EWG-43 Agenda Item 13(b)
New and Renewable Energy – APEC Smart Grid Initiative

PROGRESS REPORT ON THE APEC SMART GRID INITIATIVE (ASGI)

Multilateral Framework for the APEC Smart Grid Initiative

Instructions from Energy Ministers at EMM-9

The Fukui Declaration from the Ninth Energy Ministers Meeting in 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."

Energy Smart Communities Initiative (ESCI)

Japanese Prime Minister Kan and U.S. President Obama announced the Energy Smart Communities Initiative (ESCI) on the occasion of the APEC Leaders meeting in Yokohama in November 2011. ESCI includes pillars for smart power grids, smart buildings, smart transport and smart jobs and education. The smart power grid pillar includes tasks on smart grid road maps and a smart grid test bed network. These tasks can be reinforced through ASGI.

International Smart Grid Action Network (ISGAN)

An International Smart Grid Action Network (ISGAN) has been established through a Clean Energy Ministerial (CEM) process that was inaugurated in Washington in July 2010 to link together the smart grid activities of the G20 and other major economies. ISGAN includes work on interoperability standards and a Smart Grid International Research Facility Network (SIRFN) which can draw upon the road maps and test bed network established through ASGI and ESCI.

Elements of the Smart Grid Initiative

Four different components of the ASGI can be envisaged:

Element 1: Survey of Smart Grid Status and Potential

A project completed in April 2011, EWG 01/2009S, evaluated the potential of smart grid technologies in APEC economies to enhance the use of renewable energy and energy efficient buildings, appliances and equipment. The project focused on 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 included 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 began in April 2009, was self-funded by the United States and endorsed by the APEC Energy Working Group. The project report was distributed to APEC economies and is available on the APEC website. A two page executive summary was distributed to the EWG 41 meeting in Vancouver in May 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 was distributed to the EWG at its 41st meeting in Vancouver in May 2011 and is available on the APEC website.

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.

Element 2: Smart Grid Road Maps

Studies and workshops elaborate road maps for advancing smart grid technologies in APEC. Separate road maps may be envisioned for specific aspects of grid operations such as the development of interoperability standards across grids, the evolution of Advanced Metering Infrastructure (AMI), the buildout of charging infrastructure for electric drive vehicles with communications protocols between vehicles and grid, the integration of distributed generation into the overall electric grid, or the development of local micrograms for isolated communities.

Although it is unlikely that there can be a single road map in each of these areas 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 will 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).

Two projects related to smart grid road maps were completed in 2011, and five new projects are starting in 2012. The completed projects are EWG 07/2011A, "Addressing Challenges of AMI Deployment in APEC" carried out by Chinese Taipei and EWG 05/2011A, "APEC Workshop on Energy and Green Transport Benefits of Electric Vehicles" carried out jointly by China and Hong Kong, China. Starting in 2012 are new projects on grid technology to support electric drive vehicles (EWG 11/2011, "Stock-take of Electric Vehicle Interface with Electricity and Smart Grids Across APEC economies and the Potential for Harmonization" led by New Zealand), technology to build microgrids in isolated communities (EWG 15/2011A, "Piloting Smart / Micro Grid Projects for Insular and Remote Localities in APEC Economies" led by Russia), grid technologies to reinforce distribution networks (EWG 17/2011A, "Promotion of Energy Efficiency and Renewable Energy in Low Carbon Model Town of APEC through Distributed

Energy Source – Identification of Potential, Challenges and Solutions" led by China), and linkage between demand response and renewable energy penetration (EWG 09/2012A for a "Study of Demand Response's Effect in Accommodating Renewable Energy Penetration in the Smart Grid" led by China) and grid integration of hydropower (EWG 07/2012A for a "Small Hydro and Renewable Grid Integration Workshop" led by Viet Nam). A central goal of ASGI smart grid road maps activity will be to pull together the common road map elements from these projects so that they are available to all APEC economies as they develop smart grid programs.

Element 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).

SIRFN will be a coordinated network of smart-grid research test-bed facilities located in ISGAN and linked to the ASGI. These test-bed facilities will be selected based on their complementary capabilities to conduct specialized, controlled laboratory evaluations of integrated smart grid technologies including cyber security, plug-in hybrids, load management, automated metering infrastructure, protection, network sensing, energy management, renewables integration and similar technology applications. SIRFN will provide members the ability to research pre-competitive technologies and systems approaches in a wide range of smart grid implementation use cases. In this way, research within each individual member economy will derive the value of the unique capabilities and environments of the other partner nations. Data from these tests will be made available to all members to accelerate the development of smart grid technologies.

Element 4: Smart Grid Interoperability Standards

The APEC Committee on Trade and Investment (CTI) began discussing the trade and investment dimensions of interoperability standards for Smart Grid technologies under the APEC Regulatory Cooperation Advancement Mechanism on Trade-Related Standards and Technical Regulations (ARCAM) in 2011. The CTI's ARCAM dialogue on Smart Grid interoperability standards took place at SOM2 in May 2011. Recommendations for further cooperation among APEC member economies to prevent the emergence of unnecessary barriers to trade in this area was endorsed at CTI 3 and SOM3 in September 2011. These recommendations were endorsed by APEC Ministers and Leaders in November 2011. One ARCAM recommendation was to represent ARCAM outcomes in other bilateral, regional, and international fora, notably the World Forum on Energy Regulation in Quebec City, Canada, May 2012." To implement this recommendation, a *Workshop on Regulatory Approaches to Smart Grid Investment/Deployment*, to be held May 16-17, 2012 in Quebec City, Canada, was funded in January 2012. Workshop topics will include: interoperability standards and the role of regulators; international standards development; cyber security; consumer data and privacy; and vision for a 21st century grid.

Timeline for the APEC Smart Grid Initiative

Element 1: Survey of Smart Grid Status and Potential

- Initial projects completed in early 2011.
- Follow-up work on best practices considered by interested economies in late 2011.

Element 2: Smart Grid Road Maps

- Project concept notes for road maps developed and endorsed by EWG in 2011.
- Economies that wish to contribute ideas to the road maps identify themselves in 2011.
- Workshop on APEC smart grid development and road mapping held in conjunction with a meeting of the Expert Group on New and Renewable Energy Technology in 2011.
- Workshop on electric vehicles in Hong Kong in October 2011.
- Stock-take of EV interface and harmonization potential to be completed in 2012
- Workshop on microgrids in Vladivostok, Russia May or June 2012, report by December.
- Workshop on distributed generation in Beijing in October 2012, report by December.
- Report on demand response to accommodate renewable energy penetration in 2013.
- Workshop on grid integration of small hydropower facilities in 2012 in Viet Nam.
- Reports from workshops to EWG-42, EWG-43 and subsequent EWG meetings.

Element 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.

Element 4: Smart Grid Interoperability Standards

- CTI addressed smart grid interoperability standards in ARCAM in 2011.
- Workshop on interoperability standards and related issues in Canada in 2012.
- Further follow-up pursuant to CTI ARCAM recommendations.

Detailed Discussion of AGSI Components

<u>Smart Grid Status and Potential</u>

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 percent of this total going to the electric utility sector as it expands from 2,138 terawatts (TW) of generating capacity in 2002 to 4,207 TW of capacity 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 Maps

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 development of interoperability standards across grids, the evolution of Advanced Metering Infrastructure (AMI), the build-out of charging infrastructure for electric drive vehicles with communications protocols between vehicles and grid, the integration of distributed generation into the overall electric grid, or the development of local microgrids for isolated communities. Road maps can define strategies which focus on new construction or incremental updating of legacy equipment or both. 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 United States, Korea, and Chinese Taipei illustrate the type of targets, scale, and coverage of current APEC smart grid road maps. Best practices from development of these road maps may presumably be applied in a broad range of economies throughout the APEC region and beyond.

Road Map for Development of Interoperability Standards

The *NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 1.0,* provides the output of the first phase of the smart grid plan for the National Institute of Standards and Technology (NIST) in the United States. 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. Extension of this work throughout APEC has been proposed through the ARCAM, which is detailed in the separate section on interoperability standards that follows below.

Road Map for Development of Advanced Metering Infrastructure (AMI)

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. The economy’s 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 percent of electricity consumption (9.8 TWh), and reducing 4.39 million tonnes of CO_2 emissions.

A project on "Addressing Challenges of AMI Deployment in APEC" was proposed in January 2011 by Chinese Taipei, with cosponsorship by Japan, Korea, Thailand and the United States. Work began in April 2011 and should be complete by April 2012. A power grid must become "smarter" in order to maximize utilization of renewable energy and improve energy conservation. Advanced Metering Infrastructure (AMI) can help the grid to do so. An AMI system typically consists of three components – a "smart meter" at the customer's premise, a communications network between the smart meter and the utility, and a "meter data management application" (MDMA) at the utility. The system can enable more intelligent energy consumption decisions for customer side and provide more efficient and reliable gird for utility side. But field trials indicate that there are many obstacles to overcome for wider AMI implementation. These include policy, meter reliability, information security, and customer education. The project will investigate and compare the development strategies and current status of AMI in all APEC economies, identify effective AMI polices and best practices, and provide recommendation for AMI deployment.

Road Map for Development of Electric Vehicle Charging Infrastructure

China and Hong Kong, China hosted an "APEC Workshop on Energy and Green Transport Benefits of Electric Vehicles" on 24-25 October 2011. There were over 150 participants from 15 APEC economies and several non-APEC economies. A portion of the agenda was devoted to EV infrastructure and standardization. This included discussion of connectivity standards for EVs and their potential harmonization. A key aspect of EV infrastructure development is the development of communications prototols between grids and vehicles. Such protocols can allow the vehicle owners or operators to communicate their requirements to the grid operator, in terms of how much charge they will require (how much distance they expect to drive) and when they need the charge delivered (when they will need to start their next trip). They can also allow the grid operator to meet the vehicles' requirements in the least-cost way from available generation.

An important finding from the workshop discussion is that development of EV markets can enhance power grid operations. Presentations indicated that an eight-hour overnight charging period would provide around two to four times the amount of charge required for typical daily driving distances. It follows that EVs could be employed as a mobile form of energy storage for load shifting on the power grid. They could be charged in residential districts at night time, off-peak, when marginal generating costs are low. They could then be partially discharged in commercial districts where the drivers are working, during the day time, thereby helping to provide power during peak demand hours yet retaining sufficient energy for driving back home.

Several measures were discussed to help bring about the grid-enhancing benefits of EVs. Development of charging infrastructure by power companies, property developers, building management companies and government was seen as important. Standardization of the charging infrastructure, providing a harmonized communications protocol between utilities and EVs, would be helpful, as would a variety of charging modes and locations, ranging from low-voltage plugs in buildings for slow charging to dedicated high-voltage charging units for rapid charging. Improvement of battery technologies for longer life time, higher performance, higher energy density, less charging time and lower cost, as well as improvement of other EV components for higher performance, better cooling and reduced weight, would also play key roles in promoting the market penetration of EVs and obtaining the associated benefits for the power grid.

Related areas for future work in APEC were suggested. Accelerated harmonization of standards for electric vehicle and charging infrastructure, including the charging voltage, current, power, protocol and charging plug, was suggested in order to reduce EV business uncertainty. Region-wide cooperation between automobile manufacturers to standardize the EV charging interface, communications protocols and other technical design features was also proposed as desirable.

The "Stock-take of Electric Vehicle Interface with Electricity and Smart Grids across APEC Economies and the Potential for Harmonization" to be conducted in 2012 aims to enhance understanding of EV connectivity to electricity grids and identify harmonisation opportunities for EVs and supporting technologies to promote the deployment and integration of EVs. It will assess both current and planned grid and vehicle interconnection standards and regulations for EV deployment across APEC economies; Then it will recommend areas for harmonization of connectivity between EVs and power grids to reduce trade barriers and promote EV deployment.

Road Map for Grid Development to Support Distributed Renewable Energy Sources

Several projects are planned or underway to better map out how smart grid technologies can help increase the market penetration of renewable energy sources. These include studies on the promotion of renewable energy in low-carbon model towns and on the impact of demand response measures to accommodate increased renewable energy penetration, as well as a workshop on how smart grids can facilitate the grid integration of small hydropower facilities. These projects respond to directions from the Ninth APEC Energy Ministers Meeting (EMM-9) in Fukui, Japan on promoting energy efficiency and renewable energy technologies,

China is leading a project on Promotion of Energy Efficiency and Renewable Energy in Low Carbon Model Town of APEC through Distributed Energy Source – Identification of Potential, Challenges and Solutions, which received APEC funding in 2011 for work in 2012. The project aims to study and identify the potential, challenges and solutions for application of distributed energy sources in promoting energy efficiency and renewable energy in low carbon model towns of APEC, with a focus on the government policies required to support distributed energy. The technical and economical barriers which may hinder the development of distributed energy and their possible solution will be discussed. The application of distributed energy and its potential benefit to APEC economies will be studied. A workshop will be organized in October 2012 in Beijing to share findings from the study, and a final report is to be issued in December 2012.

China will also lead a Study of Demand Response's Effect in Accommodating Renewable Energy Penetration in the Smart Grid for which APEC funding was approved in February 2012. Demand response is a change in electricity consumption in response to price signals or incentives, for example to reduce electric loads or to shift peak loads to off-peak periods. Such demand response may reducing requirements for new generating capacity but can also help accommodate additional renewable energy generation. If demand can be adjusted downward when intermittent renewable generation fluctuates upward, or upward when renewable generation fluctuates downward, overall load will be made more stable, and more renewables can be accommodated. The study will assess the practical feasibility of demand response for accommodating additional renewable energy penetration. It will then examine how resulting benefits might be distributed among different types of electricity users and suppliers so that the demand response strategy benefits all. Supporting policies and regulations will be evaluated. China will be examined as a case study of how the demand response system for renewables could operate commercially.

Viet Nam will be leading a Small Hydro and Renewable Grid Integration Workshop which has received approval for APEC funding in 2012 and should be completed by the end of 2013. Small hydro-electric generation systems are being utilized as part of a cost-effective generating mix in many APEC member economies. Such hydro systems are of special importance in developing APEC economies where they often provide the only firm power available in rural areas. However, as economy-wide grids are established, small hydro energy systems pose unique technical problems to power grid operators. The workshop will bring together project developers, electric utility representatives, and government officials who are involved in small-scale hydro and other small-scale renewable power development in APEC economies. They will share experiences on best practices and problems associated with the integration of small hydro and other renewable energy systems into their electric grid. The main planned outcome of the workshop will be a suggested road map for addressing small hydro grid integration problems.

Road Map for Development of Microgrids

Russia is leading a project on “Piloting Smart Microgrid Projects for Insular and Remote Localities in APEC Economies.” The project is focused on the application of smart grids to the many communities in APEC that are located in remote or isolated areas with limited or no access to centralized energy supply infastructure. These areas tend to face bigger challenges of securing a stable and efficient local electric energy supply.

Smart grid is an emerging technology that has already proved its efficiency of transforming the electric supply industry from a centralized, producer-controlled network to one that is less centralized and more consumer-interactive. Can this technology be an effective solution to the needs of remote/isolated areas? Does it require a special approach, given the small-scale generation, limited local demand and other constraints of local communities? What design a pilot project should follow to introduce smart/micro grid technology to less developed and perhaps economically disadvantaged communities? These are the questions that the project seeks to address through a analytical and physical meeting activities. A workshop is planned in Vladivostok, Russia in May/June 2012 with a final report to be issued by December.

Multidimensional Smart Grid Road Map in Korea

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. (This aspect relates to the development of interoperability standards across power grids.)

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. (This aspect relates to Advanced Metering Infrastructure development.)

3) *Smart Transportation:* It aims to build a nationwide charging infrastructure that will allow electric vehicles to be charged 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. (This aspect relates to development of harmonized communications protocols between EVs and the grid.)

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. (This aspect relates to development of distributed generation and microgrids.)

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 among service suppliers 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.

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. The test bed network established through ASGI and ESCI can be expected to form a major component of the Smart Grid International Research Facility Network (SIRFN) that has been established through the global International Smart Grid Action Network (ISGAN)

An example of such an activity in the APEC region is the Jeju Island smart grid test bed in Korea. 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. 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 approximately US$200 million (US$50 million public funds, US$150 million private investment) from December 2009 to May 2013 in the Jeju Island smart grid test bed.

Another example is the smart grid test bed funded by the U.S. Department of Energy at Sandia National Laboratory. Sandia's Distributed Energy Technologies Laboratory (DETL) conducts research on generation, storage, and load management at the component and systems levels and examines advanced materials, controls, and communications to achieve a reliable, low‐carbon electric infrastructure. DETL researchers analyze the effects of high penetration of renewable technologies and distributed energy on the grid and resolve issues related to grid interconnectivity, controls, security, safety, performance, reliability and interoperability. DETL's reconfigurable infrastructure simulates a variety of real‑world scenarios, such as microgrids and smart grids, remote operations, and scaled portions of utility feeders and the transmission infrastructure. DETL's test bed includes EMS and SCADA capabilities which can be used to test cybersecurity measures and vulnerability of smart grid technology and devices to cyber attack.

An ISGAN-APEC Smart Grids Test Bed Networks Workshop was held in Washington DC on January 24-25, 2012 where over fifty experts and officials from laboratories and government agencies in nine different economies discussed practical steps toward building a global network of smart grid test beds. APEC economies represented included Australia, Japan (Institute of Energy Economies of Japan – IEEJ) , Korea (Ministry of Knowledge Economy – MKE), and Chinese Taipei (Industrial Technology Research Institute – ITRI) . There were also European participants from the board of the Distributed Energy Research Lab (DERLab) network, Germany's Fraunhofer Institute, the Austrian Institute of Technology, and laboratories in Finland and Sweden. They agreed in principle to establish a Smart Grid International Research Facility Network (SIRFN) as an Annex to the ISGAN Implementing Agreement. They also agreed to exchange more detailed information on planned and ongoing testing activities in six areas: Renewable and Distributed Energy Resources Integration, Buildings Automation, Electric Vehicles Integration, Microgrids, Distribution Automation, and Cyber Security.

Representatives from Germany, Korea and the United States confirmed that they were prepared to make their test bed facilities available to other economies on an equitable basis. Other economies were encouraged to confirm the availability of their smart grid test bed facilities to qualified researchers. Preliminary discussion took place on the nature of access to facilities – including the types of researchers and research institutions that would have access, the sharing of costs between hosts (such as for routine facility maintenance) and visitors (such as for travel and accommodation), and the system for reserving access to facilities at specific times and places.

Significant discussion occurred regarding where the test bed network would fall on the broader technology development path (i.e., from research and development (R&D) to technology demonstration and validation to product commercialization and certification). Participants generally agreed that the network should not duplicate existing international R&D collaboration, nor should it attempt to replace existing testing for commercial certification. An opportunity was noted for the network to test and "prove out," short of official certification, specific interoperability concepts. It was agreed that more detailed, systematic discussion would be required to set forth the operating modalities of the test bed network, with recognition that specific modalities might differ among the six areas of interest.

Participants agreed that the test bed network would have significant value to the smart grid community through development of standardized information on major smart grid test beds and test facilities, systematic comparison of the capabilities of these test beds and test facilities, identification of gaps and overlaps between their smart grid testing program, and subsequent realization of opportunities to leverage each other's work through better planning and coordination of smart grid testing programs. Information will be gathered through the contact groups established in the six areas of interest and shared through the ESCI knowledge-sharing platform and ISGAN knowledge-sharing Annex. It was further agreed that contact groups within each area of interest should to begin identifying potential areas of collaboration and developing projects that will demonstrate the added value of the smart grid facility network.

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. In 2011, the CTI undertook work on interoperability standards for Smart Grid technologies through the APEC Regulatory Cooperation Advancement Mechanism on Trade-Related Standards and Technical Regulations (ARCAM). Under the ARCAM, the CTI developed concrete recommendations for advancing further regulatory cooperation related to smart grid interoperability standards. These recommendations, endorsed at CTI 3 and as SOM 3[1], are based on the report of the ARCAM Dialogue[2] held at CTI 2 in Big Sky, Montana and the U.S. paper presented at CTI 1 in Washington, DC that outlined Smart Grid interoperability standards [3] as an emerging regulatory issue with significant potential to impact trade and investment in the APEC region.

In the recommendations endorsed at SOM3, APEC economies committed to prevent unnecessary obstacles to trade and investment related to Smart Grid interoperability standards because such obstacles will hinder achieving the broader economic and societal benefits that will accrue through the deployment of Smart Grid technologies across the region. APEC economies agreed to take specific steps to promote transparency, collaboration and global solutions in the development of Smart Grid interoperability standards; to enable competition and innovation in specific markets for Smart Grid technologies; and to integrate ARCAM outcomes into cooperative work on Smart Grid interoperability standards in APEC and other fora. They also agreed that CTI and EWG should coordinate on follow-up work on interoperability standards.

These recommendations were endorsed by APEC Ministers and Leaders in 2011. One recommendation was to represent ARCAM outcomes in other bilateral, regional, and international fora, notably the World Forum on Energy Regulation (WFER) in Quebec City, Canada, May 13-16, 2012. To implement this recommendation, the United States proposed an APEC project in the CTI's Subcommittee on Standards and Conformance (SCSC), with co-sponsorship from China, Chinese Taipei, Japan and Korea, to hold a Workshop on Regulatory Approaches to Smart Grid Investment and Deployment in Quebec City immediately before or after the WFER meeting. The project received APEC funding in January 2012, and the workshop will be held on May 16-17. Workshop participants will include regulators, private sector experts, SCSC officials, and officials responsible for standards and trade policy. They will discuss development of international interoperability standards, the role of regulators on interoperability, consumer data and privacy, cyber security, and visions for a 21st century grid.

---

[1] See 2011/SOM3/032anx3.
[2] See 2011/SOM2/CTI/043rev2.
[3] See 2011/SOM1/CTI/015.