling multiple vendors to provide compatible components or devices to service a larger system, network, or device. For Smart Grid, interoperability standards will facilitate market competition in a wide variety of distribution and transmission equipment, appliances, software and other products. This competition will promote faster diffusion of technologies and, hence, more rapid realization of consumer and societal benefits, including lower costs, increased energy efficiency, and greater reliability.