U.S. Department of Energy
Electricity Advisory Committee Meeting
October 19 & 20th, 2011

Minutes

EAC Members in Attendance:

Richard Cowart
Regulatory Assistance Project
CHAIR

Rick Bowen
Alcoa

Honorable Robert Curry
New York State Public Service Commission

Jose Delgado
American Transmission Company (Ret.)

Roger Duncan
Austin Energy (Ret.)

Robert Gramlich
American Wind Energy Association

Michael Heyeck
American Electric Power

Joseph Kelliher
NextEra Energy, Inc.

Edward Krapels
Anbaric Holdings

Ralph Masiello
KEMA

Richard Meyer, for Barry Lawson
National Rural Electric Cooperative Association

David Nevius
North American Electric Reliability Corporation

Irwin Popowsky
Pennsylvania Consumer Advocate

Wanda Reder
S&C Electric Company

Brad Roberts
Electricity Storage Association

Honorable Tom Sloan
Kansas House of Representatives

Gordon van Welie
Independent System Operator of New England

Mike Weedall
Bonneville Energy Administration

Brian Wynne
Electric Drive Transportation Association

EAC Members Not in Attendance

Guido Bartels
IBM

Frederick Butler
Butler Advisory Services

Ralph Cavanagh
Natural Resources Defense Council

Lisa Crutchfield
National Grid USA

Dian Grueneich
Morrison and Forester LLP

Honorable Barry Smitherman
Railroad Commission of Texas

Richard Vague
Energy Plus Holdings, LLC

Public Attendees

Derek Bandera
GenOn Energy

Tom Bialek
San Diego Gas & Electric Company

Jim Creevy
NEMA

John Howes
Redland Energy

Robert Lasseter
University of Wisconsin-Madison

Philip Mihlmester
ICF International

Brad Nickell
Western Electricity Coordinating Council (WECC)

Debra Raggio
GenOn Energy

Elliot Roseman
ICF International

John Shenot
Regulatory Assistance Project (RAP)

Andrew Shine
Battelle

Mary Toler
Battelle

Fritz Walker
Air Products

David Whitely
Eastern Interconnection Planning Collaborative (EIPC)

Press Attendees

none

U.S. Federal Attendees

Warren Lasher
ERCOT

U.S. Department of Energy Attendees

Honorable Patricia Hoffman
Assistant Secretary for Electricity Delivery and Energy Reliability

David Anderson
Office of Energy Efficiency and Renewable Energy

Bill Parks
Office of Electricity Delivery and Energy Reliability

Caitlin Callaghan
Office of Electricity Delivery and Energy Reliability

Kerry Cheung
Office of Electricity Delivery and Energy Reliability

Graham Coates
Extern

Lot Cooke
Office of General Counsel

Michelle Dellafior
Office of Electricity Delivery and Energy Reliability

Hank Kenchington
Deputy Assistant Secretary for R&D, Office of Electricity Delivery

David Meyer
Office of Electricity Delivery and Energy Reliability

Matt Rosenbaum
Office of Electricity Delivery and Energy Reliability

Energetics, Inc. Attendees

Peggy Welsh

Cami Dodge

Natalie Kempkey

Katie Shay

Welcome and Opening Remarks, October 19, 2011

Richard Cowart, Chairman of the DOE Electricity Advisory Committee (EAC), opened the meeting by thanking everyone for attending and extending his appreciation for everyone's willingness to participate. *Mr. Cowart's* comments were echoed by *The Honorable Patricia Hoffman*, Assistant Secretary for Electricity Delivery and Energy Reliability (OE), U.S. Department of Energy (DOE).

After EAC members introduced themselves, *Mr. Cowart* outlined the agenda for the two day meeting, which was to develop the EAC's work plan for 2012 and full EAC approval of the three Subcommittees' White Papers to be presented during this meeting. *Mr. Cowart* stated that the thoughtful vision statement from DOE on future of the grid that the EAC would hear over the course of the meeting would tie in the 2012 work plan to the Committee's work and lead to a continuing process of advice and deepening engagement with DOE.

Presentation on the U.S. Department of Energy's Vision for a Future Grid

William Parks, Senior Advisor to DOE, presented to the EAC a vision for the future of the U.S. grid to the EAC members.

Mr. Parks began his presentation by providing context for why the DOE was providing a vision for the future of the US electric grid. *Mr. Parks* said that technology solutions are not the only answer to solving the uncertainty and complexity of the future grid. *Mr. Parks* noted that certain unknowns, such as the future generation mix and emerging forces, will induce changes to the grid. He questioned if the U.S. would see a different grid, and how could we be ready for what emerges. *Mr. Parks* answered that what exists are commonalities, upon which "best bets" could be placed. Examples he gave included electrification of vehicles and the integration of renewable energy. *Mr. Parks* further stated that the electric industry is seeing changes in demand transformation, the complexity of the grid expanding and how it is being analyzed and the vulnerability of energy infrastructure. Mr. Parks noted that some variables would remain uncertain and be shaped later on as these issues evolve. He noted that it is crucial that policies, markets and technologies be thought in a holistic manner for the future vision of the grid.

From this discussion, *Mr. Parks* questioned whether or not there is one comprehensive vision of the future of the electric grid. He stated that currently his team does not have such a single vision. However, he emphasized that what is being undertaken is a discussion of the idea of how can we enable a seamless cost-effective electricity system from generation to end use, capable of meeting the clean energy demands and capacity requirements of this century while allowing consumer participation and electricity used as desired- consumer choice. While this idea is being solved, *Mr. Parks* stated that the grid could not lose the attributes of accessibility, reliability, low cost, and service as this a package, a trade off for flexibility on other options. *Mr. Parks* asked the EAC how this was possible without adding costs to the system.

Mr. Parks emphasized that a single goal for the future of the grid seems like a complicated and impossible task, the grid must be improved to improve the rest of the electrical system. Drivers for this modernization include President Obama's President's goal of a significant scale up of clean energy, broad definition of clean energy of 80 percent, maintaining global competitiveness and leadership in the technology arena and a reliable, secure and resilient grid. He stressed that this goal of modernization is too important to not accomplish and that new paths would have to be uncovered in a proactive manner to optimize on investments.

Mr. Parks and his team have done some initial analysis on where opportunities for grid modernization might be leveraged. *Mr. Parks* reported that one such area of note was power electronic devices. However, he noted that one question surrounding this technology was how to get a price effective device in the longer term. *Mr. Parks* stated that it was key to allow 100 percent consumer participation and choice in the resulting technologies and market structures.

Mr. Parks continued the presentation by asking the EAC members for their input on what goals should be determined for the grid of the future. He stated that his team is currently still defining what goals are necessary and possible to achieve and scale up to a national level. Some uncertainties about the scalability revolve around the direction that advanced modeling computational tools to perform these functions will develop. Secondly, the future a hybrid grid (i.e., AC-DC) is uncertain, especially for what use in the end sector, at the transmission planning level and in designing system flexibility. He noted that currently DOE is very interested in energy storage technologies, but that these also have certain uncertainties built into them as well. To emphasize the fact that the goals and vision of the future grid are not certain, Mr. Parks suggested that there was a need for a portfolio of options across DOE. This is possible with current and planned robust projects occurring, from basic science to partnering in the market place.

Mr. Parks noted that there are many agencies, actors and organizations involved in the planning of a future grid. These factors can lead to institutional complexity and be potential barriers to change and innovation due to risk aversions and the extensive process of gaining buy-in. *Mr. Parks* stated that this complexity necessitated an environment of innovation and avoiding risk aversion to change while still preserving consumer rights and protection. He emphasized that providing dynamic protection privacy in cyber security was necessary for the future grid.

Mr. Parks suggested that the Recovery Act Smart Grid project could be a focal point for his Grid Tech Team activities and could help engage multiple stake-holders including the utilities, PUC's, academia, and government. Another important role for these projects would be to serve as a test-bed for components, software, security, operations, and help to address institutional barriers, educate, and convey DOE's vision to the public.

Mr. Parks closed by stating that the next steps for the Grid Tech Team were to meet in November 2011 and also the National Electricity Forum in February 2011 to gather DOE and outside points of view. These meetings will help inform their long term goal developing a strategic roadmap for DOE activities.

EAC members, *the Honorable Robert Curry*, *Michael Heyeck*, *Irwin Popowsky* and *Gordon van Welie***,** provided responses to *Mr. Parks'* presentation.

Mr. Curry's response to *Mr. Parks'* presentation

Mr. Curry responded that he brings with him an understanding of the sensitivities of trying to please various political interests. In light of this, *Mr. Curry* stated that *Mr. Parks'* presentation did a good job of trying to synthesize irreconcilable views on reforming energy policy. *Mr. Curry* noted that the state of New York is in sync with the energy goals *Mr. Parks* presented, being a founding member of RGGI and pursuing carbon emissions reduction goals by 2015. *Mr. Curry* agreed with *Mr. Parks* that the emphasis on the development of utility scale energy storage and decreasing the size and cost with DC converter stations is a good focus to take the grid into the future. *Mr. Curry* noted that on-site energy storage would allow optimum use of the existing transmission system, renewable energy, and avoid new construction in New York and it surrounding suburbs which is relatively expensive. *Mr. Curry* also noted that the cost of convertor stations and their large footprint are limitations of the current application of DC converter technology. He stated that any focus in investing further in pilot projects in DC converters are projects that should be considered.

However, *Mr. Curry* cautioned that the version of the grid presented by *Mr. Parks* appeared to be optimistic in some respects and should be re-evaluated based on cost, time and public perception constraints. *Mr. Curry* said that a ratepayer impact assessment would be useful in assessing costs for the modernization of the grid. *Mr. Curry* then asked *Mr. Parks* to clarify what DOE means by a "smart grid." *Mr. Curry* asked for this clarification as he stated that in his opinion DOE's the goal for 26 million smart meters in homes and a business by 2013 is costly and a significant burden on ratepayers. *Mr. Curry* then went on to offer that it is highly unlikely that New York be able to contribute to this deployment of part 26 million smart meters in homes as the distribution system component is too costly. *Mr. Curry* pointed out that in New York a recent survey by ConEd showed that there was no significant interest in management of energy usage.

Mr. Curry stated that a doubling of nuclear energy by 2035 was necessary to decrease the dependency on any one fuel source to achieve diversity of resource mix. *Mr. Curry* disagreed with *Mr. Parks'* assessment that there will be a long-time frame for natural gas shale to make a transformation. He stated that there are promising opportunities, such as Utica and Marcellus, in which there has been an interest to drill. He noted that doubling our nuclear capacity will required reconstruction of the existing stations and then some, resulting in a significant financial undertaking. He noted that DOE is aware of the cost of building replacement plants in states where generation and distribution have been separated. This could lead to a large ratepayer burden. *Mr. Curry* stated that there needed to be choices made about what back-up fuel will be for electric generation. In his opinion, investing in nuclear fuel would be worth this financial burden.

He noted that the trend over the last 10 years is that for every generator built, it was fueled by natural gas. Therefore, he argued that we would continue to see more natural gas expansion than nuclear in

near term giving political and financial considerations. Mr. Curry concluded that given this division on where the future fuel of the grid will be, the vision of grid must be tempered by the realities of the electric industry.

Mr. Curry emphasized that safe and reliable service, available to the consumer at affordable prices is the goal of the New York Commission. In order to complete this goal, it is necessary to examine the aging distribution infrastructure and how to rebuild it. For example, as New York cuts back on air pollution, its fuel needs will change. *Mr. Curry* questioned how replacing and rebuilding the distribution system was to be financed. *Mr. Curry* explained that for New York, this was a question of whether or not to continue a 1 billion dollar subsidy for energy efficiency and renewable energy standards. According to *Mr. Curry*, the Commission felt that this was the only available option at the time, and so the subsidy was continued. *Mr. Curry* used this example to illustrate that because of the stalemate by the federal government on energy policy, State Public Utility Commissions are making these energy policy decisions. As such, there is a vision at every level. *Mr. Curry* stated that there is a need for the federal government to harness these visions to get a unified vision nationally.

Mr. Curry continued to make some observations about what he thought energy priorities should be. He stated that energy storage should be the first priority. *Mr. Curry* argued that that is might not be necessary to eliminate all congestion. Compared to the costs of new transmission construction along the east coast and to the east coast, what looks like high levels of congestion in some places is actually economic when compared to the cost of system upgrades. *Mr. Curry* noted that this is in agreement with Mr. Parks' recommendation to pursue "no regrets," high value propositions. *Mr. Curry* stated that with regards to modeling and the N11 contingency analysis, it is already mandatory in the bulk electric system under NERC and that current electrical models reflect reality. He went on to state that economic planning is inaccurate because it is difficult to forecast economic parameters. According to *Mr. Curry*, one of the most difficult aspects would be establishing a dialogue with local regulators. It is here where DOE needs to be careful to reach out to the state regulators, and not neglect to engage them. *Mr. Curry* also suggested that there was a need for a federal/DOE backstopping siting authority to provide incentives to keep the process moving forward and not stall indefinitely. *Mr. Curry* agreed with *Mr. Parks'* presentation that there was a need for need for codes and standards. He added that the state of California has developed their codes and standards well. He suggested that there might be ways to encourage this aspect of a California model for implementation that will allow the facilitation of similar codes and standards nationally.

Following *Mr. Curry's* response, *Mr. Parks'* and EAC members provided follow-up comments.

Mr. Parks' responded to *Mr. Curry's* observation that the federal government would intrude into the states' ability to solve their own problems. *Mr. Parks'* assured the EAC that that is not a role that the federal government wanted to take on. He commented that he believes that partnerships at all levels are the most constructive method to solve issues and find workable compromises. *Mr. Parks* also responded to concerns about DOE's vision for the future of natural gas growth. He agreed that DOE should look at this scenario more closely, but noted that while there are multiple solution sets that DOE has offered, DOE is not necessarily advocating a specific one.

Mr. Curry responded, noting that he still disagreed with DOE's assumption of the average for natural gas in future scenarios. *Mr. Parks* then asked *Mr. Curry* to explain his vision of how to forecast the use of natural gas in the future scenarios. *Mr. Curry* stated that the difficulty DOE's projections are contrary to industry expectations of a significant growth in natural gas that it does not portray the visions of a future grid as necessarily viable.

Roger Duncan suggested that DOE look to the reports prepared by the International Energy Agency (IEA) which is the standard look at future projections. *Mr. Duncan* noted that there has been a consensus as far as the rise of gas and that there currently are not projections for 40 percent nuclear, over the timeline DOE has presented. *Mr. Parks'* clarified that DOE intentionally took some 2001 data and built the forecasts based on this data in order not to overemphasize the near term. He noted that often forecasting is unpredictable and difficult to get right. He noted that in the past years the discussions around fuel mix have all been different than that of today's discussion. As such, *Mr. Parks* cautioned that the EAC should not put too much weight upon the immediate future scenarios.

Mr. Heyeck's response to *Mr. Parks'* presentation

Mr. Heyeck began his comments noting that the industry is risk-adverse, and that as a result innovation in research and development suffers. *Mr. Heyeck* noted that part of this paralysis is due to the number of actors and regulators involved in the decision-making process. Because the energy industry is so fractured into many different sectors and because the electric industry is as well, that began that construct for organizations such as the Department of Energy and the Electric Power Research Institute (EPRI). These two organization's plan for the future of the grid must be linked together. *Mr. Heyeck* also commented that currently the industry tends to extrapolate a future based upon what is occurring now, without knowing what discontinuities might occur. *Mr. Heyeck* believes that one such discontinuity is that the industry is currently very centralized in its processes. However, there will be a move towards decentralization. What is unknown is the scope and characterization of such decentralization. However, *Mr. Heyeck* stated that based on a survey of certain technologies, such as community energy storage, solar and micro-grids, in the next 20 or 30 years, the industry will not be fully decentralized, but reach a medium in between complete centralization and decentralization. *Mr. Heyeck* stated that it is from this point of view that one should consider *Mr. Parks'* presentation.

In order to address what future needs of the "21st century consumer" the three pillars of the grid are the grid (the physical assets), real-time control and the operator of the assets. By understanding these drivers and the needs of the future customer, there will be an insight into what are the drivers of the change in the industry and possible discontinuities. *Mr. Heyeck* noted that almost a third of infrastructure assets in the United States are at or near the end of their useful life, and will need to be replaced. The essential question then becomes, will these assets be replace in kind, or replaced with more efficient, secure, technology? *Mr. Heyeck* believes that DOE has a role instrumental in providing standards to facilitate enhanced efficiency.

According to *Mr. Heyeck*, a second driver is fuel rationalization. They key point is what the next fuel source: gas, nuclear, wind, solar? With these two points in mind the third driver must also be included in the discussion- the 21st century customer and their reactions to characteristics of electricity delivery, such as outage management. *Mr. Heyeck* pointed to EPRI as a good body of research and knowledge to help address these issues.

Mr. Heyeck continued to address two boundaries, between the utility and competition and between DOE and the manufacturer. For the first, if the boundary moves, a different type of R&D profile incentive will be created that might yield improvements in the future. For the second, he noted that it is important that the manufacturers be motivated, and that the market is an appropriate place to do this to develop better technology. Making equipment more modular so they can separate out the 40 year old life equipment, from the life of equipment that is "plug and play" is a crucial technology development.

In response to *Mr. Parks'* comments about HVDC, *Mr. Heyeck* stated that the lines are more efficient and that once a DC circuit breaker is developed, the paradigm of going to AC and back to DC again will not exist. He noted that as the aging assets are replaced, with the better use of right-of-way, HVDC will play a larger role in the future of the grid. *Mr. Heyeck* commented that larger control areas are necessary as the method of small control areas and small balancing authorities will not be viable in the future. *Mr. Heyeck* believes that larger balancing authorities will be necessary to address market issues and intermittency.

On the issue of wide area monitoring and control, *Mr. Heyeck* supports the installation of synchrophasors. However, he commented that the infrastructure behind the phasor measurement units (PMUs) must be upgraded. He argued that data collection, data visualization needs to be advanced in order to have better wide area monitoring and control. *Mr. Heyeck* cautioned that the necessary inclusion of cyber-security could be a barrier to this technology development.

Mr. Heyeck concluded his comments, stating that there could be many unknown "game changers" in the equation and that these might be viable options for the future of the grid.

Mr. Popowsky's response to *Mr. Parks'* presentation

Mr. Popowsky started his response with a quote from the New York Public Service Commissioner Chairman stating that approximately one million electricity consumers in New York, in New York State, are currently more than 60 days in arrears on their electric bills. *Mr. Popowsky* explained that this meant that these consumers had not paid their bill this month, nor paid the bill last month. This statistic is important because the repercussions mean that these consumers are in danger of losing this essential, life-sustaining service. *Mr. Popowsky* stated that this evidence tells us that the nation needs to change the way in which electricity is produced. He suggested that these changes might increase the cost of electricity significantly and therefore make it even more difficult for customers to pay these monthly bills. *Mr. Popowsky* stated that from his consumer advocate perspective, the great challenge for this industry and the nation is how to ensure universal availability of reliable and affordable electricity service in an environmentally sustainable manner. *Mr. Popowsky* did not think that the intent of the

vision is different from the DOE vision. *Mr. Popowsky* quoted Mr. Park's presentation, noting both their visions are to enable a seamless, cost-effective electricity system from generation to end use capable of meeting the clean energy demands and capacity requirements of this century.

Mr. Popowsky stated that the traditional interpretation of the grid is the generator at one end and the end user at the other. *Mr. Popowsky* commented that when examining the DOE vision from this perspective, he agreed with the technical recommendations for the transmission and distribution system that make up the bulk of the report. *Mr. Popowsky* also agreed with *Mr. Heyeck* that there is aging infrastructure that needs to be replaced with the most cost-effective, advanced methodologies to get the cleanest, lowest cost power from the generators to the end users. He further agreed with the statement that there is corresponding technology in place to allow consumers to receive the greatest possible benefit from the grid.

Mr. Popowsky agreed with the presentations finding regarding consumer participation in the smart grid initiatives. He agreed that allowing consumer participation as desired is necessary and that enabling customer participation into electricity markets and demand response should occur, and the goal of allowing 100 percent customer participation and choice. *Mr. Popowsky* noted that the phrasing of these quotes were very distinct from other language such as require or mandate or assume. *Mr. Popowsky* then argued that his interpretation of the DOE vision does not assume that all or even most customers, residential customers in particular, will choose to become active participants in retail electricity markets or time of use rates or peak pricing programs. *Mr. Popowsky* agreed that this vision does not require such participation. *Mr. Popowsky* argued that DOE is seeking to make such programs available to the extent that customers desire or wish to participate, and that this was the correct approach.

Mr. Popowsky stated this is a relevant distinction he has not seen active interest in many of the residential pricing services that the smart grid may have to offer, even where consumers have had extensive exposure to these programs. *Mr. Popowsky* agreed with *Mr. Curry* that many consumers will be able to save money and many would not, just as many will not be able to change their electricity usage patterns and benefit. *Mr. Popowsky* then explained that this was the reason why the language used in the DOE mattered. These programs and technologies should be available to consumers, but one should not necessarily rely on consumer participation in these programs in order to justify them.

Mr. Popowsky commented that consumer energy efficiency should play a larger role in the national energy goals and DOE vision of the future grid. He stated that many programs exist that can be leveraged for consumer participation, such as appliance efficiency standards, building code standards and conservation programs. *Mr. Popowsky* commented that this is almost certainly the cheapest first step, toward achieving that energy efficiency. *Mr. Popowsky* observed that the pathway to the national goal of 80 percent of electricity from clean energy resources isn't clearly defined by which clean energy resources. While he noted that the presentation was not designed to address this, he urged that fundamental changes in the electric generation mix will be needed to reach such goals. *Mr. Popowsky* agreed with previous commentators that it is not logical to assume that there would be a decline in natural gas generation, as set forth by *Mr. Parks'* forecasts.

Lastly, *Mr. Popowsky* disagreed with the conclusion about institutional complexity and all the players. *Mr. Popowsky* noted the statement that the multitude of stakeholders and key actors are barriers to change and innovation, due to risk aversion and extensive process of gaining buy-in. *Mr. Popowsky* concluded his comments, arguing that in some respects, the multitude of stakeholders and actors can also be a source of innovation and that ideas can come from the state level and the regional level up, not just from the national level down.

Mr. van Welie's response to *Mr. Parks'* presentation

Like the previous responses, *Mr. van Welie* took issue with the natural gas statistics presented by *Mr. Parks*. *Mr. van Welie* stated that operational interdependencies will ultimately require investment in observability between the systems. He commented that as the nation sees a decline in conventional coal that gap will be filled by natural gas. As such, this interdependency is going to become an issue in the future.

Mr. van Welie next responded to the issue of institutional complexity. From his perspective, there are two worlds: one dimension being the split of responsibilities between the FERC and the state regulators and then the other dimension being how far the states have actually allowed restructuring to go within their industries. *Mr. van Welie* stated that these two worlds are very different if you are a planner.

According to *Mr. van Welie*, the only space to plan holistically is in the vertically integrated structure, where there is one regulator. He noted that in the decentralized or restructured parts of the industry where you have the organized, wholesale markets, the ISO/RTO planner is really dealing with the result of the competitive markets. *Mr. van Welie* observed that the premise is that the ISO defines the services it needs and lets the marketplace respond to provide those infrastructure investments that will meet those requirements. As such, *Mr. van Welie* argued that it might be almost impossible for the ISO planner to plan holistically because, by definition, the ISO planner would have to adopt a central planning role. *Mr. van Welie* continued that given the split in the jurisdictions and the myriad of participants in the marketplace and an uncertain future from a technology point of view, it might be best to not plan holistically, but instead design a method to allow the industry to evolve organically in a way that is efficient. *Mr. van Welie* commented that standards are necessary for this design, especially for interaction and communication of devices.

Tying this point into the discussion of AC/DC hybrid configurations, *Mr. van Welie* stated that while he thinks DC is a good technology, he questioned whether or not DOE should have a strong focus on this one technology in their vision for the future of the grid. *Mr. van Welie* commented that while DOE can influence design, the role of planning has effectively already been given to the regions to determine cost-effective solutions to the reliability problems facing that region. According to *Mr. van Welie*, this means that the grid will evolve according to market economics, the actions of state regulators and market participants. He observed that this would be difficult to control.

Mr. van Welie agreed with *Mr. Parks'* comment that a role for DOE would be to take certain technologies to the point where they become cost-effective, whereby this technology would become a tool for planners to implement.

Mr. van Welie agreed with *Mr. Parks* that there is a need for advanced monitoring capabilities. As the grid becomes increasing complexity in terms of grid operations with highly variable and limited energy supply on the system, matched to highly variable demand, micro-grids, and demand response, the amount of variability on the system is expected to increase, and the complexity will increase. *Mr. van Welie* proposed that current modeling and applications will not be able to handle this type of increased variability. Investments in this area will need to be made.

Mr. van Welie offered some thoughts on what he expects to see for the future of the grid. *Mr. van Welie* stated that the industry was going to evolve fast in terms of the communication interaction between wholesale and retail, which would completely bypass the substation. He stated that communication between wholesale and retail will open up and it will be appliances like the electric vehicle that will drive that. Based on this thought, *Mr. van Welie* suggested that a better approach would be to develop a framework for interconnectivity and not predetermine what the outcome will be. This would again necessitate standards. DOE can play a valuable role in examining what is currently occurring, and facilitating convergence to encourage productivity in the industry. This would help diminish the chance of stranded assets, as well as islanded investments.

Finally, *Mr. van Welie* commented that DOE's emphasis on cyber security correct. *Mr. van Welie* observed that cyber security will be a key issue and it will need to evolve as fast as the industry around it will.

Following *Mr. Curry*, *Mr. Heyeck, Mr. Popowsky* and *Mr. van Welie's* responses, the floor was opened for EAC members and *Mr. Parks* to provide follow-up questions and comments. The discussion is summarized by topic below.

Discussion on a Centralized or Decentralized Approach to Transmission Planning

Edward Krapels commented that DOE has valuable role to play if the regional laboratory concept continues now and in the future. *Mr. Krapels* believed that in the future the U.S. would continue to be a nation of regions, electrically, and that therefore DOE's ability to remain impartial and facilitate different solutions and standardization of types of rules and regulations and technologies is unique.

Joseph Kelliher commented that there is more uncertainty today on what future electricity supplies will be than any other 20 year horizon he can remember. *Mr. Kelliher* also commented that there is uncertainty on what demand patterns will be, and also about energy technology. *Mr. Kelliher* suggested that *Mr. Parks* understated the institutional barriers. *Mr. Kelliher* stated that institutional barriers prevent the grid from changing, causing stagnation. *Mr. Kelliher* said that institutional barrier were in part the ownership structure of the grid. He noted that there are 500 donors in the grid and a third of

the grid is owned by the Government, and that each donor acts for different motivations. Additionally, most of the grid is owned by vertically integrated enterprises and that the grid is sited under laws that assume local delivery, assuming no interstate grid. *Mr. Kelliher* observed that these are all substantial institutional barriers. *Mr. Kelliher* disagreed that there would be standardized citing and permitting processes within the near term. *Mr. Parks* agreed that the solution is not likely to occur within a short time frame.

Mr. Kelliher disagreed with Mr*. Popowsky* in that stakeholder processes could be a valuable process, except where there are many opinions but no consensus. *Mr. Kelliher* added that fractured nature of decision making, at least at the regulatory level, is pretty stark. Another institutional barrier that *Mr. Kelliher* identified was the nature of traditional rate regulation, noting that often it is constricting to technology. Lastly, he added that institutional barriers will at the very least slow down change, if not actually prevent it all together. *Mr. Parks* agreed that this was perhaps the most pressing challenge to overcome.

Discussion on the Future Role of Natural Gas in the Electricity Fuel Supply Mix

Mr. Krapels suggested that DOE might be useful as a guardian of the idea of portfolio and risk diversification instead of imposing certain standards for what these should be. *Mr. Krapels* noted that the Federal Energy Regulatory Commission (FERC) also performs this function, suggested that DOE might have a stronger role to play in this respect.

Mr. Curry commented that with while the current enthusiasm of shale development and transportation and ease of access can keep the domestic price levels higher, that is not the global case.

Discussion of Transmission Options for the Smart Grid

Mr. Curry questioned who pays for distributive generation. He asked if the expectation is at the local level of if it was the responsibility of the state Commission. He also pondered if redundancy would need to be built in, or if the owners of distributive generation would take on that risk. He suggested that was a financial a scope issue for the responsibility of the incumbent regulators, utilities, delivery systems, etc.

Mike Weedall emphasized that it is important to examine the non-wire solution, non-construction alternatives to transmission. He pointed to the increasingly difficult challenge of getting transmission sited.

Tom Sloan agreed that there was insufficient attention to the use of transmission innovation to better use our existing corridors. *Mr. Sloan* proposed that DOE should be examining these issues. He also suggested that once the stimulus money has been spent, there would be an institutional struggle facilitating policy maker education to encourage and reward first adopters. However, *Mr. Sloan* emphasized that customer benefits would not occur if everyone waits for someone else to do it. *Mr. Sloan* also agreed that could lead research and facilitation and encouragement and technological exploration, did not see any other actor who would fill the role of educating the decision maker. *Mr.*

Parks agreed that DOE we should emphasize the role of education more, but that DOE has struggled with the perception that education is not a traditional technology-based agency's role.

Discussion of Defining the Vision for the Future of the Grid

Wanda Reder stated that the EAC and industry must expand beyond traditional boundaries in order to get a vision that can garner consensus. She commented that this would involve more consumer participation. *Mr. Parks* responded that the key is to study and understand, from DOE's viewpoint, where those interfaces are positioned. He acknowledged that this point was important, noting that traditionally DOE is not good at "non-stovepipe" activities. *Ms. Reder* responded that DOE should work to engage regionally in its vision outreach.

Ms. Reder also commented that the grid has been underinvested in and the assets are aging. She pondered what amount of investment that would take to acquire appropriate technologies inserted at the appropriate places so that the grid is positioned for the future. *Ms. Reder* proposed that there should be more of understanding of the rate of aging assets and the implications of different scenarios different scenarios to facilitate conversation about grid modernization. *Mr. Parks* agreed that DOE is looking to examine concepts and not focus just one solution.

Ms. Reder also commented that moving forward with lessons learned from DOE's stimulus projects is a useful exercise, noting that there are successes that can be advocated currently.

Ralph Masiello commented that a common theme in EAC comments about the vision of a future is uncertainty. He added that the utility industry does not understanding uncertainty and know how to value on flexibility.

Assistant Secretary Patricia Hoffman recognized that predicting the future is near impossible and change is tough. She added that the industry needs to strive for additional capabilities, to make decisions are built on analytics and costs and benefits. *Assistant Secretary Hoffman* noted that as more information is reported and is analyzed, there will be a better understanding of what the future grid will look like. She suggested that expectations of the grid will have to be examined closely. *Assistant Secretary Hoffman* stated that her office has tried to examine the metrics behind the expectations should be, but that this analysis is very difficult or perhaps a series of metrics. She acknowledged that whatever metrics are developed and used will inevitably spill over from the electric industry to others, such as natural gas infrastructure. Therefore, the interdependencies of those infrastructures will have to be examined to tie such expectations into the future vision of the grid. *Assistant Secretary Hoffman* commented that DOE would be taking a regional approach as DOE evolves the electric grid. She asked the EAC members to take this view, but to also examine the grid with other regional neighbors and participants in mind.

David Meyer continued the discussion of the future of the grid by talking about the future of research and development funding. I've been struck so far at how there's been, no one has mentioned the availability of research and development money. He noted that the uncertainty regarding this funding makes it necessary to have a clear sense of priorities and get as much input as to how to address this range of possible research and development topics and research and development projects with limited funds.

David Nevius added that a company named Analysis Group for Regional Energy Alternatives (AGREA) has a method for multiattribute scenario analysis. This method is to bring together people with various positions and desires to reach some agreement. Instead of prescribing a centrally planned solution or letting everything come up from the bottom, it brings all of that together in a framework that allows people to reach agreement. *Mr. Nevius* recommended that the EAC look into this technique. *Mr. Parks* noted that he is familiar with this technique and would look into it more closely. He added that Sandia National Laboratory and other laboratories were working on one project for the energy, water and access issues that have some front-end tools that have a lot of embedded data in them that would be relevant for this thinking.

Mr. van Welie suggested that DOE might try the approach of not defining a specific end vision, commenting that whatever the vision resulted might be resisted in some form or fashion. He explained that rather than trying to define a vision in physical terms or in terms of outcomes, it might be a better approach to define the in terms of the principles DOE would like embodied in the regional solutions. *Mr. van Welie* also stated that it is very hard to determine a future vision if the future is uncertain. *Mr. van Welie* also suggested that it might be helpful if DOE picked certain technologies that are close to a breakthrough and might dramatically change outcomes, in order to stimulate research and development investment in those areas.

Mr. Krapels agreed with *Mr. Nevius* in that it would be very helpful to the EAC if the research and development options and dilemmas were presented at a less aggregated level.

Chairman Cowart closed the discussion for the day, commenting that the nature of this document and the process and the conversation is to emphasize this is a "living document" and a conversation that might result in being regional in nature as it evolves. He agreed that there would not be a single, national view here. *Chairman Cowart* stated that this showed the need for DOE to have a coordinated strategy. *Chairman Cowart* commented that this discussion might be an appropriate topic for the EAC 2012 Work Plan.

Public Comments

Comments from *Derek Bandera*, GenOn Energy

Mr. Bandera stated that there would be significant changes on the grid and grid reliability in the future. He suggested that a topic the EAC might choose to discuss would be the transition to the future following the EPA environmental regulations to be enacted shortly. *Mr. Bandera* stated that as GenOn is a former Mirant Company, it had a run into circumstances relating to the DOE Emergency Authority under emergency situations. *Mr. Bandera* explained that DOE can direct generators to run and that the environmental regulations put pressures on units that are not in the market anymore, or are being retired or in the process of being upgraded. He commented that the importance of that backstop emergency authority will be something that people will look to. He suggested that a critical element of using the emergency authority is understanding the instances that it has been used, but has not worked well because of environmental conflicts.

Closing Remarks, October 19th, 2011

Chairman Cowart thanked the EAC members and other attendees for contributing their comments to the discussion and adjourned the first day of the October 19th and 20th, 2011 meeting of the EAC at 5:05pm EST.

Welcome and Opening Remarks, October 20th, 2011

Richard Cowart, Chairman of the DOE Electricity Advisory Committee (EAC), opened the meeting by thanking everyone for attending. *Mr. Cowart's* comments were echoed by *The Honorable Patricia Hoffman*, Assistant Secretary for Electricity Delivery and Energy Reliability (OE), U.S. Department of Energy (DOE).

Panel Discussion on Micro-Grids

Ralph Masiello gave the introduction for the first panel. Mr. Masiello explained that this panel was to help the Energy Storage Subcommittee evaluate whether some aspect of microgrids should be a topic for the 2010 Work Plan. The panel presenters included *Merrill Smith*, *Robert Lasseter* and *Brad Nickell*.

Merrill Smith, DOE Program Manager, presented DOE microgrids activities and the future direction of the microgrid program.

Ms. Smith began with an overview of the microgrid work performed under the DOE Smart Grid Research and Development program. She pointed out the Smart Grid R&D Program goals, and the long-term 2020 goals for self-healing distribution grid for improved reliability and integration of DER/FDR, electric vehicles for improved system efficiency. *Ms. Smith* also told the EAC members that areas that that microgrids can make an impact include a 20 percent saving reduction in distribution outages, greater than 90 percent reduction in outage time of required loads, and 20 percent load factor improvement,.

Ms. Smith then provided the EAC with a definition for a microgrid, noting that this definition was derived from the Microgrid Exchange Group, made up of individuals working in microgrid deployment or research. *Ms. Smith* explained that a microgrid is a group of interconnective loads and distributed energy resources within clearly-defined electrical boundaries that act as a single controllable entity with respect to the grid. A microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected or island-mode. She mentioned that the U.S. Navy and the U.S. Air Force's definitions for a microgrid closely match up to DOE's definition.

Ms. Smith next explained how microgrids fit into the role of grid modernization and support the attributes of energy efficiency, system efficiency, reliability, and security, directly impacting the distribution grid. *Ms. Smith* told the EAC that DOE has demonstration projects for the integration of renewals and other distributed energy resources, a modeling effort for distributed energy resource integration, the CERTs test bed, and the CERTS technology being used in one of those projects. *Ms. Smith* also noted that her program is working on a DOE-wide basis through Energy Surety Microgrid activities through a project called Smart Power Infrastructure Demonstration for Energy Reliability and

Security (SPIDERS) and standards development. For the demonstration projects, *Ms. Smith* explained that the primary goal was to show their ability to reduce peak load that the system saw by 15 percent. The CERTS microgrid test bed is being expanded to add intermittent sources, intermittent generation sources, some storage, and some load-shedding. The modeling effort is centered on the DER CAM model is a tool for optimizing the use of distributed energy resources in the microgrid. *Ms. Smith* explained that the SPIDERS project will be three microgrids of varying complexities. Also included in this project is a cybersecurity overlay, approved by the Department of Defense, for three bases- Pearl Harbor Hickam, Fort Carson, and Camp Smith. *Ms. Smith* also told the EAC that her programs were supporting the development of IEEE P1547, and IEEE P1547.4, a microgrid standard focused on islanded systems and connecting and disconnecting to the grid.

Ms. Smith informed the EAC that most of the current program work is focused on designs, test beds, and some demonstrations, and some analysis. Some additional research and development activities that DOE has identified are overcoming technical and cost barriers for broader acceptance of microgrids and their deployment.

Ms. Smith next talked about long-term program targets: improve system efficiencies by greater than 20 percent, reducing emissions by 20 percent, and reducing outage time to require loads by greater than 98 percent. She also mentioned that the program is looking to develop commercial-scale microgrids at a cost comparable to non-integrative baseline solutions to make these systems viable.

Based on a laboratory planning group's analysis, energy resources comprise 30 to 40 percent of a microgrid's cost component, depending upon fuel type. She noted that switchgear protection and transformers, Smart Grid communications and controls, and site engineering and construction components of the microgrid can be pre-engineered and developed to drive down costs. *Ms. Smith* noted that the microgrid itself would have to be designed for an individual site and is a cost that cannot be alleviated very much. *Ms. Smith* informed the EAC that with information gathered from her efforts, the next step would be to use this information here, given available funding, to develop a solicitation to target specific research areas in microgrids.

Robert Lasseter, Emeritus Professor, College of Engineering, University of Wisconsin-Madison, presented on the technology implications of the microgrid.

Mr. Lasseter began his presentation by linking past year's work to what DOE and others have been currently accomplishing in the micrgrid area. He explained that microgrids came about from complexity from distributed energy resources- from small internal combustion engines, microturbines- that it became necessary to deal with this complexity. *Mr. Lasseter* stated that the next step was to look at complexity of the overall power system and reliability. He told the EAC that is logical the customer level as the concept of power quality, but at the high-voltage transmission system, it is not as clear, hence the need to address this issue.

Mr. Lasseter questioned whether the correct focus was reliability or availability in terms of transmission. He stated that if there were enough sources at the user level, then outages are not as critical as long as they do not cascade out. Therefore, it might be necessary to modify design levels of reliability down to

the customer level for on a need specific basis. He argued that this is a paradigm shift. He commented that the choice was whether or not to control an individual component, and at what level of complexity. He noted that this is what the microgrid does, physically grouping these devices with the loads and make them a single controllable unit. *Mr. Lasseter* explained that there are two main drivers for microgrids- dealing with high level of penetrations or dealing with a high number of these new sources, and also really improving efficiency and reliability without relying on the utility. According to *Mr. Lasseter*, the industry has the capability to address emissions and the efficiencies, CHP transmission losses, demand-side management, and renewable energy. He noted that with respect to reliability and modularity, what is desired is "plug-and-play" to scale the system without extensive engineering relative to the microgrid itself.

Mr. Lasseter explained two models currently in use, the CERTS microgrid or the autonomous model and the command-and-control systems. The difference between the two systems is that with the control system existing generation is used with an added layer of control and communications to let it island versus the autonomous model where the component itself is modified by changing its control algorithms, so that it is "plug-and-play" enabled in a microgrid.

The main challenge with the control system model is that if the control system fails, it may not be able to function as an island. Additionally, if there was a need to want to expand the microgrid, a redesign to the design algorithms and communication systems would be necessary. The autonomous model can work without communications, but has communications on the multiple second timescale. Because the system is in the building, reliability increases as there is less susceptibility to faults in the higher voltage line with the ability to island autonomously and resynchronize. This means more flexibility and less engineering. *Mr. Lasseter* emphasized that the important aspect of any microgrid is allocating overloads. This means that more load can be added more to the system while the microgrids protect themselves by reallocating the load balance when there is a transient change in it.

Mr. Lasseter next explained the various microgrid projects that he is involved with. He explained that these projects are trying to show microgrids as a grid resource. Most grid resources either are a generator or a load internal stability. A microgrid to the utility can look at both.

Thomas Bialek, Chief Engineer, Smart Grid, San Diego Gas & Electric Company (SDG&E), presented on his company's microgrid projects and lessons learned from a utility perspective.

Mr. Bialek began by stating that when SDG&E looks to the future of the Smart Grid, microgrids and technologies give the customer more reliability options. According to *Mr. Bialek*, SDGE is starting to see homes that start to have these types of functionality associated with microgrids. As prices of PV systems drop, as electrical vehicles proliferate, and Smart appliances become more available, there will be scenarios where customers, via their choice, decide to implement these options which will provide them an additional level of functionality.

Mr. Bialek commented that part of the questions surrounding microgrids was deciding how far to take its design features with regards to outage and how long the customer needs to be islanded, for hours or for brief interruptions.

Mr. Bialek stated that SDG&E has microgrid projects examining integrating and leveraging various generations of storage configurations, reducing the peak load. He noted that a key distinction is the focus on enabling customers to become active participants by managing their energy through price-driven load management. *Mr. Bialek* said that the idea then becomes focused around how to operate the utility today. From a utility perspective, will the same types of systems or same types of criteria be applied to look at managing this local microgrid. Additionally, load generation balance between customers-i.e., industrial customers, campuses, substation circuits- will need to be examined, as well as how much reliability is desired. Ultimately, this defines the boundary of the microgrid.

Mr. Bialek concluded his presentation, noting that microgrids are in many respects an alternative service delivery model under Smart Grid that takes into account also the energy policy goals of California and is a driver for customer choice. *Mr. Bialek* commented that utilities need to be proactive to understand how to leverage this technology to provide customers with opportunities and empower them to make intelligent choices.

Following *Ms. Smith*, *Mr. Lasseter,* and *Mr. Bialek's* presentations*,* the floor was opened for EAC members to provide follow-up questions and comments. The discussion is summarized by topic below.

Discussion on Standards

Mr. Masiello voiced a concern from the viewpoint of the ISO that the interconnection standards for distributed generation in the U.S. are focused on safety, and as such disconnects occur on a fault. He questioned what would be the effect of transmission fault and possible thousands of megawatts of distributed generation tripping off. *Mr. Masiello* asked then if for the microgrid there was a need for a fault ride-through capability.

Mr. Bialek commented that SDG&E advocates an IEEE P1547.8 draft or the German Grid Code types of systems standards to achieve ability, capability, flexibility. *Mr. Lasseter* responded one of the main objectives of the CERTS microgrid was to deal with stability in a practical sense. He noted that stability issues arise when systems are exporting large amounts of energy lot of energy from a microgrid and then whether riding through or tripping off becomes a situational type of problem. However, demonstrations have shown that there are no stability issues based on the microgrid itself

Discussion on Building Automation and Microgrids

Mr. Masiello commented that a key element of any microgrid installation is building the grid system and the integration of the building automation systems*. Mr. Lasseter* responded that the intent is to integrate this quality into microgrids. He noted that Oak Ridge National Laboratory previously prepared a report examining how CERTS microgrids could be integrated into the building control system.

Discussion on the Planning Tools and Financial Justification for Microgrids

Mr. Masiello asked if there were cost/benefit analysis tools being developed to help evaluate the financial feasibility and justification of microgrids as a planning tool. *Mr. Bialek* responded that part of the requirements of SDG&E's projects are to provide a cost/benefit analysis. *Ms. Smith* added that

when more projects that have microgrids, by DOE's definition, are deployed there will be data to analyze this issue. Ms. Smith stated that based on her experience to day, all utilities should go through a Smart Grid deployment planning process to address all the different issues that are being raised, both with microgrids the bigger Smart Grid integration.

Chairman Cowart commented that there are 3 different model for smart grid applications: individually Smart-metered applications with a central controlled system; the microgrid model with more autonomy behind clusters of users; and lastly an increasing penetration of renewable on the system with a need for larger balancing areas and more transmission to connect remote, larger generation sources to the network that is at the other end. *Chairman Cowart* then asked for comments on whether or not the future of the power system would be more distributed or much more integrated across larger geographic regions.

Discussion about the Utility's Role in Managing Micrgrids

Michael Weedall asked *Mr. Bialek* to explain SDG&E's policies about being a provider in an emergency event, and on a service-wide scale-up. *Mr. Bialek* commented that SDG&E is aiming to actively participate and enable these technologies. SDG&E also sees opportunities in providing a community level of microgrids where in the instance of an event people can aggregate and at least have a place where there is electricity. He noted that while customers can do this on their own SDG&E would like to be involved in this activity.

Ms. Reder commented that this changes the operational paradigm. She asked *Mr. Bialek* to comment on potential planning tools and processes and the implications of this paradigm shift. *Mr. Bialek* stated that the change comes from looking at the event from a transmission perspective or a system perspective versus looking at it from the bulk system level where the issues concerning a transmission event become relevant. *Mr. Bialek* responded that one of the challenges that we have is distribution planning and designing the system around that. With the paradigm shift, where now there is inverter-based technology, there is a need for transient studies to find out what needs to be accomplished at the distribution level. From a planning tool perspective the question becomes how to translate the data that exists from a steady-state model into a transient model. *Mr. Bialek* stated that this technology currently does not exist. There is also a need to develop planners' abilities to model disparate systems.

Mr. Krapels commented about business models and how they seem to be constantly evolving. *Mr. Krapels* believes that microgrids will evolve like the IPP model where there are independent microgrid development companies that can take the best of the technologies and then sell various products according to customer need. *Mr. Krapels* suggested that the next couple of years a number of independent microgrid initiatives with all of the attributes of IPPs will emerge. *Ms. Smith* commented that she has already seen this shift within the industry. She noted that this change is evolving from companies that have a microgrid system and then are going beyond being the technologist who supplies the system. *Mr. Lasseter* agreed that this is a promising direction. *Mr. Lasseter* replied that what is missing from the current discussion is what the distribution control system needs to know and what the financial implications are of a system with certain characteristics and constraints.

Discussion about International Microgrid Applications

Mr. Krapels inquired what research on international microgrids has been performed, specifically in Germany, Japan and Singapore. *Ms. Smith* responded that DOE participates in CIGRE, which is looking at microgrids, has worked with the Chinese, and that the Japanese are conducting several demonstrations in the U.S.

Discussion on Regulatory Rules Regarding Microgrids

Jose Delgado commented that both technical and regulatory aspects need to be addressed. The regulatory aspect is usually a question of who pays. *Mr. Delgado* stated that basis electric service is something everyone pays for, while those who require premium service pay for it themselves. *Mr. Delgado* observed that reliability is a driving force for microgrids. He noted that customers are these drivers, such as the military, need reliability at an extremely high level. *Mr. Delgado* questioned how to reconcile the needs and services of those who need this service with those that need basic service. He asked if anyone was looking at a policy across the system where the bulk of the consumers do not really need that level of reliability.

Mr. Bialek commented that in the long-term, this issue is a discussion about how rates are structured and how utilities recover their costs. *Mr. Bialek* questioned if in the differentiated levels of reliability would be offered. *Mr. Bialek* commented that state regulars might take issue with this concept, arguing that all customers are equal. He suggested that customers should only pay for the service they want. *Mr. Bialek* offered the opinion that in the long-term differentiated levels of reliability should be a service that the utilities should be able to offer.

Mr. Curry added that it has been the experience of many different states that there has been a separation of generation and distribution. In that process, the ratepayers who paid for the generation were paid for its disposition to the private sector. Mr. Curry observed that in jurisdictions where there is no separation of generation and distribution a "cannibalizing" of the system took place where the value of the generating assets was diminished by substituting in a microgrid setting potential generation on the autonomous basis. He concluded that this is essentially cannibalizing the system that other people have paid for. *Mr. Curry* asked what the thinking on this challenge is from a reliability standpoint, to the extent that the system is backstopping microgrids in any jurisdiction.

Mr. Sloan suggested that there was a need for net metering; i.e., letting the small ratepayer subsidize the bigger guy who could afford to go off grid. He noted that moving from the reliability components of a microgrid, which a utility can help manage, to that being an independent aggregation with an independent power source will have customers fleeing the traditional utility. As this happens the rate of recovery of investments and affordability of electricity begins to become concerning to him. *Mr. Sloan* stated that it was the role of DOE to helping state commissions, public policymakers, and utilities understand what the impact on the ratepayers, on the utility, and on that provider of last resort.

Mr. Masiello commented that there can be an economic case for microgrids in many places without the reliability issue. *Mr. Masiello* said that in his opinion it is not hard to see a future where increasing percentages of load cannibalizes. As such, the industry needs a roadmap for this outcome.

Chairman Cowart asked for comments on how a competition versus regulation debate might unfold for microgrids. *Mr. Bialek* responded that SDG&E has been examining the challenge of recovering cost without unduly burdening those who cannot afford the installation of their PV system. He answered that they have taken the first step by filing is in front of the California Commission. He suggested longer-term the rate structures need to change and that how utilities recover authorized rate of return should change as well. SDG&D believes that the future will have more distributed architecture than what it is today based on California energy initiatives. In this case, *Mr. Bialek* sees a hybrid model at some point, with high level larger systems with more integration, but also very distributed at the local level.

Assistant Secretary Hoffman added that there are critical loads, critical assets, and so not all loads are equal. She questioned that as the industry examines reliability and different levels of reliability, what needs to happen to manage critical loads and critical assets on the system.

Discussion about Investing in Microgrids

Mr. van Welie commented that there is an opportunity for DOE and FERC to work together more closely. He noted that FERC is creating substantial incentives through a number of mechanisms. The past few years, many of the ISOs have allowed demand response to play through the capacity markets. And just recently, FERC came out with Order 745, which would pay demand response sources the full locational marginal pricing (LMP). *Mr. van Welie* explained that usually the consumer would look at the benefit coming from avoided consumption as being the only incentive for making an investment. Now, FERC will pay full LMP for the balancing service that is being provided to the group. As such there is more bigger incentive invest in microgrids because microgrids as another form of demand response. Mr. van Welie suggested that there is an opportunity for closer collaboration between DOE and FERC to in terms discuss technical issues and cost allocation issues.

EAC Energy Storage Technologies Subcommittee Framework White Paper Discussion

Mr. van Welie provided a description of the section addressing congestion capacity. *Mr. van Welie* summed that the implication of a congestion capacity product is that the market or the ISO should solve the congestion. He argued that congestion is a price signal that reflects a transmission constraint or dispatch efficiency. With regards to congestion, some benefit and some do not attain benefits. The incumbent generator benefits because they are getting dispatched and they are getting their price. The losing group in this situation is the consumer. The price signal is a signal to the consumers affected by that congestion, or the agent, acting on behalf of those consumers, to take action.

Mr. van Welie proposed two ways to address congestion. A first way one is through a financial hedge, such as a financial transmission, and a second is to make an infrastructure investment. He stated that only when the cost of the alternative rises or is less than the cost of the congestion will the consumer or their agent be incented to actually do something about it. *Mr. van Welie* noted that the discussion And I around microgrids is a good example. He observed that were it not for that congestion signal, the person sitting in that load pocket might not see the financial incentive to actually go and make the investment in the microgrid.

However, *Mr. van Welie* disagreed with the notion that the ISO should be solving the very problem it is signaling. Instead, *Mr. van Welie* offered that the ISO should create a price signal for the market place through market design.

Mr. Masiello asked for EAC comments to the Draft Energy Storage Subcommittee White Paper. Chairman Cowart commented that it is important address thermal storage and managed charging of vehicles as performing a lot of the services that we think of when we think of storage. He explained that if we are looking for systems that will take advantage of variable renewable resources when load is low; we ought to be thinking about storing that value in hot water heaters, icemakers, and charging vehicles in the middle of the night, etc. He noted that many of those functions are similar to storage. This will likely be the dominant way to use off-peak generation resources to avoid lost resources.

Assistant Secretary Hoffman commented that an important attribute for energy storage is to be cost-competitive or that it can provide the services for the least cost or market-competitive. She stated that from DOE has preformed congestion analysis in 2006, 2009, and in 2012 and that the markets are setting prices, but there is as of yet no resolution. *Mr. van Welie* responded that in his opinion congestion does not necessarily have to be completely alleviated. In fact, it might be the most economic result, to live with that congestion. As congestion rises, reliability becomes a problem and the ISO or the market operators have an obligation reduce the reliability threat to a much broader area than just a local area, typically through transmission investment. *Mr. van Welie* observed that this is also an economic signal, but ISOs are limited in their role in the market.

Mr. Krapels suggested that the DOE congestion study is not one of the more critical and useful things that the Department does because congestion is an energy measure, while the electric system is energy plus capacity. He noted that FERC Order 1000 will become a large driver of transmission and microgrid investment.

Assistant Secretary Hoffman asked the EAC to comment on how to value storage that is put on a residential premise. *Mr. van Welie* commented that he thinks there is a value stream today for storage resources where they can meet the services as expressed by the system operators today already. However, he noted that this is limited, but expects it to grow in the future with the growth microgrids and renewable and highly-variable demand creating a greater degree of flexibility by market resources. He noted that the system operators will have to evolve their market designs in order to more definitively express those needs.

Assistant Secretary Hoffman asked *Mr. van Welie* how a vertically-integrated system, in the case of distribution planning tools, are going to value storage. Mr. van Welie commented that this analysis will be unique as the vertically-integrated utility has a responsibility given to them by their state regulator to perform least-cost integrated resource planning. He noted that it will depend on which markets are being accessed as there will be various methods in terms of getting the revenue return.

Brad Roberts commented that the most benefit will come from having the utility control the dynamics that can go with it. He stated that it will be interesting to see California's new rules which will allow storage to be on the customer side with a fairly hefty rebate, similar to solar, to play out. *Mr. van Welie*

mentioned that FERC is examining storage as a transmission investment. *Mr. van Welie* noted that his previous remark was to look at storage as an energy resource within the marketplace.

Ms. Reder added that community energy storage device that is hooked up on the low side of a transformer serving a community can potentially provide many different value streams, and potentially could be there just for the microgrid application purpose. However, the systems really not set up right now for that kind of dynamic interpretation of an asset class. *Ms. Reder* thought that there was a need to change paradigms to be more nibble in cost allocation and benefit interpretation. *Mr. Heyeck* agreed.

Chairman Cowart proposed language for a second paragraph. "This paper focuses on electricity storage technologies that result in electricity being delivered back to the grid. We recognize that many of the benefits of storage, for example, peak-load reduction, taking advantage of off-peak, low-emissions resources, and congestion relief, are also provided by energy storage systems, such as thermal systems and the managed charging of electric vehicles. Those topics will be addressed by the Committee separately."

Mr. Nevius provided one change to the first recommendation in the white paper to insert a link to published material by NERC on viable resource integration.

ACTION ITEM: The EAC voted to approve this paper in full, with *Chairman Cowart's* proposed language and *Mr. Nevius'* suggested NERC research links in the paper.

Panel Discussion on Interconnection-Wide Transmission Planning Processes

Mr. Meyer started off the panel discussion by providing brief background comments. The Recovery Act gave DOE funding spend specifically for interconnection-level transmission planning. *Mr. Meyer* noted that this funding is significant as there are long term issues facing the electricity sector. He noted that the goal for this funding was not to replace existing planning mechanisms and the institutional planning activities taking place but rather to build on them. Another objective for this program is to give states and NGOs a greater opportunity to participate and establish long-term conversations and relationships.

Brad Nickell, Director of Transmission Planning, Western Electricity Coordinating Council (WECC), presented a brief update on the DOE-funded Regional Transmission Expansion Planning Project in the Western Interconnection and the WECC's 10-year plan.

Mr. Nickell said that WECC has been involved in stakeholder outreach by actively engaging NGOs and by funding travel and stipends for NGOs. WECC also created a constituency stakeholder group, the Scenario Planning Steering Group. The Steering Group is made up of one-third state and provincial leadership, both from the regulatory side as well as from the energy offices and Governors' representatives. The other part of that constituency group is about one-third non-governmental organizations and about one-third traditional utility planning types, which brings together all the diverse interests. *Mr. Nickell* also stated that WECC is creating a number of long-term capital planning tools that enable us to bring in environmental, water, and cultural data into the transmission planning process. *Mr. Nickell* noted that

WECC is leveraging data from the Eastern interconnection, DOE-funded activities, and is also partnered with universities and academic institutions.

Mr. Nickell commented that the Grid Modernization Pilot leveraged a number of activities that were managed under RTEP WECC has also created and administered a survey on behalf of DOE to ascertain the permitting status of major lines in the Western Interconnection. He stated that the answers to this survey that also drove the selection of the lines that were announced by President Obama. The single biggest value proposition of RTEP is the opportunity to educate many non-traditional planning stakeholders on the importance of getting transmission built and how this does connect into lowering the environmental footprint overall of producing electricity.

Mr. Nickell told the EAC that the plan is based upon a regional interconnection-wide perspective and covers aspects in terms of reliability: grid utilization; cost; and environmental impact. WECC has arranged its plan in three ways: 1) expected future network (based on planning assumptions from state, provincial, local, and regional planning groups' planning activities); 2) alternatives to this expected future according to cost and grid utilization and; 3) number of other insights specifically related to environmental and water aspects as well as variable generation integration. He commented that the plan is stakeholder-driven.

Mr. Nickell commented that some of their observations are gaining attention. WECC examined a number of alternative resource packages related to meeting enacted state renewable portfolio standards and found alternatives that look less expensive than some of WECC's assumptions that were provided by stakeholders. That has set off some interesting discussions between a number of different states. Additional observations have been made with respect to reliability and congestion-based observations, as well as some issues related to available generation, cooperation on planning.

Mr. Nickell informed the EAC and DOE of activities WECC would like to see in the future. One is to leverage the activities that DOE funded through RTEP and the grant to WECC. The information is useful for DOE to meet its obligations under EPAct 2005 and the triennial congestion studies. Secondly, DOE should continue to support WECC-led analyses and leverage WECC's robust stakeholder process to support your DOE's mission and objectives at the national level. *Mr. Nickell* would like to see WECC continue to leverage other DOE-funded activities, and specifically, promote to the Department other related DOE-funded activities that can be applied to planning activities nationwide and at different levels. Lastly, continued support of the Power System Engineering Research Center (PSERC).

Warren Lasher, Electric Reliability Council of Texas (ERCOT), presented an update on ERCOT's ARRA activities.

Mr. Lasher provided a brief overview of ERCOT and its system characteristics to the EAC members. *Mr. Lasher* noted that its planning process is five years, with planning process participation by specific transmission owners. ERCOT has an established process for a long-term transmission plan, a 10-year plan that has been developed three times. It is required by State law to be done every even-numbered year. ERCOT has recently established significant investment in new transmission for renewable energy

projects, the CREZ plan. The entire plan, approximately 2300 miles of new right-of-way, is scheduled to be completed by the end of 2013.

In April 2010 ERCOT received ARRA funding from DOE to support its long-range planning process. *Mr. Lasher* explained that goal of the funding has been to enhance the existing long-range planning process in two ways. First, to allow ERCOT and stakeholders to develop new tools which will provide additional and analytical capability for the long-range planning process, and to establish new stakeholder forums for evaluating the long-term needs of the system. Secondly, been to expand the future view of the ERCOT system from a 10-year plan to a 20-year plan. ERCOT has already established a business-as-usual scenario in order to vet those tools, and has had detailed regarding the set of scenarios that will comprise this initial long-term planning analysis. *Mr. Lasher* explained that new technologies to incorporate into ERCOT's long-range planning analysis include demand-side resources, solar resources, storage, geothermal, electric vehicles, among others.

David Whiteley, Eastern Interconnection Planning Collaborative (EIPC), presented on EIPC's ARRA-funded study results.

Mr. Whiteley gave a brief background overview on EIPC. EIPC was formed with the intention of integrating and analyzing the approved regional plans in the East, and to develop potential expansion scenarios and do transmission expansion analyses on those expansion scenarios in a manner consistent with Orders 890 and now Order 1000. EIPC applied and was awarded a $16 million grant by DOE for studies in the East. The DOE transmission study project is being conducted in two phases, creating an open and inclusive stakeholder structure and process to participate in the study, and completing integration of the existing regional plans over 10 years.

Mr. Whiteley told the EAC that the stakeholder process has been established and is functioning with 29 Steering Committee members and stakeholders from all sectors and the states. The stakeholders are in the final stages of choosing three scenarios that will be analyzed from a transmission standpoint in 2012. Mr. Whiteley highlighted eight of these future resource expansion scenarios that have already been chosen. He noted that these scenarios are economically driven. The eight futures that were ultimately chosen by stakeholders include a business-as-usual case (a no-further-policy-option future), policy options based on a carbon-constrained future, an RPS with a 30 percent renewable portfolio standard implemented nationally or regionally, the Energy Efficiency Demand-Response Case, a nuclear resurgence future, and the Combined Federal Climate and Energy Policy which combines a carbon constraint, an RPS requirement, and energy efficiency and demand response.

Mr. Whitely explained that the objective of the national implementation of a carbon constraint, and was to get 80 percent of the carbon out of the economy by 2050. This was achieved by charging for carbon emissions in the entire economy. EIPC found that by 2030 the electric sector of the economy is almost decarbonized with 250 gigawatts of coal retirements, 300 gigawatts of wind development, and approximately 120 gigawatts of combined cycle, with nuclear and hydro as still present.

Mr. Whitely explained that EIPC's transmission study approach has been to take transmission lines and examine them as if they are single blocks to establish an approximate estimate of what would be

required. He noted that for five of the future scenarios where there was a significant amount of transmission added, the transmission miles added and cost anywhere from $30 to about $60 billion.

Mr. Whiteley noted that the value so far has been creating the stakeholder process itself in the East, where there hasn't been an interconnection-wide analysis. The inter-regional coordination and discussion taking place within the planning authority community is useful as it brings the planning authorities together to look at this study at a time as one comprehensive study. This has been highlighted by the development of the inter-regional case for 2020. The discussion around how to build a 20-year-out case has been very valuable as an educational planning tool. An insight that has emerged has been realizing that not every system and scenario can be modeled simultaneously, but that they need to be broken out into pieces.

The floor was opened for EAC members to provide follow-up questions and comments to *Mr. Nickell*, *Mr. Lasher,* and *Mr. Whiteley's* presentations. The discussion is summarized by topic below.

Discussion of Transmission Siting Challenges

Mr. Nevius asked *Mr. Nickell* to explain how WECC's study is examining how to site facilities on federal lands. *Mr. Nickell* responded that that WECC handles permitting, not siting. He noted that WECC does play a role in facilitating such conversations by calling attention to the need and usefulness of transmission projects such as with the DOE pilot and the MOU. *Mr. Nickell* also stated that as part of the Topic B funding to the Western Governors' Association, they are looking into state and federal cooperation on moving needed transmission projects expeditiously through their respective permitting processes at the state and federal level.

Mr. Krapels asked *Mr. Lasher* to comment on how ERCOT or the Texas Commission decided who would build the various transmission lines for wind integration. Mr. Lasher stated that the plan itself was first established and the lines were certified as lines for the CREZ. Following that ERCOT went into a rulemaking process where various transmission companies bid on the right to build those transmission lines. He noted that there have been extremely detailed technical studies that have been conducted associated with reactive power needs, and those studies have been coordinated by all of the transmission companies.

Mr. Nickell explained that the process grew out of a legislative mandate and has been given very high priority. Moreover, projects were required to be fast-tracked through the regulatory routing process on a six-month deadline. After six months, by Texas law, once a project is determined to be fast-tracked either for a reliability need or by the Texas Legislature, it is given 180 days to go through the routing process. If on the 181st day a route is not approved by the Commission, then it is approved by law. He noted that Texas is a unique case because many lines went through regions of Texas where there is not a lot of population. Some of the lines went for 20-30 miles over one person's land. However, he commented that this process grew out of a belief in the overall need for and desire for increased renewable energy for Texas. *Mr. Curry* added to *Mr. Lasher's* response on siting renewable energy, noting that the Commissioners each met with a group of ranch owners one-on-one. Mr. Heyeck added

that Texas has been successful in siting as there is one planning authority, one siting authority, and one regulator.

Mr. Kelliher asked *Mr. Lasher* how post-permitting development has proceeded for CREZ lines as permitting was fast tracked. *Mr. Lasher* responded that construction is generally on schedule. The schedule was incorporated into part of the companies' bids and so the transmission companies committed to getting the projects finished extremely quickly. Once they were locked into that kind of a schedule, there was real incentive to make good on that. *Mr. Kelliher* asked *Mr. Lasher* to comment on the costs involved and if the developer has to prove that the additional costs are prudent. *Mr. Lasher* answered that the developers can ask for prudency when the line is used and useful. Costs are being tracked on a quarterly basis. He noted that costs have increased, mainly due to routing considerations but that costs are generally tracking what the original cost estimates were.

Mr. Duncan asked *Mr. Lasher* to comment on a possible second round of CREZ for coastal or offshore wind given that transmission is becoming scarce and as the western build out is being completed. *Mr. Lasher* responded that CREZ was a very rigorous and difficult process and at the moment there is a need for long-range planning process to answer such regulatory questions in a timely manner.

Discussion of Non-construction/Non-wires Alternatives into the Planning Process

Mr. Weedall asked *Mr. Nickell* how WECC was incorporating planning on non-construction or non-wires alternatives into WECC's planning process. *Mr. Nickell* explained that as part of WECC's expected future and alternatives, WECC examines energy-efficiency and demand-type management programs representative of existing statutory levels, and how this impacts the need for energy and for transmission.

Discussion of Incorporating Energy Storage into the Planning Process

Mr. Roberts asked *Mr. Nickell* if energy storage was being examined by WECC. *Mr. Nickell* responded that WECC did examine energy storage, in particular modeling pump hydro projects and compressed air energy storage. WECC is focused large-grid storage where there are sufficient amounts of energy and capacity. WECC identified this area as a need area to focus more analytical activity. He added that one challenge WECC has had is creating models that represent actual storage operations and correct pricing of storage.

Mr. Roberts asked *Mr. Whiteley* about energy storage in EIPC's planning process. *Mr. Whiteley* answered that, similar to *Mr. Nickell*, storage is not shown in our models as a resource option because of the unique characteristics of storage and the difficulty in modeling "energy-in/energy-out" and prices. He noted that energy storage has been included at some levels, but it is not an economic option that is chosen.

Discussion of Modeling and Impacts

Mr. Bowen commented that air regulations have been impacting generation for ERCOT. He asked *Mr. Lasher* how ERCOT has been modeling these impacts. *Mr. Bowen* specifically asked if ERCOT had taken

into account MAC impacts on the solid fuel plants and resulting scenarios. *Mr. Lasher* responded that these specific regulations have not been incorporated the scenarios being developed for ERCOT's studies. However, he stated that the analysis that ERCOT is doing as a part of the request from the Public Utility Commission are being done with the same models and by the same team as is working on ERCOT's future scenarios.

Mr. Krapels asked *Mr. Whiteley* how EIPC models inter-area reliability projects. *Mr. Whiteley* answered that EIPC has not started its transmission studies yet. However, EIPC will have both New York and PJM there to look at one case with one future set of resources and come up with a joint solution. He added that EIPC provides value because it helps inform the regional processes as to what the potential future might look like, and supports Order 1000 inter-regional coordination requirements.

Discussion of Interconnection-wide Planning and Collaboration

Mr. Nevius asked the presenters to comment how they are coordinating and sharing experiences with interconnection-wide planning processes. *Mr. Whiteley* commented that he has exchanged information with *Mr. Lasher* and *Mr. Nickell*. However, he noted that these interconnections have different routes, and as such in the immediate term there is not much information to be shared on specifics.

Mr. Popowsky agreed with *Mr. Whiteley's* comments that there is value in getting the stakeholders to operate on a consensus basis has been valuable.

Chairman Cowart asked for comments regarding creating a permanent mechanism for the planning process to be supported and participation by the relevant stakeholders to be supported over time, as WECC is currently doing, in the East. *Mr. Whiteley* commented he was uncertain about the development of this as it is unclear what value the East will get out of this process, but that EIPC was formed before the DOE issued its FOA and with the intention of enhancing the coordination between the regional planning authorities in the East. *Mr. Meyer* responded that it is apparent that the transmission planning process needs to be informed by a common vocabulary, common set of data, common understanding of what the real options are. He emphasized that this kind of collaboration is essential. *Mr. van Welie* also added that this collaboration is valuable and that the planning authorities or coordinators can build into their budgets the ability to support this from a technical and analytical point of view. He noted that it will be challenging to determine how to fund the states' involvement and all the other participants in the industry that wish to become involved. *Mr. Nickell* stated that from a state participation perspective it is very important to have the regulators participate in the conversations. In response to *Mr. van Welie*, *Mr. Nickell* noted that the West the Western Interconnection Regional Advisory Body (WIRAB) receives Section 215 funding, the same funding vehicle that WECC uses for its budget. He explained that this is a possible funding vehicle and a business model, to use ratepayer-based funding to ensure that states can participate in planning activities.

Mr. Curry asked for comments regarding how FERC has been involved in the interconnection planning process. *Mr. Meyer* commented that FERC has attended many meetings for these interconnection-level planning efforts. *Mr. Meyer* also commented that the directive in FREC's Order 1000 ensures that regionally planning entities will communicate about lines that cross their shared boundaries, and that

these regional planning entities will take state or local policies into account or local policies so that they are reflected in law or regulation.

Discussion of EAC Transmission Subcommittee Memorandum on Securing the Grid

Mr. Heyeck started off the EAC discussion of the Memorandum on Grid Security by updating the EAC. From talks with experts, *Mr. Heyeck* reported on gaps that needed to be addressed which included: 1) determine specific grid vulnerabilities to HILF events and cyber attacks; 2) developing grid component-hardening standards; 3) developing specific gaps in sparing the critical components. *Rich Meyer* responded with edits to the document on specific language changes. The EAC approved his changes in full.

Mr. Roberts commented on Recommendation number three outlined in the paper, asking if there were certain size transformers that are not currently built in the United States. *Mr. Heyeck* responded that 765 kV transformers are not built here and that some 345 kV plants have been built.

ACTION ITEM: The EAC voted to approve this paper in full, with *Mr. Meyer's* proposed language.

Discussion of EAC Transmission Subcommittee Memorandum on the Interdependence of the Electric System Infrastructure and Natural Gas Infrastructure

Mr. Heyeck started the discussion on this Memorandum by stating that the essence of the document is that firming-up electric capacity is not linked to the firming-up of the capacity in the gas pipes, and there needs to be a linkage between the two otherwise there will be a reliability issue with the grid. He noted that in many states the Governor can declare an emergency, and the firm capacity, even if it is declared firm, can be negated by a Governor's action. As such, there is a disconnection between electricity supply and fuel supply.

Discussion of Recommendation Number 3: DOE should fund research on the use of natural gas to replace older coal-fired electric generation units that cannot cost-effectively be retrofitted to meet increasing EPA regulatory standards

Mr. Krapels commented that Recommendation number 3 does not fit in the context of the paper. He questioned why DOE should fund research on the use of natural gas as it would likely in the future fuel of choice to replace retiring coal plants. *Mr. Heyeck* answered that the term "research" is inaccurate, and that the thinking of the Subcommittee was a focus more towards planning and expanding capacity, rather than researching. Chairman Cowart responded that the focus is planning on the likely use of natural gas or on the potential for natural gas to replace all the coal-fired generation. Mr. Delgado added that this recommendation also makes it aware that this issue exists and can put in jeopardy what is the bulk of the new generation; that at critical times when there is alternative need, the generation may not have fuel. This can be a significant problem as the share of gas as fuel increases in the future. *Mr. van Welie* suggested that Recommendation number 3 be deleted, and inserted as a comment under

Recommendation number 1 when examining a dependency issue, increased dependency on natural gas as a result of retirements of all the coal units should be evaluated. *Ms. Reder* suggested that the recommendation could be strengthened by commenting on the transparency or visibility across domains.

Discussion of Recommendation Number 2: DOE should focus coordination/research/facilitation activities noted in the document

Mr. Kelliher commented that Recommendation number 2, "Policies to ensure that gas supply and gas pipeline capacity will be available to generation resources on a firm basis when required to maintain power system reliability," is unclear. He noted that this is not a new issue and that it first arose in New England in 2005 or 2006, and FERC has asked this question at least twice and has been reassured by ISO New England and others that the two days do not have to match up. He added that gas is available on a firm basis, but because the amount sold is not typically know, gas is not sold on a firm basis. *Mr. Kelliher* commented that Recommendation 2 is unclear because gas is available on a firm basis, but the recommendation suggests that generators should be required to buy gas on a firm basis. He also questioned how those costs should be borne- by the generators if it is not dispatched or if the costs should somehow be socialized.

Mr. van Welie responded that not all gas generation needs to be firm. In New England the need is to have gas-fired generation backed up with an alternate fuel supply or local storage, in order to be able to ride through a temporary interruption of gas supply into the New England region. He noted that as New England looks forward, it sees that a large percentage of the oil-fired capacity will retire in the next five years which will likely be replaced by more gas-fired generation. *Mr. van Welie* commented that in the rest of the country where there is low natural gas prices gas will displace coal generation such as in the Mid-Atlantic area, particularly all the smaller, less-efficient coal units. He concluded that the dependency between the two systems will grow over the time and it is necessary to have a mechanism to ensure electric reliability but that currently the market designs are not expressing that need. *Chairman Cowart* agreed that this was the intent of the recommendation.

Mr. Krapels asked *Mr. van Welie* if FERC or another regulatory actor currently give warning if there are natural gas concerns that might impact electricity generation in New England. *Mr. van Welie* answered that there was not because there is no centralized structure for giving any warning. From this cooperation between New England and the gas industry has increased substantially over the years.

Mr. Heyeck explained that the intent of the recommendation was to define the gaps between ensuring electric reliability and ensuring the gas is there for electric reliability. Alternatively, to the extent that gas is dependent upon electricity, it is to make sure that it is consider as a critical load.

Mr. Krapels asked the EAC if a "North American Gas Reliability" organization existed. *Mr. Nevius* responded that he has worked Natural Gas Supply Association and the Interstate Natural Gas Association in the past. Mr. Nevius also commented that the dependence of gas systems, pipelines, compressor stations, on a reliable supply of electricity was addressed in the early 1990's with the Interstate Natural Gas Association via a coordination study. The findings were that many utilities did not know who was behind some of the meters, and they may have been compressor stations and that though they were gas-powered compressor stations, they had electric controls. This meant that for a load-shedding event, the utility may inadvertently cut off load for that meter or cut off that meter, not knowing that they are actually sort of cutting off or reducing their throughput gas supply. From this the NGA Operating Committee and NERC Operating Committee adopted a resolution to address this issue, but it did not address the address the intrastate gas pipeline system. This is a gap that needs to be addressed.

Additional Comments

Assistant Secretary Hoffman commented that she welcomes comments from the EAC regarding toolsets to have a wider area of visualization of the interdependencies with respect to high-impact, low-frequency-type events, specifically GMD. She also stated that with respect to the gas and interdependency issue, DOE is looking to engage TSA from the safety point of view as well as inviting FERC to have a discussion on some of the reliability and some of the firming and impacts.

ACTION ITEM: The EAC voted to approve this paper in full, with *Ms. Reder* and *Mr. van Welie's* proposed language included with Recommendation number 3 moved as a bullet point under Recommendation number 1.

Discussion of EAC Smart Grid Subcommittee White Paper on Grid Impacts of Deployment of Electric Vehicles

Ms. Reder began the discussion by summarizing the purpose for the "White Paper on Grid Impacts of Deployment of Electric Vehicles." She noted that the scope is focused on near- and mid-term (5-15 years) of cost allocations, implications on overloads, exceeding ratings, roaming, rates, cost allocation, security, but did not include any "vehicle-to-grid" analysis.

David Anderson, from the Vehicle Technologies program in DOE, invited to contribute comments at the EAC meeting. *Mr. Anderson* commented the impact on the grid of electric vehicles (EVs), from an energy supply standpoint, it is much less significant than the small percentage of inefficiencies in moving power around the grid. He noted that the EAC paper was consistent with the goals and activities in the Vehicle Technologies Program.

Mr. Anderson commented on the general assumptions of the EAC white paper. He agreed that the stated range of 1 to 6 kilowatts is representive as a load on the grid. He stated that an EV can be plugged into a wall socket (i.e., Level 1 charging") with a draw of about 1.5 kilowatts, with Level 2 charging reaching almost 20 kilowatts. However, the vehicles that are being deployed are really on capable right now of about 3.3 kilowatts, with a few upcoming vehicles capable of 6.6 kilowatts. He

noted that there is DC fast-charging infrastructure being deployed, reaching up to 50 kilowatts. *Mr. Anderson* informed the EAC that this charging infrastructure is the source of big, instantaneous loads on the grid and that standards are being developed to kind of define fast-charging at up to 100 kilowatts. These fast-charging components will not be at the residential level but instead used at industrial, commercial-type facilities. He stated that this type of fast charging was implemented with renewable generation, solar panels, or with in-ground energy storage, large batteries, to mitigate effects of having such a large load placed on the grid.

Mr. Anderson next commented that the Vehicle Technologies Program also perceives vehicle-to-grid technology as long-term. He explained that there are demonstration projects going on, but in the immediate-term, vehicle to grid is a farther-reaching technology due to concerns of the auto manufacturers and the fact that they are reluctant to warranty batteries that might be exposed to any cycles not used for moving the vehicle around.

He noted that the statement was made that EVs are likely to remain significantly more expensive in terms of purchase price, but much less expensive on a cost-per-mile basis as compared to conventional motor vehicles. *Mr. Anderson* added that the analyses in his office state that it is still not cost-competitive.

Mr. Anderson told the EAC that he agreed with the conclusion that the biggest impact on the electric power system in the medium-term of widespread EV deployments is likely to be at the electric distribution level. If purchases of hybrid electric vehicles are an indication, *Mr. Anderson* expects to see plug-in electric vehicles clustered in the same neighborhood. If this happens, we should expect to see impacts at the local distribution level, due this clustering.

Mr. Anderson commented that when Electric Vehicle Supply Equipment (EVSE, i.e. the vehicle charger), is installed, it typically involves the pulling of a permit from the local jurisdiction. *Mr. Anderson* explained that for his office's deployment projects there are efforts to install the mechanism whereby the permitting authority can notify the utility when a permit is pulled, so that the utility is aware that an EVSE is going in. The Vehicle Technology Program is helping to deploy about 20,000 EVSEs around the country, supporting about 13,000 electric vehicles or plug-in vehicles, concentrated in major municipal areas. He agreed that most vehicles will be charged at home or wherever the vehicle is kept overnight. Over the next three years the projects will collect a large amount of information on how consumers use their vehicles and their plug-in infrastructure. This data will help inform the decisions of what the impacts on the grid are going to be.

Mr. Anderson stated that in the long-term there is more price elasticity with regard to consumer demand and fuels prices than in the short-term. Over time, with elevated fuel prices, consumers tend to purchase a lot more fuel-efficient vehicles but you cannot expect them to do so in the short term every time the price increases.

Lastly, *Mr. Anderson* agreed with the recommendations set forth by the EAC.

Following *Ms. Reder and Mr. Anderson's comments,* the floor was opened for EAC members to provide follow-up questions and comments. The discussion is summarized by topic below.

Discussion on EV Charging Patterns

Mr. Duncan commented that most of the charging today is occurring at the residences, noting that there is hardly any use of the public charging stations. He added that fast-charging is not necessary for residential users. Mr. Duncan argued that the bottleneck with charging is occurring because a lack of charging for in condominium and apartment buildings. He explained that there is a residential charging bottleneck for EV owners who do not have garages and are not using the public charging stations. He noted that the idea of community energy storage being combined with public infrastructure to offset that load is more complicated than first noted.

Mr. Popowsky agreed with *Mr. Anderson's* comment that that most residential charging will be done overnight. However, even if customers are not fast-charging but instead implementing the longer overnight charge, if these customers also plug in at the time of peak demand there is still cause for concern for load management. He suggested that this be added to the EV paper.

Mr. Popowsky commented on the concern of understanding how to appropriately allocate costs among service territories and roaming charging of EVs. He stated that this issue should only be of concern if the customer is termed as the car or the driver. According to *Mr. Popowsky*, the customer should be the charging station. From this view, if the EV is at a residence, the bill will go to that location, as that is where the charging station is located. The same can be said for wherever the charging station happens to be located. *Mr. Popowsky* suggested that this paragraph be deleted, as there will be no issues with billing.

Discussion regarding Payment of Electric Vehicle Infrastructure

Mr. Duncan commented that he did not agree with the statement that customers would not pay for other's EV infrastructure installments. He did not see the circuit-level distribution system upgrades as large enough to trigger rate increases on the local level. He noted that current new substations now going into expanded neighborhoods are not being resisted by the neighborhoods that are not having the new substations, and as such did not think that EVS would be different.

Discussion of EVs and the Potential to Balance Renewable Load on the Grid

Chairman Cowart commented that EVs can offer the opportunity of significant new managed load to help balance variable renewables on the grid. *Chairman Cowart* submitted to the EAC a sentence incorporating this language into the EV draft. *Mr. Cavanagh* objected in that this was potentially a substantial challenge. *Chairman Cowart* argued that in order to accept a high degree of penetration of variable renewable generation, there has to be more managed load. EVs are a new source of managed load. *Mr. van Welie* offered a change in language that balanced both sides of the challenge, stating the point that there is a need for additional balancing resources, and that electric vehicle charging could be one of the resources to provide this service.

Discussion on the role of the Automobile Industry in Designing EV Charging Methods

Mr. Wynne explained to the EAC that there are three main options for charging: 1) charge immediately; 2) defer; 3) set the time for charging to be completed by. *Mr. Wynne* suggested that automobile manufacturers' role is designing cars so that there is an interface in the car that reminds the consumer, that gives the consumer the option to charge at a time that is more convenient for the grid, when there is more energy available.

Discussion on Cost of EVs

Mr. Delgado clarified that the paper was addressing the per-mile expense of the car, without using the capital. *Mr. Anderson* agreed that fuel costs change how cost effective EVs become. He agreed that going forward as battery costs come down and as fuel price becomes more volatile, the equation would shift more favorably to plug-in vehicles. *Mr. Weedall* disagreed with this statement, noting that the tax credit makes the car more cost effective than traditional vehicles. *Mr. Anderson* responded that the price of the EV, even after the tax credit, it still expensive compared to the class of vehicle the EV is in. *Mr.* Duncan noted that the important point in this discussion is that operating costs are cheaper for EVs, on a per-mile basis.

ACTION ITEMS: Language on the following topics were added to the draft EV paper: 1) DC fast-charging expected in the near- to mid-term (5 years); 2) the concern of a charging "bottleneck" with fast-charging and public charging; 3) EV load used to balance intermittent renewable load. The paragraph addressing EV charging and bill allocation was deleted.

Discussion of the EAC 2012 Work Plan

Chairman Cowart introduced a request from DOE for the Committee and the Subcommittees to be more proactively engaged on directly relevant policy matters. The EAC also requested that DOE be more actively engaged itself. The first EAC request was for more direct connection to senior staffers at the Department working on particular projects. The second EAC request was for the Department to try to anticipate decisions in front of the Department on which they want precise input from the Committee. The aim is to develop a reciprocal relationship of engagement, focused on issues the Department is currently discussing.

Mr. Meyer emphasized that once promising work topics had been identified and before the Subcommittee invests effort in research or writing, the next step is to begin active dialog with the appropriate people in DOE. This process flow will ensure that EAC analysis will be of the greatest relevance and value to DOE.

Topic 1: Microgrids

Mr. Heyeck suggested the topic for 2012 as a next-generation EMS system to address variability, storage, and the many aspects that will be new to they system. He commented that EPRI is doing work, but a step would be to identify what DOE is doing, and then fill in the gaps that might exist. *Ms. Reder* added that the location of the intelligence, either layered or distribution, should be added to the scope of this topic. *Mr. van Welie* suggested that the topic of microgrids and next-generation EMS should be linked to the recommendations embedded around modeling that the EAC has put on the table. So, we already have on the table the need to improve the modeling. *Mr. Roberts* agreed with this recommendation as a topic for 2012.

Ms. Reder suggested that benefits arising from the stimulus projects should be highlighted. She added that 2012 would be an opportunity to bring visibility to the extent that there have been challenges or barriers that might be suggestions of where the EAC can focus policy discussion. *Ms. Welsh* added that the ARRA projects are just now beginning to report benefits, October being the first reporting period. She suggested that the EAC should look to ask for that information at its July 2012 meeting.

Mr. Roberts proposed that the EAC should examine the economic impact of microgrids on operating utilities.

Work Topic 2: Coordination between DOE and other Agencies

Mr. Heyeck suggested that a 2012 work plan topic would be to examine coordination between DOE and EPRI and the National Laboratories' research agendas. *Mr. Meyer* supported this decision, noting that it is important to identify where such gaps might exist.

Work Topic 3: Replacing Aging Infrastructure

Chairman Cowart proposed that the EAC should examine the issue of aging infrastructure and the appropriate pace of reinvestment or replacement that will be needed. A second issue to be addressed is policies needed to ensure that replacement of infrastructure is not locking in the technology of the past rather than Smart Grid technology. *Ms. Reder* supported this topic.

Work Topic 4: Transmission Planning

Mr. Cowart proposed that DOE has a strong interest in having policymakers focus on ways to improve participation in or the process of transmission planning, not the technical modeling. He explained that this process should be structured in such a way that there will be greater public acceptance of the need for new assets. *Mr. Meyer* and *Mr. Nevius* supported this topic proposal. *Mr. Heyeck* suggested that it would be useful to sync the time cycles of the planning authority and the NEPA process, to prevent delays. *Mr. Weedall* added that some success has been had assembling roundtables of regional leaders and representatives from outside the region, and engaging the public in this manner. *Mr. Whiteley* added that Order 1000 requires long-term transmission plans to consider non-wires alternatives, and this should be another area for the EAC to examine.

Work Topic 5: Regionally Aligning the DOE Vision of the Future

Ms. Reder proposed that the EAC should work with DOE to socialize the vision from a region perspective and obtain alignment with EPRI and CIGRE and EEI, NRECA, and others, to build consensus around the vision, which could then be presented to others and invoke active dialogue

Work Topic 6: Current EPA Environmental Regulations

Mr. Heyeck suggested that the EAC should address EPA regulations and how they will impact the industry. He argued that the impact of retirement of plants should be examined, but also potential dispatch issues because of emission limits should be monitored.

Work Topic 7: Reliability Risk Factors

Ms. Reder suggested that the EAC should examine reliability risk factors and various scenarios that might impact the reliability of the grid. *Mr. van Welie* stated that this is not the role of the EAC as the transmission authorities undertake such planning. *Mr. Meyer* stated that it might be possible for the EAC to gather this information, but leave actual formal consideration of these issues to the appropriate bodies.

Work Topic 8: EAC Provides Comments on DOE's Vision

Ms. Welsh stated that the EAC has an opportunity to comment on *Mr. Parks'* presentation and provide some written comments on the initial vision to help with the development of it, specifically within the areas presented on technology, R&D technology change, market design, policy and institutional problems. *Mr. van Welie* commented that one approach DOE might embrace would be to abandon the notion that DOE can affect outcomes directly, and rather state what policy themes it would like to see develop and then let the processes to get there develop organically. *Mr. van Welie* proposed that this might be a way for DOE to create stability for the industry from a policy point of view and across Administrations. *Mr. Nevius* agreed that a better exercise for DOE might be to not state a single vision, but acknowledge many visions for the future of the grid.

Adjournment

Mr. Cowart thanked the EAC members and other attendees for contributing their comments to the discussion and adjourned the October 19th & 20th, 2011 Meeting of the EAC at 4:01 pm EST.