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SMART GRID'S FUTURE:
EVALUATING POLICY OPPORTUNITIES AND CHALLENGES AFTER THE RECOVERY ACT

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The Consumer Perspective on the Smart Grid:

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PROCEEDINGS

MR. WEST: Okay. We'd like to invite our next panelists to come up, and we're very pleased to welcome three people who are going to play a very crucial role in terms of shaping the smart energy grid policy that develops. As Aneesh just mentioned, two of them are actually co-chairs of the President's efforts in this area and the third individual also is going to play a major role.

So, I'm pleased to welcome George Arnold to Brookings. George is the national coordinator for smart grid interoperability at the National Institute of Standards and Technology. This plays a major role on the standards side of the smart grid debate. We are also pleased to welcome Pat Hoffman. Pat is the assistant secretary in charge of electricity delivery and electricity reliability at the Department of Energy. And Richard Newell is the administrator of the Energy Information Administration of the Department of Energy.

So, the format that we're going to follow is I'm going to ask each of them to just briefly give us their views on what they think the key challenges are for the smart grid and then we will welcome questions and comments from the audience.

So, we will start with George Arnold of NIST.

MR. ARNOLD: Good morning, Darrell. I'd like to add my thanks to the Brookings Institution for arranging this seminar. And, you know, I'm a technologist, so I'd like to maybe start the discussion with some of the technology issues and challenges and then obviously we want to quickly move to the consumer and other perspectives.

But I think technology is the place to start because indeed if you look at the history of our innovation and economic development over the last several decades, it's really been the technology discontinuities and changes that have enabled much of the innovation and growth that we've seen. So, I'd like to maybe start by just reminding us how big the challenge is and the opportunity is with the smart grid.

Several years ago the National Academy of Engineering ranked its analysis of the greatest engineering achievements of the 20th century, and do you know what was number one on their list? It wasn't human space flight. It wasn't the internet. It was the electricity grid, the greatest engineering achievement of the 20th century.

I think this is really a once in a lifetime opportunity. The grid, the architecture of the grid that we have today, and I'll talk a little bit more about some of its aspects, hasn't changed that much in the last hundred years. It hasn't changed that much in a hundred years, and I believe if we do our jobs correctly, that future generations may refer to the smart grid as the first great engineering achievement of the 21st century.

Now, I come out of the telecommunications and IT industry, so I tend to look at things through the -- we all look at things through colored glasses. My glasses look at the transformation that we've seen in the communications and IT space over the last 30 years. And when I talk to an audience this size I sometimes like to do a little bit of market research.

So, let me ask you to think back 25 years and raise your hands if you were using computers 25 years ago. This is 1985. Okay. How many of you were using PCs in 1985? About half; that's typical. How many of you were using the Internet in 1985? Okay, ARPANET. Okay, this is typical.

So, those few of you who were, could you imagine that today you would be getting your telephone, your 500 channels of high-definition TV, you know, exchanging data over an IP-based connection? Was that in your thought process? No. Could you imagine that you would be publishing your intellectual property to the world in addition to getting access to it through your computer?

These things were just not imaginable. So, I've been scratching my head thinking about what are some of the things that we can't imagine that we might be able to do someday. And so one thought that occurred to me was, well, maybe houses would have, you know, roofing shingles and siding that is made of solar PV material and would be generating power, right? This is a sort of far-out scenario. Well, it's not so far-out. If you look at Popular Mechanics magazine of a couple months ago, you'll see a picture there of a manufacturer that's offering solar PV roofing shingles. I think it's Dow. And, you know, we're going to be seeing in the next few years a second generation of solar PV that's half the cost of the current generation. So I could well imagine somewhere out in the future building codes might require houses to be made of -- you know, have solar PV material and to have storage so that you can smooth out the

variability.

So, these are some of the things that are going to be possible. I mean, so there's many parallels to what's happened with the internet and how that's transformed the architecture of communications. The idea of moving intelligence from centrality out to the endpoints has -- there are a lot of parallels here.

One thing that is different though is that in the IP space, much of this change occurred without anybody knowing it was happening. All of these technology developments were being done by researchers in the academic community, then industry, in stealth mode, and then starting around 1995 with Netscape, we started to see the impacts and it's really had a dramatic transformation on our lives and the economy.

This is different with the smart grid because we're seeing the same kinds of technology discontinuities, but they're being played out now in full view of the public. We're all being touched by them with, you know, the controversies about smart meters and whatnot, and so for us to effectively apply this technology, and there's certainly a raft of technology issues and considerations that need to be addressed successfully, we also need to address the economic, social, and political aspects and that's why this session is so important.

So, just very quickly and then I'll wrap up, my concept of how the future grid differs from today's grid. Number one on my list is consumer participation, and let me say, demand side management. If you think about the load on the electric grid, it has this characteristic shape that very few people are using electricity at night, a lot of people on summer afternoons are using lots of electricity, and basically the engineering of the grid is sized, in terms of generation, to deal with that few minutes per year when usage is at its peak, and the rest of the time that capacity is sitting there idle.

So, again, parallels in the communications industry, for decades, you know, we've had pricing plans that incent people to do their communications during nonpeak hours. We've had, you know, technology that has really managed the -- smoothing out the flow of traffic so that assets are better utilized. The same issues are going to be possible with the grid.

The second big change is distributed and renewable generation and storage.

The grid that we have today is -- it's very deterministic. You know, demand on the grid can be forecasted to within 3 to 4 percent accuracy. The models have been around for many years. And capacity is deterministic. It's dispatched as needed.

In the future, with wind and solar, and with smart appliances that interact with the grid -- electric vehicles -- both the demand is going to be very different than our models can predict today, and the generation is going to be much less controllable.

How do we deal with that? Innovation. These new technologies are going to enable new products, services, and markets. The automation and data will enhance our reliability and ability to keep the grid stable. You know, the U.S. grid, as marvelous as it is, we have an average of about 160 minutes of downtime per year per customers. The comparable figure in Japan is about 8 minutes per year, in Singapore it's 2 minutes per year, and those outages cost our economy at least \$80 billion a year by one study.

And finally we have the opportunity to replace a lot of our usage of oil with electric vehicles using this idle capacity in the grid to power them, and this introduces a host of challenges as well as unknowns in terms of how are consumers going to react to that new technology.

So, some of the challenges that we have to face in effectively transforming the grid, we've got many, many stakeholders, as a previous question indicated, we have very large investments that are going to be made, and for this to happen we need to have a clear, shared vision of what we want out of the grid, how we're going to get there, and a shared view and understanding of the benefits.

We have to find ways to encourage innovation and experimentation to allow the new technologies to prove their value and get into deployment. At the same time we have to have standards and interoperability that enable that innovation to occur without stranding assets. We have new business models and regulatory frameworks that may be needed to support the kinds of changes, we see that certainly in the history of the communications field. And we need to have better models of performance so that we can control these new grids with the promise of the new technologies that are available.

So, that's just a sort of Reader's Digest of what I see as some of the key challenges and opportunities for the grid as we move forward.

MR. WEST: Okay. Thank you, George. Our next speaker is Pat Hoffman of the Department of Energy.

MS. HOFFMAN: Good morning. First of all, I would like also to thank everyone for being here because I think today is a very important discussion.

I'm going to pick up where George left off and add my thoughts as we recognize the diversity of what we're trying to accomplish here with the smart grid. There is a lot of different requirements out there and different needs depending on who the customer is and how we define the customers and the objectives of the smart grid.

So, I'm going to try to pull that into perspective building off of George.

As we look at some of the requirements for the grid in the future, we're looking at how do we want to manage the peak in the United States. George talked about the time usage on the peak, but we want to be able to manage that better. We want to be able to integrate renewables into the system so we want to have the flexibility -- the electric grid to have the flexibility for that integration of renewables, whether it's a large scale central renewable plant, or distributed renewables located at the consumer's home. We want to improve the efficiency and the operations of the electric system. We want to enable new technologies, the plug-in hybrid and electric vehicles. We want to make sure that they will be enabled and the grid will be supportive of that technology as that comes online.

A lot of this is driven differently by states' objectives. We have to keep this in mind. Some states have peak load reduction targets. Some states have renewable portfolio standards. Some states have a goal that they want to be the leader in electric vehicles. So as the states define their goals, the smart grid is going to evolve around those goals, so different states and where they're driving their utilities is how the evolution of smart grid is also going to develop, so I wanted folks to recognize that the way the states are engaging and defining their objectives, whether it's legislatively or performance based for utilities, that is going to influence how the technology develops.

Smart grid. We talked about smart grid innovation. Just adding a little bit more to that and the innovation is we really want to have an automated energy delivery system, a network that can be characterized by a two-way flow of information, but capability of providing monitoring and situational awareness from the power plant to the consumers to the appliances. Most people talk about the appliances and the consumer side of the equation, but we're really trying to do a full, integrated network of communication and capabilities.

As we talk about utilities and consumers -- utilities, there's different business models. We're going to have a really engaging discussion on the different types of utilities and their business models. Some of you who live in a municipality and have a municipal utility, some people would say, hey, we've been doing demand management all along. It's been an integrated part of our philosophy of doing business. The co-ops versus the IOUs, each of those have a different business model and how they're going to develop the smart grid is actually different depending on their community priorities or their investment decisions.

So, as we move forward, we're going to actually try to have an engaging discussion on some of those differences.

As we look at consumers, smart grid has, and energy management and load reduction has been very much apparent in large industrial consumers. This is business as usual for those type consumers, so as we're looking at those consumers, we're taking the lessons learned from the industrial customers moving it to the commercial customers such as the Walmarts of the world, the big box retailers. They've actually really advanced some of the capabilities of managing their energy consumption and bringing some of that knowledge base and lessons learned down to the rest of the residential market. So, we're actually doing an evolution here and the question that was raised earlier is very valid. Some aspects of the smart grid have been going on and we're trying to actually maximize that potential so we can truly operate and manage the grid in the most efficient form possible.

So, where does that lead me? It leads me -- the biggest question is, as we look at the value of the smart grid and some of the things George talked about, documenting the benefits. One of the biggest things we need to do is make sure that we've got the right data.

Collect the data from the pilot projects, the projects that the Department of Energy is working on, plus other projects that are out there, projects that have been done before ARA activities, actually collect the data to actually document and demonstrate the value and the benefits.

Some of the things that we're looking at from a performance metric is transmission visibility, being able to see what is happening across the transmission system from a wide area perspective. Reducing the electric bill, are we going to help consumers reduce their electric bill? Can we achieve a certain percentage of peak load reduction? Are we going to improve the system efficiency in the United States? Will we be able to document shorter outages, shorter frequency and duration of outages in the United States? George mentioned the numbers. Those are really the metrics that we need to go after to say, are we going to achieve the value? How do you take these metrics and translate them to something consumers can really appreciate? I think ultimately consumers are going to look at their pockets and the money and can they manager their money and actually see a savings, so we do have to recognize that.

Just to add a clarification and I'll wrap up there. The \$11 million included money that the Department of Energy had for the power marketing administrations for the borrowing authority to build transmission lines, so that was the complete package of that number.

Thank you.

MR. WEST: Okay, thank you, Pat. And our last speaker is Richard Newell, also of the Department of Energy. And after Richard we will open the floor again to questions and comments from you.

MR. NEWELL: Thank you, Darrell. It's a pleasure to be here.

Before turning to my thoughts on certain challenges presented by the smart grid, it may be helpful for me to provide a brief introduction to my agency and its role. The U.S. Energy Information is the statistical analytical agency within the U.S. Department of Energy. Our mission is to collect, analyze, and disseminate independent and impartial energy information to promote sound policymaking, efficient markets, and public understanding of energy and its interaction with the economy and the environment. By law our data and analysis are independent and of approval of any other office or employee of the U.S. Government and so our views should not be

construed as representing the Department of Energy or the administration.

That said, clearly the smart grid has significant implications for both data and analysis, which are key aspects of EIA's mission. Starting with analysis, one of the first assignments given to EIA at the beginning of the Obama Administration was to assess the impact on EIA's baseline energy projections of about \$40 billion in energy-related programs included in the Recovery Act, including substantial funding for smart grid investments.

As EIA analysts grappled with this task, it was not yet clear how the smart grid funding would actually be applied, something that is now occurring under Pat Hoffman's able leadership, but even putting that aside, there was surprisingly little information to work with from an analytical point of view.

The smart grid broadly defined involves investments all along the path linking generation sources to loads of customer -- on customer premises. Smart grid improvements on the transmission system which have received much less public attention than smart metering, have the potential to reduce line losses, allow for more throughput on existing transmission lines, and provide operators with more effective ways to monitor and control grid operations to reduce the likelihood of major loss of load events that impose high costs on society.

Smart meter investments also offer opportunities for both load shifting and load reduction. Load shifting is facilitated and encouraged by dynamic electricity pricing plans which provide consumers with an economic incentive to shift their consumption from peak periods when prices are high to off-peak periods when prices are low.

One key question is the extent to which such dynamic pricing plans are actually implemented following smart meter installation and the extent of participation in those plans if they're offered on an optional basis.

For the purposes of the Recovery Act analysis, EIA relied heavily on recent analyses by the Electric Power Research Institute, or EPRI, of the impacts of a fully developed smart grid on line losses, reduction in peak load, and conservation. EIA baseline projections had already assumed improvements in each of those areas. Based on the Recovery Act's smart grid program, the rate of improvement of these areas was accelerated, but EIA did not adopt a polar

assumption that the Recovery Act programs alone would result in full realization of the EPRI impacts of a fully developed smart grid. This is just one piece of a much bigger puzzle.

Our initial estimates necessarily represented a very rough cut as there is significant uncertainty regarding actual impacts, which has already been alluded to. First, while the grants and other support to smart grid technologies under the Recovery Act are intended to act like a kindling to accelerate the widespread future adoption of smart grid technologies based on their value to electricity providers and consumers, the extent and timing of future unsubsidized adoption of these technologies has yet to be determined.

In addition, the ultimate impact of smart meters and other elements of smart grid hardware that are oriented towards encouraging load management and conservation, will depend on the extent to which smart grid software is available such as dynamic pricing programs. It will also depend on whether such programs are mandatory or optional and the rate at which consumers participate in optional programs, as I mentioned earlier.

Impacts will also depend on the extent to which complementary software and hardware makes it easy for consumers to realize and exploit opportunities for savings through changes in their consumption patterns, such as systems that allow appliances to respond autonomously to real time prices under consumer defined parameters. In fact, a key question is the extent to which human behavior will be a continuing presence at all once the decision to deploy certain technologies has been made.

EIA is working closely with the Office of Electricity Delivery and Energy Reliability to develop an agenda for further analysis of the smart grid and its impacts.

Of course the foundation for analysis is data. As the smart grid investments funded by the Recovery Act are actually put into place, there are several distinct levels at which data will matter. One of these is certainly case study data from areas that are leading in smart grid technology. Recipients of smart grid grants under the Recovery Act will be required to report a wide variety of data through an information clearing house, as Pat Hoffman alluded to.

Nonetheless, some important data needs cannot be met through reporting requirements based on grant recipients. To update our early estimates of penetration rates

catalyzed by the Recovery Act program, we need to track the diffusion of smart grid technologies throughout the country over an extended time period. In addition to tracking hardware deployment rates, it is also important to understand the nationwide rollout rates for dynamic pricing plans. Recognizing this need, EIA plans to expand its work in this area.

To begin this process in 2011, EIA has proposed the following modifications to its electric power surveys: One is introduction of photovoltaic and storage technologies as distributed and dispersed generation sources. Also, expansion of data collection for net metering installations to include the amount of behind the meter capacity as well as the specific technology. So, for example, how much photovoltaic capacity lies behind a net meter in a distributed fashion?

In addition, EIA has proposed to collect on a monthly basis the number of AMR and AMI meters deployed as well as the number and capacity of net metering installations. These changes will allow EIA to monitor the deployment of these equipment installations in a more timely manner.

Finally, future data collection requirements may need to identify subsets of smart grid deployments based on types of meters deployed, the uses of those meters, and how they are combined with a variety of regulatory based incentives to promote changes in energy use. We are working with the Office of Electricity Delivery and Reliability to help define the scope of our future data collections and our FY 2011 budget request includes an initiative to enhance our smart grid efforts.

In addition to being the target of data collection, the smart grid can also be a tool for data collection. Currently EIA is required by law to conduct a Residential Energy Consumption Survey, or RECS for short. The REC survey allows EIA to gather information on the physical characteristics of housing units, the appliances utilizing, such as space heating and cooling equipment, demographic characteristics for households, and the types of fuels used. EIA has historically conducted 45-minute interviews with about 5,000 households out of the 111 million-plus households in the United States, once every 4 years. This year EIA is using \$8 million of Recovery Act funding to triple the sample survey size in order to increase the number of

states that can be discreetly analyzed and to provide more detailed benchmarking for measurement of ongoing energy efficiency initiatives.

Potentially the smart grid offers a way to collect this information at a more granular level, from a larger sample of households, and at lower cost, but collecting, managing, and making wise use of the vast amounts of data that could stream from the smart grid is a challenge that we're all just beginning to understand.

In sum, the development of the smart grid will likely generate new sources of data for businesses, consumers, and energy suppliers and help them use energy more efficiently, reduce the cost of transmitting and generating electricity as well as reducing the associated emissions. However, to get to that point, more information will be needed to understand the impact of different smart grid deployment technologies or strategies all along the electricity transmission system to the advance metering infrastructure at the point of final electricity use. Your input on EIA serving enhancements and analysis needs is important for ensuring we are collecting relevant data for tracking the challenges of developing and deploying the smart grid.

Thank you.

MR. WEST: Thank you, Richard. We'd like to open the floor to questions and comments from you. So, again, if you can raise your hand. Right here on the aisle.

SPEAKER: Thank you very much. A question for Richard Newell. In designing the scope of your next phase of data collection, to what extent did you rally the public service commissions and the offices of the people's counsels in designing this new scope?

MR. NEWELL: As part of our -- we do a regular reevaluation of our -- this is our particular electricity supply surveys which is an ongoing survey that we do both on an annual basis and monthly basis. That goes through a federal register, notification process, and there's other opportunities for public input along the way. I don't know exactly the extent to which we directly reached out specifically on smart grid to those entities. One thing I'll say is that at this point we have larger plans for really focusing in on smart grid and significantly expanding our collection there. What we've done so far is really what I would kind of call incremental improvements around our existing surveys. So, for surveys that we currently have and the ones I

mentioned were the ones that go to electricity providers, we basically thought, you know, how are the ways that we could add questions to the existing surveys to tap the respondents that we currently have?

In order to get a full handle on a smart grid, I think we need to have some significant additional survey implementation and development which would reach probably more to the Northeast -- North American Electricity Reliability Council -- there's a huge amount of information that is at the public utility commission and at the utility level that we don't currently collect. But again, in terms of the -- a key challenge there is the aggregation of that extremely detailed information up from utilities to state public utility commissions to regional transmission organizations. And it's a quite complex undertaking, so this is something that again we have planned as -- we have a request in to expand our efforts as part of our next budget cycle, but -- and I think that's where we would really get more specifically engaged with folks on designing a more full-blown smart grid data collection effort.

MR. WEST: Right here on the aisle.

SPEAKER: My question is a very local level. Do you have any idea of improvement for transformers, because transformers take up so much space in urban land, and also it blows up once or twice in a year and we get four or five hours outage?

MS. HOFFMAN: We are looking at, not under the ARA -- well, under the ARA funding we are actually looking at intelligent transformers, which is actually looking into maintenance to help look at predictability for any failures of transformers and so an improvement in the transformer from that perspective. From an R&D perspective, we are looking at innovative transformer technology such as a solid state transformer. EPRI is also looking at other advanced transformer technologies.

So, there are things in the research stage at this moment, but not ready for deployment.

MR. WEST: Over here in the front.

MS. THOMPSON: This is a two-part question for any and all of you. I'm Carol Thompson from Strategic Consulting.

The first is, what is the greatest challenge we face over the next one, two, and five years? And related to that is what do you want to accomplish over the next one, two, and five years? What legacy do you want this first Obama Administration to leave or to carry on in the next administration? And just -- you know, really to lay the groundwork so things can't go backwards?

MS. HOFFMAN: I'll start. The greatest challenge is probably consumer -- I have two great challenges: consumer education and looking at the regulatory environment are the two near-term challenges that I see. For accomplishments, it is actually setting the framework that we actually can document and verify the value of the smart grid so that we can actually show to consumers you have less outage time that you have the options as you look at your bill to be able to make decisions and that you feel empowered.

So, from my perspective, the challenge and the opportunities both focus on how we can document the value and the savings to consumers.

MR. ARNOLD: Well, I'll add to that the challenge that I focus on, which I don't know that it's necessarily the greatest challenge, but it's a big one, is moving the existing grid, which to a large degree has a lot of proprietary and customized technologies across 3,100 utilities, into a framework based on open standards that enables innovation to occur. And so, you know, focusing on allowing that to happen is really a major challenge and what I hope that we can accomplish in the next one to five years.

MR. WEST: Okay. Right here.

MS. RESLOCK: Hi. I'm Lori Reslock. I know most of you guys up on the panel, but -- I've been touching -- I've been engaged in transmission and distribution and end use and spent time with Pat yesterday and I've spent a lot of time with George talking about these issues. So, I'm engaged in a lot of the pilot projects around the country, both in the United States and Europe, and one of the things that I have some concerns about, and we've all talked about it, about the data gathering, but I wanted to direct the question to you, Richard, is there's so much innovation, the rate of innovation or the rate of change that's taking place in each of these pilots is rapid. One of the examples that you talk about -- I'll give you a couple of examples because I

think it's important when we gather this intelligence that we almost date stamp it because we need to know that what we did 12 months ago is no longer -- we're negating -- we're moving beyond the knowing from 12 months ago and we're moving to a next level or generational development, I would say, in the products.

One example, when you talk about meters, a meter is a sensor that's hitting; when we're taking a look at line loss, we're seeing it at the end of the line and it's interfaced to the consumer. But we already know in the last 18 months, we need to move those sensors all the way up the distribution system, all the way to the substation.

So, when we take a look at the design of the sensor itself, that's, you know, my friends at Itron are saying, you know, we're a metering company, but now in order to deploy the meters, we're doing three months of data mapping with the utility. So, are we a services company about meter data management?

And then on top of that, when we want to do voltage optimization to optimize the distribution system, do we need to bring those sensors all the way up the distribution stack to the substation?

So, that totally changes your sensor profile, so if we're only at a point in time going to evaluate the ROI or the business case sitting at the meter, we've got a huge problem. Because we can get -- 365 days a year, we can reduce load 3 to 5 percent by dynamic voltage optimization without ever impacting the consumer, but that requires smart sensors sitting on the distribution system itself. And when we talk about smart transformers, we have those technologies out there as well where we're able to do fault detection. So, those kinds of things, when we move to FLSR for the self-healing grid, are -- you know. And I work with all of these utilities in the field right now, they're asking about these technologies and they want to know, but they want the data coming out of the field. But if you put a date stamp on what you just said, it would already be inaccurate, okay, because the value prop does not necessarily only sit at the meter. That meter is a consumer interface.

You know, so when we take a look at the deployments in Europe, they're much more advanced in terms of looking at this whole system holistically and a lot of the utility -- I was

saying to Pat yesterday, most of the utility executives in Europe come out of engineering where in the United States the IOUs are more financiers, accounting, and attorneys.

MR. WEST: Okay, so can we get a question here?

MS. RESLOCK: Okay. So, those are a couple of --

MR. WEST: It's very interesting. I don't want to insult you.

MS. RESLOCK: Yeah. Okay. So the question is, is amongst all of you, when we're doing the data gathering, how are we capturing the evolution and learning inside of these pilots so we make sure that when we do the business cases -- because your datasets are going to be basically sort of rubber stamps -- how are we capturing that evolution and learning because the business case ROI is going to change rapidly over the next 18 months?

MR. NEWELL: Well, I think I'll quickly say there's two roles here, I think, for information collection analysis. One is in the context of specific pilot programs which there is a lot of attention on right now and I think the work that Pat's group, in terms of collecting the information as part of the reporting associated with smart grid grants under the Recovery Act, would be the key way to track that.

From an EIA point of view, what we really do -- we do ongoing statistical surveys and once we bring smart grid in, which we've already started doing, but to bring it in in a greater fashion, this will be to do it, you know, forever, unless 30 years from now it doesn't make sense to do it anymore. So it's going to be a gradual process for us for new innovative technologies will probably have to adjust questions as we go along. We'll have to stay on top of that.

One of the reasons why we're introducing this not just into our annual collections, but into our monthly collections is to be able to stay on top in a timely basis, but I think that we will learn a lot from the information that's collected through the pilot programs that Pat is overseeing and in fact we're coordinating now with their office to see what data they're collecting, assess the data that they collect through that so that will influence the type and form of questions that we ask in our surveys, but I think this is going to have to evolve over time. I don't know if you want to say more, Pat.

MS. HOFFMAN: Just real quick. The data from our projects will also be

collected and put on the smart grid clearinghouse, right, on the website in which we will have all that information summarized so people can actually take a look and utilize the lessons learned.

As we collect the data from the projects, the projects are just starting right now, we will actively put it out as projects finished.

MR. ARNOLD: I'd also like to add to that that in the standards work that we do, one of our projects is on standards for distribution automation and obviously placing sensors in the distribution network and having standards for data so that it can be accumulated and analyzed is another thing that we focus on.

MR. WEST: Okay. There's a question right back there.

MR. SINGH: Thank you. I'm Rajin Singh from World Bank. My question is about renewable energy sources.

You know, on one hand most of the countries, they are talking about introducing more and more resources. On the other hand, we are talking about its integration with the grid. With the limited resources available, what should be the priority? I mean, is there any percentage of the, let's say, total generating capacity that once a country reaches certain percentages then it becomes mandatory that the grid has to be smart so that this integration can take place, because right now the percentage is quite low in most of the countries.

MS. HOFFMAN: I actually think that requirement's going to differ, depending on the location and the part of the United States you're talking about and the system characteristics. So, we're going to have to actually evaluate that as we look at the system. For example, some parts of the country may be able to take up to 40 percent before actually having significant investments. Other parts may start seeing concerns 10 to 15 percent. So what we're going to have to actually look at is what are the more localized needs as we bring renewables onto the system?

And from the state's perspective, states are driving the renewable energy standards. And what we want to do is make sure that the grid is flexible enough that we can adapt as those technologies and the cleaner technologies are brought on to the system.

MR. WEST: Okay. Right next to him.

MS. ASHENFELT: Thank you. My name is Mariah Ashenfelt, and I work for the Netherlands Office of Science and Technology. We've heard a lot about opportunities and challenges now that deal with the smart grid, but I haven't heard about the opportunity the smart grid offers for people with the wrong intentions to either hack into the system, shut it down, gain access to delicate data. How are you going to incorporate this in the policy? Are you going to look at it from a state level, from a national level? How are you going to ensure consumer trust in this?

MS. HOFFMAN: With respect to cyber security, what our goal is is to incorporate cyber security with the smart grid as the technology develops versus thinking about cyber security as an afterthought. So, as we build the smart grid, we're building the cyber security requirements into that. George is looking at some of the guidelines for cyber security. We're looking at and working with the utilities, how they would procure technology that's more cyber security and has looked at evaluations for soundness with respect to cyber security.

So, a lot of that is going to be built into the projects as we go. Each of the projects has to do a cyber security plan and evaluation and so we do have that that we're working on as well.

MR. WEST: Over on this side. There are two questions. The two of you can decide which order.

MR. BEHR: Thank you. Pete Behr with Climate Wire for Patricia Hoffman. Could you elaborate on your concerns about the regulatory environment? And particularly, are you seeing a trend at the state level to slow down smart grid deployment or are state regulators raising valid, important questions about how this will affect consumers?

MS. HOFFMAN: I actually think state regulators are asking valid questions and important questions. It's now becoming a point of what is the objectives that the states want to achieve. I think some of the state regulators, as they look at what do they want to achieve with respect to peak load reduction, are really saying, how should they look at innovative rate designs, whether it's a critical peak program or a rebate type program, in order to achieve those objectives.

So, I think what you're now starting to see is some of the pieces actually coming together with respect to the smart grid, that haven't been thought about, or they have been thought about, but we haven't actually been able to pull some of those objectives together, whether it's an objective of integrating electric vehicles as a future goal for some of the congested cities as they look at, say, an environmental issue, or what they hope to achieve.

So, I think some of those pieces are starting to come together.

MS. WILLIAMS: I'm Cher Williams, from the RAND Corporation. I'm asking a question -- it seems clear that there are benefits to the utilities and the rest of the electric sector for implementation of the smart grid. However, I've heard the argument made that the benefits to consumers are not so clear. For instance, the incorporation of increased amounts of renewables is likely through either subsidies or rate increases to increase the cost of electricity to the consumer. And in addition, the consumer's risk the loss of privacy and on top of that, even if the smart grid functions as it is promised to be, the consumer will now have an additional responsibility of continuously monitoring their consumption of electricity.

So, given that the consumer runs a potential risk of paying more, losing privacy, and being bothered more about their electricity consumption, how is this good for consumers, and can you address that argument?

MR. WEST: Not to mention the fact that you're going to have to be watching your dishwasher in terms of the communications it has with these grids according to some of the comments.

MS. HOFFMAN: Okay, a couple things. You first talked about renewables. Consumers can put renewables on their houses with some of the incentive programs. The value of renewables is the choice of the consumers as they put that on the system on the distribution level. As we look at state requirements for renewable portfolio standards, you're going to see more renewables go into the electric system. What we want to do with the smart grid is make sure that the system is capable of managing those renewables. For example, if a cloud cover comes over and you have a drop in the output from the renewable technology, you have to pick it up somewhere else if the wind doesn't blow --

MS. WILLIAMS: That hasn't been necessarily a consumer oriented benefit, though, that's more of a policy -- in other words, the consumer, as an individual, what would be the benefits to them?

MS. HOFFMAN: Well, from the renewable technologies, you're talking about a cleaner environment, but the benefit is when -- I'll go back to consumers on the household. If you have several households where you have PV systems on a distribution feeder at the distribution level and a cloud comes over and the generation output drops, it has to be picked up somewhere else, so even at the distribution level, we must manage the system to be capable of handling the variability of the renewables.

The other thing that you asked about with respect to energy management is I think consumers need to have a choice in how they manage their energy. So, therefore, if it's automated -- so, consumers really don't have to play with anything or monitor anything that is the easiest way for consumers to really get engaged, so it's very much seamless to them. We talked about that in the telecommunications, how everything just evolved, that consumers did not have to have a lot of hands-on.

I think other consumers are going to want to have a greater say in how they do their energy management. A lot of those options and architectures, I think, are being heavily debated right now, of what is the best interface to dialogue with the consumers with respect to providing them that information and I think that information actually has to be tailored to where the consumers can best receive it. So, whether it's a smart thermostat versus a computer energy management system versus something that is automated for the consumer, is all different options in which the consumers can take advantage in the future.

SPEAKER: If I could just add a little bit on to that. You know, the appliance industry has done a lot of research on both energy efficiency and now also on let me say load shifting. And what I'm told by the industry is that they're kind of at the point of diminishing returns in terms of overall efficiency and that the real gains now are the ability to reduce peak usage.

So, you know, each appliance has a different sort of way it operates. And if you imagine a refrigerator, there's no reason why a refrigerator should go into its defrost cycle which consumes a lot of power when demand for electricity is at its peak.

But today, since refrigerators are dumb and they don't know anything about what the load is on the system, they just, you know, go into defrost whenever they feel like it. So the ability for an appliance like that to automatically, you know, communicate with a grid and understand when these peaks are occurring, or, you know, through dynamic pricing, a lot of this sort of load shifting that results in ultimately a benefit to consumers because the inefficiency we talked about, where like 20 percent of the capacity in the system is there just to handle the few hours a year of peak demand, if you can, you know, get rid of that, we can accommodate a lot of growth in demand for electricity without investing in new generation capacity, and that will translate into lower costs for consumers.

MR. WEST: Okay. I think we have time for maybe two or three more questions, so right there.

SPEAKER: I just – at the moment, most electric prices are based on a cost of service, great base rate of return model. Do we anticipate a continuation of that model as smart grid is deployed, or does anybody think about a different model or a new model?

MS. HOFFMAN: I don't know if I have an answer to that. I think that's a very good question. I know we have somebody from the Maryland PSC on the next panel, maybe we can pick that question up there. But also, I would guess that that is going to be a strong discussion in the NARUC summer meeting coming up next week.

SPEAKER: I'd make a very quick comment on that. I mean there has been a history in the U.S. of restructuring the electric power sector in terms of how those markets operate. In terms of wholesale power markets, there's been significant continuing change in wholesale power markets. That hasn't slowed down so much in terms of retail market pricing. You know, the California electricity crisis slowed down a lot of activity that had been taking place there. But I think there is continuing interest in, you know, giving customers the option of time of use, if not real time pricing.

You know, the industrial sector has tended to be directly interested in that, and so those consumers, you know, often actually seek that. But, you know, it has slowed down a bit, certainly in terms of when you measure it in decades, but there's a number of reasons why it seems like there's a reason for it to continue to evolve, including smart grid.

MR. WEST: Okay. We have a question right there.

MR. SHUE: Hi, thank you. My question is about the type of utility and how that effects the –

MR. WEST: Give us your name and organization, please.

MR. SHUE: Oh, hi, my name is Eddie Shue; I'm from the Science and Technology Policy Institute. So regarding Patricia Hoffman's comment about the different type of utilities, I'm wondering how – whether it's publicly owned or investor owned, how that effects their deployment of smart meters, and if this may be easier for one or the other.

MS. HOFFMAN: I don't know whether it's easier, it's different. So as you look at municipals or coops and their ownership structure and how responsive they are to consumers, i.e., if they're owned by the consumers or owned by a board that represents consumers, they have already taken or they have a different philosophy with respect to managing the cost of service and the price of electricity and their investment structure.

And so from that perspective, it's just a different investment relationship, as well as how the service is provided or their goals with respect to the utility, so I think it just needs to be kept in mind.

MR. WEST: Okay, a question right there.

MR. CAULSING: Evan Causing; Deloitte Consulting. There's been a lot of discussion about smart appliances, smart meters, things like that as we've been talking this morning, and one question I had for the panel was, these smart meters are composed of electronic components which have a much shorter life span than utilities are currently used to dealing with. They might only last for a few years versus a 55 or 60 year life cycle on a power plant. Also, a lot of these smart technologies in deployment are not being passed through on rate cases. So the question is, as these are being deployed, one, who's going to pay for them, and

also, over time, a couple years from now, who's going to pay for it again when it dies at the consumer site? How's it going to overcome that hassle factor on the installation?

MS. HOFFMAN: I'll take a stab at that. That's a good question, but I think there is an expectation that the meter technologies will last the 20 – 30 years, and how they invest or how utilities invest in the infrastructure will depend on how they perceive with the right case with respect to the IOU's and the independent – each of the states. So beyond that, we might take that question up in the next panel session.

MR. WEST: Okay, there's a question over here.

MR. PAVLOVIC: I'm Karl Pavlovic, I'm with a consulting firm here in town, Snively, King, Majoros and O'Connor, and my question is about the elephant that isn't in the room. What role is the Federal Energy Regulatory Commission currently playing in this interagency cooperation and what role should it play?

MS. HOFFMAN: Well, first of all, FERC does participate in dialogues and discussions, but FERC is also a regulator. So we're very cautious to recognize the regulatory position that they have with respect to regulating investment on the wholesale level. So with respect to smart grid, under ESA, one of the roles is to look at and review standards that are developed by NST with respect to the smart grid and the review of those standards from a regulatory perspective.

Additionally, they do look at the rate structures, the rate incentive, excuse me, at the wholesale level and how that can be either a proponent or for the smart grid technology.

SPEAKER: I'll just add that, you know, FERC is really an active participant in the smart grid task force that involves all of the federal agencies at an operational level. FERC has been an observer and participant in the new policy committee that Aneesh talked about earlier. And I can tell you that, in terms of the standards, you know, discussions, the more informed FERC is about the standards that are coming out, the better, and they are very, very actively involved. They participated in all of the workshops. NST interacts with FERC staff many times a week, so they're a key player in this.

MS. HOFFMAN: And I would add one more thing. FERC did a demand response report, looking at the value of demand response to the benefit of the electric system, and showed how much value could be obtained from reduction and peak load. So there are other ways that FERC is participating in the dialogue and recognizing the value.

MR. WEST: Okay. We just have a couple more minutes. There's a question right there.

MR. TIERNAN: Thanks, Tom Tiernan with Platts Newsletters. I want to follow up on an earlier question and the comment about the challenge on the policy and the consumer education element. I wonder if you could just give a quick vision of the federal government role in consumer education since that's – some people might argue it's more effective at the state or local level.

But also on the challenges, how much of a concern is it or how much of a worry is it that at the federal government level, you can come up with the policy framework in the fall and have the collaboration and coordination at the federal level, but not able to see that vision accomplished with the state regulatory structure and the utility structure. I'll give an example, the Maryland PSC rejection of the BGE program and the consumer backlash in California.

MS. HOFFMAN: I think consumer education has to occur at all levels. As we look and take a step back, what we're really talking about is energy management in the United States and how educated are consumers with respect to energy efficiency and really recognizing the value of efficiency with respect to the appliances they choose or how they invest in technologies for their home.

As we look at education, consumers need to understand the value of peak load reduction, and so that is an education. So the education actually has to occur across the whole spectrums. Utilities must do education. To be honest, we need a greater education program in our schools and in our educational system with respect to energy management and understanding future technologies, all the way up to the college level of education and integration of energy requirements as we look at different fields in the United States.

MR. WEST: Okay. We are out of time on this panel, but I want to thank George, Pat, and Richard for sharing their views with us. And I guess it's appropriate that that last question ended on an issue about the consumer role, because our next panel is The Consumer Perspective on the Smart Grid. That panel will be moderated by Pat, so I will ask her to step on the podium. And if we could have our other panelists come up and join us and then we will move forward with the next panel. Thank you.

(Pause)

MS. HOFFMAN: All right. So we're going to just go ahead and move into the next panel session to continue the dialogue that we started this morning. The next panel discussion is going to center on consumer views around smart grid technology, evaluating the benefits that come from access to the smart grid, concerns that are raised by consumers as the smart grid develops, and opportunities to actually inform consumers on the benefits and the operations with respect to smart grid.

We have a fantastic panel here, a distinguished panel. I'd like to just go through and introduce all the panel members. The first panel member is Barbara Alexander; she's a Consumer Affairs Consultant. Her focus is on consumer protection and service quality policies and programs associated with the regulation of competitive energy and telecom providers. Susan Covino from PJM Interconnection. Susan Covino previously served as PJM as the manager for demand side response, and she also served with the New York Power Company.

Our next panel speaker or participant is David Owens with the Edison Electric Institute. David Owens is the Executive Vice President of Business Operations at the Edison Electric Institute and really looks at the environment, energy delivery, energy services and international affairs. He does focus on the industry rules involving competitive markets.

Calvin Timmerman is with the Maryland Public Service Commission, and Calvin Timmerman is the Director of Rate Research and in the Economics Division and the Chief Economist at the Maryland Public Service Commission. So he has worked on natural gas, electricity and restructuring activities.

And our final panelist is Jamie Wimberly. Jamie is the Founder and the CEO of a Distributed Energy Financial Group which actually focuses on marketing expertise to alternative energy companies, as well as venture capitals with respect to utilities, vendors, equipment manufacturers and financial firms. So, first of all, I'd like to thank all our distinguished guests this morning. And what I'd like to do is actually, first of all, start off with a question on consumers, and where do you perceive consumers, who are the consumers, and how do you feel they should or could interact with the smart grid. Barbara.

MS. ALEXANDER: I have the first question?

MS. HOFFMAN: Yes.

MS. ALEXANDER: Thank you very much for inviting me to participate in this proceeding. As far as I know, I'm the only representative of residential consumer organizations. I'm not here on behalf of any client, but I have participated in smart grid, call me smart metering proceedings in a number of states.

Before I answer your question, I would like to ask a question. How many people in this audience have actually participated as an attorney, as an executive, as a witness, as a decision maker in a state rate making proceeding involving an electric utility? That's a little bit more than I would have projected, but it's still a mighty small group. And all of my comments today are going to be not intending to throw, you know, water on this lovely flame, but frankly, that is what I'm going to do. What is happening at the local level is not any of what is going on in the discussions you've heard to date. Smart grid is not being presented as an investment or a plan by public electric – by investor owned electric utilities. They are making proposals for smart metering in most cases, and that is only one third of the vision that I have heard described here.

The first piece that utilities have decided to focus on in terms of actually asking for permission to invest in this, get return on this investment, and get all their costs paid for by consumers, all of which is going to be mostly residential consumers, is the metering piece of this.

We have yet to really see any significant planning, promotion or proposals for fixing the grid, which is the T&D network. And you will find consumers very interested and understanding of the need to modernize the grid, whatever you call it, smart grid, modernization,

upgrading, making it more efficient, that's what utilities are supposed to do, that's what base rate cases are for. And utilities have routinely come before commissions with requests to make changes in rates and revenue requirement to reflect new investments in the system. And what's happened, unfortunately, is an overall emphasis on the metering and the pricing, and we'll get into why that's of concern to consumers maybe later.

How can consumers get involved in the smart grid? Well, I'm a noun person, I want to know what am I getting and what am I paying for, and I'm going to compare those two things, and I don't think that's unreasonable.

If my bill is going to go up \$2, \$3, \$4, \$5 a month to pay for a brand new metering system, pay the utility back for all the old meters that are not depreciated in rates yet, so they need to get all their investment back, change the computer system for billing, change the way in which my basic essential utility service is priced to me, then I want to know who's guaranteeing that I will get something out of this that will justify the cost I'm being asked to provide, and that's the link that hasn't happened yet.

MS. HOFFMAN: Thank you. Recognize both the utility side and the residential side of things. David.

MR. OWENS: You know, Barbara raised a real important question. I've heard this issue raised before, and that is that, for the most part, there's a criticism that the utility industry has not done a good job of informing the public about the benefits of the smart grid. And I'm glad she didn't just focus on the meter. And I would support and echo her observation and suggest that we need to do a much better job. We need to be able to lay out to the customer all aspects, not just of the meter, but also about the smart grid.

And if I might just elaborate just for a moment about some approaches that we probably should consider taking on. Right now we have roughly 33 states that have smart meters. We anticipate by 2019 that we'll have 60 million smart meters installed.

The average customer really doesn't have the slightest idea, for the most part, of what this meter is seeking to do. We've got to convince the customer that the meter is going to put the customer in control about their overall home energy management. We've got to

demonstrate to the customer the vision that our President has and others who are intimately involved in the smart grid.

And let me be fundamental here. For home energy management, the concept is that the customer now will be able to see in the future what the real prices are of energy for the various appliances that they are calling upon. And the customer will have the ability to look at the use of those appliances and the bills and somewhat called real time that will – the prices that will contribute to their overall bill, and they'll be able to make decisions that they want this appliance on or that appliance off. So they have greater control over their overall use of energy in their home.

They'll also have the opportunity to have the, if we have dynamic pricing, dynamic pricing meaning that you're able to adjust prices with respect to time of use. They will have the flexibility in the future through the meter to be able to subscribe to a dynamic price, and through that dynamic price, they'll be able to decide whether they want to run their dishwasher or their refrigerator at a time when it's the highest demand on the utility system or choose to get a rate preference to shift their demand and to shift their usage to other periods of time.

This vision that we have about the smart grid also suggests going beyond that to the degree that the customer is concerned about greenhouse gas emissions and wants to contribute to reducing our greenhouse gas footprint. They also have the opportunity now, and they've had it before, to install rooftop solar facilities, the whole range of distributive resources, which the smart grid will, in fact, help facilitate. And if I perfect this vision a little bit more, the automobile that they have that we will be looking not at our gasoline driven machines, we'll be looking at plug-in electric vehicles, all of these elements need to be thoroughly explained to the customer. These are not instant benefits; these are benefits that will accrue over a period of time.

And what the utility industry needs to do a better job is explaining these in brochures, in manuals, in holding dialogues with the customers, inviting the customers to participate in the regulatory proceedings, so there's a clearer link between the benefits and the costs that are necessary in order to enhance the system.

And fundamentally, or finally, there are a broad range of operational benefits that accrue to the utility operating the system, which – to the benefit of the customer, improve operation of the system. We'll be able to know when a customer is out, we won't have to necessarily look at when a meter is out, we'll know individually what customers are out and we'll be able to restore service much more quickly. I think all of these are very significant benefits. We'll also be able to, as others have indicated, we'll be able to have sensors in our transmission system, we'll be able to determine in advance where it looks like some of the electric parameters are going to lack, we'll be able to make adjustments so we can avoid an outage and keep businesses operating. These benefits, in my opinion, need to be articulated a little bit more clearly, a little bit more forcefully, and much, much broader to the consumers.

MS. HOFFMAN: Susan.

MS. COVINO: Thank you. Looking at this issue from the wholesale side of the market, I can tell you a couple of things; one is that the smart grid is here, it's here already, and I'm seeing it each and every day, and the value of it for large customers, commercial and industrial customers who are working with curtailment service providers to monetize their load reduction capability in the various markets of PJM.

Our stakeholders have spent a good part of the last five or six years enabling these resources to participate in the market, and the curtailment service providers are putting to work the kinds of innovation that you've heard about on the earlier panels to actually help customers manage their bills, and to provide the grid with valuable resources, for example, synchronized reserve. This is an important service that helps us maintain the reliability of the grid when a contingency occurs, but it requires a response within ten minutes. In some ways it's a very good service for a large commercial or industrial customer to provide, that is, to stand ready to respond within ten minutes when a contingency occurs on the grid and to be paid for that willingness to stand ready.

And we've seen some very interesting technology put to work by the curtailment service providers to automate that response on behalf of the end use site, a commercial or an industrial customer.

The other part of my answer is, besides being able to demonstrate that it's actually here is to say that, looking forward, we're intent upon being ready, ready for the kinds of integration that the smart grid promises or that it requires in terms of the reliability of the overall grid.

So, for example, if my CEO, Terry Boston, were here talking to you this morning, he's focused on the reliability of the grid in the transmission sector and through the generation sector. My work focuses more on that space between the wholesale and the retail market. But that reliability piece is so important. What he would tell you is, we can entertain or we can provide electricity to power 25 million electric vehicles because some of the states and some of the sectors of our economy have told us how important it is for them to provide jobs to move forward for the benefit of the environment to enable those kinds of things.

Electric vehicles are coming, we're told. Fine, but we need to make sure that the grid is reliable. How do we maintain that reliability? How do we service 25 million electric vehicles without building more generation? We do it through the smart grid by providing price signals, by providing other signals to customers that help us fill that valley that occurs in the production of electricity over the night and early morning hours and uses that capacity to its full advantage, closer to 100 percent capacity than we have now. So those are kind of my two quick responses.

MS. HOFFMAN: Thank you, Susan. Jamie.

MR. WIMBERLY: Let me first start with making a distinction between smart meters and smart grid. Now, you know, often times, you know, we use those terms interchangeably, and really, when smart meters – when you think about meters, they're really two-way interactive platforms, but essentially they're a regulated asset on the utility side. We switch out meters all the time. Then there's smart grid. And smart grid, quite frankly, and I understand that we're talking about it in the context of energy here, but actually it is much bigger than that, it is taking many of the advances in communication technologies and the internet and applying it to real networks and assets and commodities, energy being one of them, but you're going to see that in – communications, you name it.

That is why we are talking about utilities here. Actually, a lot of our clients, Cisco, Verizon, Internock and others, these huge publicly traded companies, very well capitalized, are coming into this space, and they expect to make billions of dollars here.

So I think it's important to remember that this is not just, you know, past prolonging utility kind of dialogue. Having said that, we have done a lot of research. EcoAligns are a strategic marketing agency, we talk to consumers all the time and those are through surveys and focus groups, you name it. So basically we just recently released a survey around how consumers perceive and, you know, what their expectations around smart grid. And there's a good story and some challenges, and the good story is that, quite frankly, they don't know what smart grid is. About 70 percent have never heard of smart grid. But when given a short definition, they like the idea of smart grid. And why is that? If they don't know about it, and yet they tend to like it, and the reason being is because part of that perception is built on smart phone, smart car, a lot of smart things. They actually like the word smart; we've tested that, too.

The second point to be made is that they actually think it's going to benefit them, too. So the challenges, though, one is around, you know, predicating this on cost or framing it up on cost, because, quite frankly, while I appreciate the fact that smart meter, smart grid are going to provide more management type options, I look out into the future and I see a wave of costs coming into – cost drivers into this sector, around aging infrastructure, around environmental impacts and pricing and carbon and things like that, and any of those benefits that might be accrued on the cost side as far as smart grid very well could be overwhelmed by these other cost drivers. I think the better question is, how do you create value in a commodity market? So it's around value. Secondly, I think that, you know, there's a real potential misalignment between the capability and the customer experience. I mean there's going to be nothing smart about smart grid or smart meters if the customer service is terrible. And quite frankly, that's something I'm very concerned about in terms of, you know, everything from communication channels, web sites, you name it, to if somebody calls up the call center and that call center rep doesn't know who that customer is, that's a big issue, that's not smart, and so there's a delivery aspect, as well.

MS. HOFFMAN: Okay, thank you. Calvin.

MR. TIMMERMAN: I'm afraid that too often the smart grid national discussion has overlooked some fundamental differences that we have with electricity as a product, as a consumer product, compared to most every other consumer product we actually deal with, and what the legacy of this consumer product is in the United States structure.

Customers have a right to consume this product. Customers are used to this product being provided under an obligation to serve. Customers are used to the price of this product being the historic average cost of the product, not the future looking cost of the product. This product has traditionally been delivered by a highly regulated utility centric delivery process and production process. Smart grid contemplates a revolution in all of this. It's best deal day, by the way, don't forget that it's best deal day, and don't forget that, unlike the American Revolution, revolutions don't always turn out quite as you anticipate.

The French one went through a variety of permutations before it eventually settled down to something that was rather closer to the original ideas of that revolution.

It's not surprising that the consumer concerns that we're hearing from Ms. Alexander and the concerns that some of the problems smart grid I guess is currently experiencing are having those difficulties because, in my mind, there are some fundamental policy questions at really both the national level and state level that have yet to be answered, and it's hard to discuss what the consumer experience is really going to be until you have some answers to these fundamental questions.

We do not have an answer to who controls the data at the moment. We do not have an answer to who controls the customer side experience at the moment. We do not have an answer as to whether the smart grid will be in a, how should we put it, an open access highway, a common carrier, or whether it will continue to be a utility dominated monopoly.

Until we start having some of these answers, I think I have a hard time telling you what the consumer experience really is going to be like, what customer education really should amount to, because answers to these questions I think are so fundamental, how consumers are going to react to this product, the success of this product, whether this product is, in fact, a

revolutionary change in 21st century electric infrastructure, or simply sort of an evolution, so to speak, of the metering we traditionally had in the 20th century.

These strike me as fundamental issues, whether the consumer is going to see an improved quality of service, whether the consumer really will see some of these promises, or control of their own experience, whether there will be lots of jobs, lots of innovation or not. And I hope in the course of the day to hear what some of you feel should be the answers to some of these questions, both at the state and federal level. I should probably give you a small disclaimer in particular that my commission is yet again in the news. It's been a few years since we've been, you know, sort of trend setter in news breaking kinds of things, but we're back there again. I am in the staff of the Public Service Commission. I am now a commissioner, I am not a commission adviser that means I don't write orders, I make recommendations.

I was, of course, heavily involved in the smart grid hearing process and the staff's recommendation in those processes, but I am not responsible for those orders, good or bad.

MS. HOFFMAN: Thank you, Calvin. Let me move on and then we'll take some questions from the audience. The next question I have is, from a consumer perspective, what applications really should we be looking at first and why? I know that we've looked at different things in the past, but how can we be assured that as we move down this process, we'll achieve the benefits? So how do we prioritize some of those applications and document the benefits? And I'm going to start with Susan first.

MS. COVINO: I think that some of the work that's being – that will be done by groups like the Demand Response Coordinating Committee as part of implementing the national action plan on demand response probably need to be highlighted here, because this is the time to really get underway and to take advantage of the investments that are being made in the smart grid up and down the entire smart grid, and let me emphasize once again what we're talking about, all the way from generation down to devices, and also to take advantage of the kind of data gathering that's going to be taking place.

So, for example, on a lot of the pilots that have been funded, a lot of the deployments that have been funded, we're going to have access for the first time to a great deal of data.

And I understand, for example, that one of the universities will be putting together a web site. What I would see as the vision going forward is groups like the coalition of coalitions that will be implementing the national action plan for demand response is really taking advantage of those data bases.

Let's be honest, there aren't too many of us that have enough time in the day to sit down and look through the web site anymore than there are folks that do demand response in PJM who have time always to negotiate our web site. They give me a call, I talk them through it, we exchange ideas, we solve problems and we move forward. I foresee the same thing happening with the implementation of the national action plan for demand response, in the sense that it will be our job as the practitioners in this area to help solve problems, to pull useful data out of these data bases and make it into information, to help it inspire others based on success to move forward and perhaps try new techniques, new approaches.

One thing we have to know is our expectations have to be realistic. If we're talking about moving forward with something like the smart grid, it's bound to be messy and it's bound to have errors in it. Some companies will make it, others will fail, but in the end, we hope to have an electric grid that's updated and able to provide better service to our customers.

MR. WIMBERLY: Well, in the short term, I think that I would focus on three things, first of all, billing and payment options. Again, you know, while we've talked about energy management, I mean what seems a lot more real to me in the short term are things like prepay and also budget billing and other things that are maybe there or not there, but I think would be enabled by smart grid in such a way that would be interesting and appreciated by at least some customers. Secondly, as I mentioned before, I think customer service has a long way to go. There could be a lot of improvements around service levels, also capabilities, tools, applications, that kind of thing.

And third, I think I would focus on communications, smart communications. One of the things that I think would be – smart grid could enable would be a much more proactive, predictive kind of relationship with a customer, meaning that a customer actually could say to a utility, look, I'm spending \$120, I'd like to spend \$100, can you help me manage that, and so smart grid essentially would allow you through the data to have the utilities say, hey, look, you're at \$80 now, you've got \$20 more, here's some recommendations to get you through to the end of the month to meet your budget.

Now, that is a sea change, I've got to say, in terms of, you know, customer service and the culture around customer service and utilities right now, but hopefully smart grid could point us in the direction of a different relationship that's much more advisory, much more proactive, much more predictive.

MS. HOFFMAN: Calvin.

MR. TIMMERMAN: First thing is, do no harm. I think we've learned recently that up front verification, testing, and truly doing – having a good testing plan, good oversight, I'll mention, for example, in our hearing process, staff recommended to the commission that the commission should have its own independent technical consultant watching the utilities, testing plan, watching the utilities, cyber security developments, data protection, all of those kinds of things basically to give the public the extra assurance that more than one set of eyes, more than one brain that's been thinking and looking at all of the things that go into making this very complicated system work right and work consistently.

It's pretty clear that this – the Bakersfield problem, for example, there will be a very high consumer expectation of success and of everything working. And I think we've learned that even saying, oh, it's going to be – 99 percent of the meters are going to work perfectly, one percent of meters is a lot of meters in a good size service territory.

And our expectations to do no harm have to be, when this thing is rolled out, when it becomes the new service for the public, the new way of doing this, there will probably be some hiccups, they're probably inevitable, but a great deal of work has to be done to make sure that this does not become a bad story early on. Once you've done no harm, I'm with the things

we've heard so far, that improved service quality should be very high on the list. That next big storm that goes through the system should be able to demonstrate that customers really have gotten back on service faster, and that that's made abundantly clear, and that it actually works.

I'm in a retail choice state that – it's my contention that part of the problem that we have had with retail choice at the mass market level at the moment is that actually an individual customer at the mass market level for electricity is not yet an individual customer.

When you serve that individual customer as a retail supplier, you serve them as if they were an average usage customer. If they have high peak usage, if they have very nice usage patterns, if they have a solar panel on their roof, it doesn't matter, they're average.

This system will make them a specific customer. Their usage characteristics will be something that a retail supplier will be able to market to directly. They will be able to create a product directly for that customer. And it doesn't matter that, you know, that that customer's characteristics are, in fact, quite different from the customer next door, even though they live in the same kind of house and they live in the same neighborhood, but this will enable that kind of product and service to be available, assuming, of course, the grid makes it possible for – to pass that kind of product and service onto them.

And the system also I think needs to be able to exploit niches as quickly as possible. If you're in a state that is very heavy on distributed renewables, for example, that system better be able to quickly facilitate rooftop solar. If that's something that's moving fast in that jurisdiction, that better be a priority.

If you're an electric vehicle lead location, that system better be able to pretty quickly accommodate the benefits of electric vehicles and make sure that if you have a whole bunch of electric vehicles now clustering in a particular neighborhood, that on the 4th of July, on a hot day, the fireworks isn't coming from blowing up transformers rather than from the fireworks that it's supposed to be coming from.

MS. HOFFMAN: Thank you. Barbara.

MS. ALEXANDER: I would recommend in the short run an emphasis on peak load reduction and the direct load control type of programs to get us where we need to go. You

know, one of the great tragedies of the restructuring movement is that it destroyed the utility and the state interest in the price of electric generation supply. All of our direct load control programs, of which there are many, were many still out there operating, were allowed to fall apart, not paid attention to, nobody cared about monetizing the value for residential now.

There's a real effort going on for commercial and industrial, but for residential, you're talking about utility as the aggregator for all practical purposes. And I would really focus on rebates that would – and the installation of smart thermostats that are controlled by the utility under a set of agreed upon protocols with the customer, and the customer gets paid some money to allow this control to occur, and the utility sells that into PJM, gets a benefit in the form of money, which is then returned to all customers in the form of a credit on everybody's bill or a reduction in an otherwise applicable rate.

That is the kind of clearly defined, very efficient, least cost approach, and using modern technology to do those programs in a much more efficient and effective way than we did in the past. You do not need a smart meter on everyone's home to do this. You do need to upgrade the transmission system, or the distribution system, the communications, the sensors, you need to do modernization of the grid to do that program, and you need to invest in the smart thermostats, and you need to offer to install it and maintain it.

That is going to get us far more bang for our buck for people who have appliances that can connect to those communication methods, and particularly central air conditioning, and hot water heaters in certain parts of the country.

The notion that appliances will somehow react to the real price of electricity is, please let me disabuse you of the practical way in which this can occur. The meter has a means of telling the utility how much you've used, right. It's the utility that's billing you. If the meter is connected to something in your home, an in home device, you won't be telling customers about prices they're not paying, you're not going to send through the hourly wholesale market whatever to people. People want to know, what am I paying for my electricity, how is my bill being calculated. There's about five or six different wholesale market prices that you might have a very theoretically interesting discussion about which one people ought to know about, but believe me,

it's not obvious, and most customers would have no use for that information. I have a new friend that I made a month ago named Ray Gogel at Current Incorporated, I don't know if you know him, but he has a great phrase to describe what we ought to be working on, consumerless efficiency programs, things people don't have to be educated about except if you let me do this, we're all going to have lower electricity bills, and you will get a credit on your bill.

So that's the kind of program that I think we ought to be headed for and that I think we can implement fairly quickly and ought to be focusing on promptly. If the last couple of weeks in the mid Atlantic area has taught us anything, it's that we've got to get going on reducing peak load demand in a very consumer friendly and efficient and cheap as possible manner. Thank you.

MS. HOFFMAN: Thank you. David.

MR. OWENS: Sometimes the benefit of going last is, you forget what the question is, or everybody said everything. So let me – so I have to say something different. I think there are three issues, energy management, service quality and responsiveness, and I think all the panelists kind of touched upon some of those. On the whole issue of responsiveness and service quality and energy management, and I'll take the Bakersfield example just to talk about lessons learned with respect to the inaccuracy of the meters, and what PGE did, it said let me do a side by side, let me take the old meter and let me take the new smart meter and put them side by side and demonstrate to the customer that the new meter that I'm putting in is just as accurate as the older meter.

What that does is it improves the overall confidence that the customer has in what the utility is seeking to do. The other thing they said is, you know there are going to be a lot of questions about smart meters, so we need to enhance our call centers so that we're able to be more responsive to customers that have questions.

And then they said, we not only need to do that, we need to have a dedicated smart meter customer call center so that we can efficiently respond to what the customers are concerned about.

On the whole notion of home energy management, I'm a believer in dynamic pricing. And as Susan was indicating, that there's a wealth of data bases, there's a wealth of

information that's being collected. We recently did a study at EEl that looked at many utilities that are using dynamic pricing tied to the smart meter. We looked at five different case studies, and I have copies of the studies if you have interest.

But as we're evolving, we need to be able to interact with the customer and let them know or make them aware that a price signal, in fact, can alter behavior, that they can have the benefit of shifting peak, they can have the benefit of having us use more efficient resources and not having to build new resources in order to serve their needs.

So having a catalog and having an understanding of the various pilot programs that are underway dealing with dynamic pricing I think is extremely valuable.

Our colleague from the Maryland Commission raised a number of issues, and in those, he was correct in saying that what the smart meter does is, it's going to create a whole new business model for the traditional utility, it's going to create a whole new set of responsibilities and a whole different regulatory model for commissioners, both federal and state commissioners, a whole new set of business alliances and relationships. That's all about change and it's about transformation. And we have to – and technology is driving this, much like technology drew the cell phone industry, technology is driving this. You can't stop technology. What we have to be able to do is to adapt to these differences.

My last point would be this, on the whole issue of access and privacy, which is a significant issue. Our teenagers, clearly they're on Facebook, they don't mind about – they don't care about privacy, but somebody like myself, I do care about privacy.

So the issue on privacy is that there does need to be an understanding of what the various states are developing. There are a broad range of states that are developing what we call privacy rules.

So the customer knows in advance that the data that the utility traditionally is collecting, there's always been a trusting relationship between the utility and the customer, but now, as we move to the smart meter and broadly to the smart grid, there's going to be the desire to have this information more broadly available, and so there has to be guidelines, there have to be guidelines that are developed to talk about that relationship and to talk about the access to it and the

considerations of it, and some states are moving in that direction. So cataloging and understanding and then have an important discussion about the use of the data and the access to the data and the transferability of that data I think is very critical.

MS. HOFFMAN: Thank you. Can we have some questions from the audience?

MR. JENISON: I'm John Jenison with the House Energy and Commerce Committee. And I think in prior technological revolutions such as smart grid promises, you've had a generation of early adopters who have left towards the technology, you've had others who have much more dragged their feet, you know, prove it to me first, then I'll go with it, and you've had others who say, you know, I like the old technology just fine, I want to stick with it.

And I guess my question goes to Barbara, David and to Pat, and that is the extent to which in the smart grid transformation it has to be a mandatory conversion of customers or whether it can be totally an opt in conversation where you have early adopters say, yeah, give me the smart meter, give me the time and use rate, give me the smart appliances, I'm ready for it, where other customers can say, no, I want to stick with the old flat rate, I don't care if they compare it to the flat earth, you know, I want to have good old utility service and I don't want to have to swap out my appliances, I can't afford it, or in order to really make this work, do you have to essentially require everybody in a service area or in a subpart of a service area to make the conversion all at once and essentially push people to be adopters.

MS. HOFFMAN: David –

MR. JENISON: And the question for you, Pat, is, how is that split, if there is one, in the demonstration and trial in the grant programs?

MR. OWENS: I guess I would start, and I would say that it would be totally inefficient to have you on a smart meter and your neighbor not on a smart meter. If I'm seeking to install the smart meter, I go before the Public Service Commission, I make my case, there's a determination if this is a cost effective investment, and the rollout should be one that's uniform rather than dysfunctional. So I do believe that once it is determined by the Public Service Commission that there's a benefit that will accrue, then I think it's appropriate that it be rolled out in a uniform way. Now, what some companies have done is, they've made a decision that we

want to evolve it, we will not install smart meters on our entire system, what we'll do is, we'll look at certain regions of our system that will roll them out, and a lot of that has got to do with the expense of the investment and also that they want to gain additional information. So they can look at the broad range of opportunities and benefits that will accrue to the customer.

But I think it would be inefficient to say that you – that I install a smart meter on your home and my neighbor not have one, that would be a very inefficient way of evolving the smart meter.

MS. COVINO: In order to justify increasing everyone's bills to pay for these investments, whether we're talking about the distribution system or a metering system or in home devices that might be funded by rate payers such as smart thermostats or in home devices, the utility has to go to the commission and present a business case and show that this investment, over a reasonable period of time, will provide benefits that exceed the cost.

I think I join with David Owens in the notion that it would be very difficult to prove a business case with a case by case installation of a meter. You would need the entire communication system capacity to be built out. You would need the meter data management system built out to handle the entire system, and it would be difficult. You could install it gradually, no question. But let me say that customers really could care less what the meter is on the side of their home. What bothers consumers advocates is three things, the costs are going up, what am I getting out of it, am I – consumer advocates unanimously oppose any move to mandatory dynamic pricing, the time of use, real time pricing, critical peak pricing, we view it as something customers should be allowed to select based on their view of their own billing situation.

We're concerned about the remote disconnection of service with these meters. The meters all have a switch on them, and there's an efficiency to connect the meter in between tenants and homeowners and people moving in and out, no problem there. You don't need a premise visit to move the meter off or on. The problem is the disconnection for non-payment, which is a highly regulated and very socially and health related matter in every state.

And if you can flip a switch at the head office and disconnect, you know, everyone scheduled legally to be disconnected on a particular day, you are going to do a lot of damage to – first of all, you're going to vastly increase the volume of disconnections that can occur because you don't need premise visits, and second of all, you're going to miss out on a lot of health and safety and ability to avoid disconnection. In some states, utilities have to knock on the door and accept payment in some form to avoid disconnection of service.

So those are the consumer protection issues that are being litigated as we speak in a lot of these proposals. And the last – I would just – one more point, please, is that utilities will not assume any risk with regard to the delivery of the benefits that they are counting in their business cases.

BG&E's business case found only 21 percent of the benefits from firing meter workers and other operational efficiencies. Why are we talking about losing jobs? But 79 percent of the benefits were related to the electricity supply, generation supply part of the bill over which BG&E has absolutely no control. And so they projected this and projected that, and that's where we have the commission in Maryland saying, wait a minute, if we're going to spend \$700 million on this, and we're taking all of the risks that these benefits you have hypothesized for us will occur, we have a problem with that, consumers have a problem with that. So those things need to be resolved to move forward on the smart metering agenda and the pricing issue.

MR. SNYDER: Jim Snyder from Isolen. Let's assume that there are very significant efficiencies to be gained from this technology, significant cost savings, let's also assume that it's a zero sum gain. Some of that will go – those – will go to the consumer; some of them will go to the producer.

I would suggest that the history of regulation of these type of utility industries is when these gains are on the table, the vast majority end up going to the producers rather than the consumers even though they're always sold going to the consumer.

So to take a vivid example, in Maryland, the last time we had one of these epic restructurings of the utility industry, with much of the same rhetoric here, decentralizing, quality improvements, what actually happened, well, rates went up by 72 percent shortly thereafter, there

was no quality improvement, management sold out with tens of billions of dollars of businesses, and the shareholders did quite well, and, of course, the consumers were left holding the bag that was sold in a similar way to here. So the question is, given the history of regulatory capture of these type of commissions, I mean they're supposed to be advocating for the consumer interest, but the reality is, the industry pays attention, they tend to get control of the process, they understand where the risks are and they ship them to the consumers, like they're doing here, consumers end up holding the bag. To what extent do we have to worry about regulatory capture?

Even if all this vision comes true, the consumers are actually not going to be the ones that benefit. There will be huge benefit for the vendors, producers, maybe it'll be social welfare because you reduce the cost, but at the end of the day, it's not going to the consumer's benefit.

MS. HOFFMAN: Calvin, do you want to start with that one?

MR. TIMMERMAN: Again, I'm speaking for myself. I'm concerned about regulatory capture myself, and that's odd to be said for somebody who's a regulator, and I don't like being captured much. But I think the list of policy points I was giving you go to this question that I cannot see this being a revolution if it winds up being entirely controlled by the utility, if the customer experience is only the experience that the Public Service Commission approves after it's been proposed by the utility, and we have lengthy hearings on exactly what that experience should be, and exactly what kind of in home display we should buy, and exactly what the web site portal should look like.

And looking at the supply side, if one of our curtailment services providers or whatever the federal people call them, you called them aggregated band response providers or something, if one of those folks have a better idea of a price product that requires controlling my smart thermostat than perhaps BGE has, in my vision, that supplier should be able to, with an appropriate arrangement with the utility, should be able to run my thermostat differently than the utility wants to run it because of the pricing product or the display service they're giving me.

If this is entirely utility centric, that's not going to happen. If that supplier can't get my usage data and can't get it basically in the same time frame as the utility gets it, this will likely

fall short. I mean it gets back to the black – telephone situation, you know. We often do ask ourselves, well, all those things all you guys carry in your pockets that you have to – that you're looking at during presentations like this, would that have ever happened if the teleco industry continued to be regulated the old fashioned way? I don't think so, I truly don't think so.

Yes, we certainly had difficulties with retail restructuring. I would suggest, in part, there's a lot of industry blame there, but there's – for it to have become a true retail product in the list that I gave earlier, there's a lot of barriers that need to be overcome in the electricity business for one of these things to become – to have the innovation, to have the consumer involvement that you have with any other innovative retail product when you're talking electricity.

And we must not forget the rocky road that we have had with innovative policies in this area. PURPA, for example, I mean do not forget that PURPA – if we had followed PURPA, smart grid would not be as big a deal today. If we had followed PURPA, everybody would all be on time of use rates.

SPEAKER: What's PURPA?

MR. TIMMERMAN: The Public Utility Regulatory Policy Act of 1979 that envisioned time of use rates for one and all, that envisioned the extensive demand side programs for everyone.

MS. HOFFMAN: If I may stop there because I know we have a couple other – keep our comments short.

SPEAKER: If I just may be very simplistic here, you raise a very good question. If you look at what is being proposed, I think there are two interrelated issues. One issue is improvement and reliability and responsiveness, and Jamie said that's a value issue, okay. What happened when we had restructuring? People were putting up dollars, they were saying we're going to spend billions and billions of – we're not saying that. We're saying we're going to improve the reliability of the grid; we're going to improve our service responsiveness.

Now, as a business, you can evaluate what that means to you; as an individual customer, you can evaluate what that means to you, but I can't sit here and quantify that for you.

Then let's look at who are the new players. At least my members are regulated by Public Service Commission, so everything we do is regulated by the PUC. They look at any profits we make; they regulate every aspect of our business. When you look inside the home, that's the other aspect of this, aside from improving the grid, putting sensors on the grid, improving the distribution system, there are a number of activities, what we call behind the meter. Many of those activities are within the home, home energy management.

Now, I heard Jamie say that his clients see a multi billion dollar business there. What that says to me is that home energy management area is going to be diversified. It's not going to be your traditional utility that is going to be the one that's going to be providing the services. The customer and the commission will make a decision about the competitiveness of that market and who the players are. So this is a whole different type of scenario that we have here.

Public policy drove restructuring, technology is driving this discussion, so it's a different kind of discussion that we're in today. We have a lot of lessons learned. If you're irritated over what happened in restructuring, then I would encourage any of you to get involved in the dialogue, to be a participant, to be an active participant so that we can take those lessons learned from restructuring and use those value propositions in terms of how we roll out the smart grid.

SPEAKER: Pat, can I just say something really quick? First of all, I've got to say, I want to be very clear here, rates are going to go up, they are going up and they're going to go up a lot, okay. And the reason being, as a nation, we have not invested in our infrastructure. Our T&D system is often times overstretched, it's just not handling – it's not configured for the market as its evolved.

Like I say, it's – we can't build a coal plant in this country right now, for the most part. Well, you know what, that time is shrinking and shrinking, our options are shrinking, and they're going to get more and more expensive.

So rates are going to go up, and part of that is because the old regulatory paradigm, and the old regulatory paradigm, one of my original partners, Tom Blord he actually did a really interesting analysis using real option theory to show that regulators are actually taking an

option now, they are in the market when they are doing resource adequacy and demanding 20 percent reserve margins, that's real expensive capacity, okay. Moreover, when you have bill presentment and other things with, you know, there's pages and pages and pages, not only is there a cost there, but there's a frustration. And so part of what smart grid might entail is moving away from consumer in the institutional perspective to customer, and customer from an individual perspective of what their needs are, you know, what their load profile is, because I'll tell you what, if it doesn't suit them, one of the things that's different now is that there is a real possibility of exit, you know, either with renewable energy or distributed energy or micro grids or community coops, you name it, if people don't like it, and if they think that they are getting, you know, bearing an unfair burden, they will exit, and so that's an option that hasn't existed before, so –

SPEAKER: If I may, Pat, I just wanted to – I think you're onto something, Cal, I think that part of the questions that are going to have to be decided are, is the utilities responsibilities end at the meter or not? The part I wanted to share with you is the stakeholders in PJM determine that there could be competitive providers of load reduction service, or CSP's, but utilities do it and can do it, independent companies can. I think by taking that decision and having it approved by FERC, we opened up a whole opportunity, a whole bunch of opportunities for the large customers, and I've seen over the last few years, we have over 60 different curtailment service providers that are in our marketplace. Some of them are developing, as you said, a niche, and they may have developed just the top of the line stuff for supermarkets, for example, and they push it across the entire footprint. Others, you know, have taken – they look at universities or they look at school campuses.

But by allowing them to compete, for the customer, not the consumer of a utility company, they're able to test their proposition and to test the value of it in the marketplace, so I think you're onto something.

MS. HOFFMAN: I know there's five or six questions; unfortunately, I have to wrap this panel up. So what I would like to do is those of you that have questions, if you could come see me afterwards and we'll log the questions that you all have and try to get answers out to make sure that they're available. We're just running out of time for this panel session. But,

first of all, I'd like to all thank our panel members for a great discussion. I think we've opened the door.

(Applause)

MR. WEST: Yes, thank you, Pat, and thank you, panelists, for your contributions. In terms of the rest of the afternoon, we're going to take a short lunch break. We have a buffet lunch that we will be providing to you; it's available in the hallway right outside here. We're just going to take a short break, you can get your food, bring the food back in here. We're going to start the next panel at 11:45. That will cover the Evolution of Smart Grid Technology. George Arnold will be moderating that. And then at 1:00, we will discuss the new business models. Thank you.