UNITED STATES DEPARTMENT OF ENERGY

ELECTRICITY ADVISORY COMMITTEE MEETING

Washington, D.C.

Monday, June 11, 2012

PARTICIPANTS:

RICHARD COWART, Chair
Regulatory Assistance Project

IRWIN POPOWSKY, Vice Chair
Pennsylvania Consumer Advocate

WILLIAM BALL
Southern Company

MERWIN BROWN
California Institute for Energy and Environment

RALPH CAVANAGH
Natural Resources Defense Council

PAUL CENTOLELLA
Public Utilities Commission of Ohio

DAVID CRANE
NRG Energy, Inc.

ROBERT CURRY
New York State Public Service Commission

JOSE DELGADO
American Transmission Company

ROBERT GRAMLICH
American Wind Energy Association

MICHAEL HEYECK
American Electric Power

VAL JENSEN
Commonwealth Edison

JOSEPH KELLIHER
NextEra Energy, Inc.

PARTICIPANTS (CONT'D):

SUSAN KELLY
American Public Power Association

BARRY LAWSON
National Rural Electric Cooperative Association

RALPH MASIELLO
KEMA

CLAIR MOELLER
Midwest Independent Transmission System Operator, Inc.

DAVID NEVIUS
North American Electric Reliability Corporation

WANDA REDER
S&C Electric Company

PHYLLIS REHA
Minnesota Public Utilities Commission

BRAD ROBERTS
Electricity Storage Association

TOM SLOAN
Kansas House of Representatives

DAVID TILL
Tennessee Valley Authority

GORDEN VAN WELIE
Independent System Operator of New England

MIKE WEEDALL
Bonneville Energy Administration

PARTICIPANTS (CONT'D):

WILL AGATE
PIDC

ANGIE BEEHLER
Walmart

GIL BINDEWALD
DOE-OE

PETER BONNER
ICF International

ANJAN BOSE
DOE

CLARK BRUNO
Anbaric Transmission

ERICH GUNTHER
Gridwise Architecture Council

IMRE GYUK
DOE

PATRICIA HOFFMAN
DOE

BARBARA KENNY
NSF

CHERYL LaFLEUR
FERC

JEFF MARQUSEE
DOD/OSD

DAVID MEYER
DOE

JOE PALADINO
DOE

PARTICIPANTS (CONT'D):

BILL PARKS
DOE-OE

ANN RANDAZZO
Center for Energy Workforce Development

ELLIOT ROSEMAN
ICF International

MATT ROSENBAUM
DOE

JON WORTHINGTON
DOE

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P R O C E E D I N G S

MR. COWART: Good afternoon, everybody, and welcome to the meeting of the Electricity Advisory Committee of the U.S. DoE.

As everybody probably knows, these proceedings are public and are being recorded. There's a transcriber with us. And so please make a point of turning on your mic when you speak and speaking clearly so that your words can be taken down for posterity and any members of the public who'd like to listen in by reading the transcript of these proceedings.

There's an opportunity for public participation at the end of our session tomorrow, and any person who would like to address the committee should sign up. And let me ask whether Elliott or Paula is keeping that list.

MR. ROSEMAN: Yes, they have a list over here.

MR. COWART: Okay. There's a list over here. If you wish to speak, let us know so we can plan on that.

We have a pretty full agenda, and we've got a lot of things to accomplish in the next day

and a half. One just mechanical thing for the new members of the committee, if you want to speak, if you want me to call on you or whoever is moderating a panel to call on you, stick your card up that way, and remember to put it down when you're through with that. I'm also told we need to remember to turn off the mics when we're not speaking.

I have to say I'm really happy looking around the room to see that the new members have been confirmed by the Secretary and that you're here. And I know a number of you have been waiting some time for the opportunity to join us. We've been waiting for you, and we're really happy to have you join us.

One thing that you will hear from me and the other members of the leadership team a number of times is we really are looking forward to the participation of the new members on the subcommittees as working participants in the subcommittees. We're going to be passing around the sign-up sheet for the subcommittees towards the end of this afternoon's session and again tomorrow. And we're enthusiastically looking

forward to your signing up and participating.

Let's begin just by going around the room and so everybody can be introduced to everybody since there are so many new people here. And we'll start with you, David.

MR. MEYER: David Meyer, Office of Electricity.

MR. POPOWSKY: Sonny Popowsky, Pennsylvania consumer advocate.

MR. PARKS: Bill Parks, Office of Electricity.

MR. CURRY: Bob Curry, New York State Commission.

MR. KELLIHER: Joe Kelliher, NextEra Energy.

MR. GRAMLICH: Rob Gramlich, American Wind Energy Association.

MR. CRANE: David Crane from NRG Energy.

MS. REDER: Wanda Reder, S&C Electric Company.

DR. BOSE: Anjan Bose, Office of the Undersecretary.

MR. BALL: Billy Ball, Southern Company.

MR. HEYECK: Mike Heyeck, American Electric Power Transmission.

MR. DELGADO: Jose Delgado, American Transmission Company.

MR. BROWN: Merwin Brown, California Institute for Energy and Environment within the University of California.

MR. WEEDALL: Mike Weedall, a recently retired vice president, Bonneville Energy Power Administration, and now a free agent.

MR. CAVANAGH: Ralph Cavanagh, NRDC.

MS. KELLY: I'm Sue Kelly with the American Public Power Association.

MR. LAWSON: Barry Lawson with the National Rural Electric Cooperative Association.

MR. TILL: David Till, Tennessee Valley Authority.

MR. JENSEN: Val Jensen, Commonwealth Edison.

MS. REHA: Good afternoon. I'm Phyllis Reha, Minnesota Public Utilities Commission.

MR. SLOAN: Tom Sloan, State of Kansas.

MS. RANDAZZO: Ann Randazzo, Center for Energy Workforce Development.

MR. MOELLER: Clair Moeller, Midwest ISO.

MR. ROBERTS: What did I do wrong here? Brad Roberts, Electricity Storage Association.

MR. CENTOLELLA: Paul Centolella, until recently a commissioner on the Public Utilities Commission of Ohio, and I suppose now also a free agent.

MR. MASIELLO: Ralph Masiello, KEMA.

MR. NEVIUS: David Nevius, NERC.

MR. WORTHINGTON: Jon Worthington, Department of Energy.

MR. ROSENBAUM: Matt Rosenbaum, Department of Energy.

MR. VAN WELIE: Gordon van Welie, ISO, New England.

COMMISSIONER LAFLEUR: Cheryl LaFleur from FERC.

MS. HOFFMAN: Pat Hoffman, Assistant Secretary for the Office of Electricity Delivery.

MR. MEYER: Welcome to the members. If you thought this was simply something to put on your resume and come to an occasional meeting, you joined the wrong group. There's a lot of work to

be done here, and we're very glad to have you.

MR. COWART: Commissioner LaFleur.

COMMISSIONER LAFLEUR: Well, thanks a lot, Rich. I just wanted to say how happy I am to be here. I try to come to these meetings. I guess I'm not an official member. And even more so as I see the new members, what a great group.

We're continuing at FERC to labor away on all of our different transmission and variable resources and other efforts that we're working on.

Just wanted to call out a couple of things in the last couple of weeks that I have done that have involved the Department of Energy. I was honored to be at the Electric Infrastructure Summit that dealt with electromagnetic pulse and geomagnetic disturbance issues, which we talked about around this table last time. And Bill Bryan was there, very able representing the Department of Energy.

Also I was with Imre -- I forget his last name -- Gyuk on a storage conference last week, so I see the efforts that you all put together in practice out in the world.

Just two quick things. At the last meeting I spent -- I did a presentation on the work that we've been doing to try to clarify the process if companies come to FERC asking us to intervene with the EPA on environmental regulations, on getting the fifth year under the mercury and air toxics rule. We've since issued a policy statement, and I thank you all for your comments on that. And now we have to implement it, and look forward to seeing a lot of you hopefully at NARUC this summer when we'll be taking the conversation forward.

Finally, we're in the process of setting up a set of regional conferences, a regional focus at least, on gas, electric interdependency issues and trying to balance doing it this summer since it's very timely with getting to as many places as we can, organizing it to have maximum participation. So we're hoping to announce those within several days so that we can get on folks' busy summer calendars.

So thank you very much. Look forward to the next day.

MS. HOFFMAN: Thank you, Commissioner

LaFleur. I'd like to also extend my welcome and thanks for all the new members and the returning members for the EAC.

I guess I'm going to continue to challenge you all with constructive discussions. And a lot of the topics that we address in this committee is really to drive conversation to further the discussion to bring things out so we can have a healthy debate on topics, and actually look at what are some of the most relevant topics coming up and coming at us, whether it's, you know, the gas, electric issue, how do you value energy storage, the EPA regulations.

I think we've had some very fruitful conversations on many topics over the last year, and I want to continue that trend and continue that purpose.

So with that, I'd like to turn it over to Dr. Anjan Bose, and he's going to give you a little bit of an introduction of some discussions that we've been having within the Department of Energy as we look at the blackout study from the San Diego blackout, as well as going back on the 2003 blackout and saying, okay, how do we move the

ball forward on a couple of things? How do we look at some of the recommendations and go after trying to get some results and get some movement in this area?

So I wanted Anjan to just at least summarize from his perspective some of the conversations we've been having at DoE and some of his thoughts and directions, and then actually ask you all for your comments and feedback. So, Anjan.

DR. BOSE: Thank you, Pat. Before I get into it, I do have some slides that I want to show you. But before I get in there, let me just say a couple of words about me. I've been at DoE for three months, and so this is my first time to address this group.

And my job is actually to try and coordinate all the things happening across the Department on the grid. And what that means is that I chair a group of -- a committee I should say. It's not called a committee. It's called a grid tech team, and it's made up of all the program managers in DoE that have any projects or initiatives that have anything to do with the grid.

So it's a group of 15 to 20 people or so in there.

And one of the things we've been trying to do is get our arms around all the things that are going on right now, but, more than that, to try and come up with a plan of how to go forward in trying to do the kinds of things that the grid is facing for the next, you know, five, 10, 15, 20 years.

And so I'll tell you what my first impressions are. So since I'm new here, I can probably tell you that. And as usual in an organization, what happens is each of the program managers of course look at what is needed from their programmatic point of view. So, for example, if you're working on solar cells, you want to know what the grid ought to do or ought to be to handle a lot of solar generation, similarly for storage, similarly for batteries. And my push has been to try and get this group to come together to say what is good for the grid. And I know, Ralph, you said this at the lunch meeting, that we should take a systems viewpoint. Now that sounds pretty simple, but what is, after all, a systems viewpoint? That is not made up of just little components.

So let me give you an example. The kinds of things we have been talking about is that we ought to be looking at a research bucket called the flexibility of the grid, not a research bucket called solar, right? Another one that you might recognize is the visibility of the grid. You know, another word, another phrase could be situational awareness of the grid. Another viewpoint, maybe another bucket may be knowledge and understanding of the grid, often translates to doing modeling simulation and so forth.

So you see where I'm coming from, and we're working very hard on trying to formulate this into an R&D plan. And I think our first push there will be under the heading of renewable integration. And as you can imagine, there's renewable integration work going on in various parts of DoE, but I think the time has come to look at it in a holistic viewpoint, and we'd like to have an approach there and a direction where we can bring these things together.

But that's not what I'm going to talk about today. I'm going to talk about, if you think of the research plan for the year is to look at

from the grid and look at what needs to be done, and what technologies need to be developed, I'd like to present to you a different look, which comes more out of the southwest blackout report and the recommendations. And that says, and I think many of you met with the Secretary and you heard him talk about the situation, and many of you brought it up as well.

And so we said, what is it that we need a visibility of the grid better? So the one obvious thing is, of course, that all the parts need to kind of come together; that is, the grid visibility doesn't get better if X, Y, Z company, whether it be a vendor or a power company, does certain things. It's got to be sort of across the board.

And let me just remind you about the San Diego blackout recommendations. They fell, I think, into three categories, and they're inadequate long- term, and operations planning, inadequate situational awareness, and there is always issues on blackouts about whether the protection systems worked right or whether they worked wrong, and if they worked right, if they

worked right in the wrong time.

So what we tried to do is say, well, if were the industry and we tried to lay out an action plan of how to go about kind of getting some handle on this. And I throw this out. This is not complete or exhaustive in any sense, but we kind of divided it up into a few phases. The first and the simplest one is first. The first phase being the planning models, and actually Jay Caspary here, who is also on loan to DoE, is helping me with this with the planning side of things.

And as you know, there's been already a great recognition that the planning coordination across any interconnection grid needs to be there, all right? And so there are lots of different -- actually some people say maybe there are too many coordinating bodies of planning right now instead of just enough and the right ones doing the right things. And so maybe that's what we need to look at.

So obviously in the planning side, everybody is distributing data with each other, but there are questions about how good the models are, how well they're tested, if one company can

exchange a model that'll be recognized by the software of another company. These are all questions.

So phase two, which actually this has to do with the high planning or operations planning, and of course, we solved the models and data exchange issues very satisfactorily in phase one and the planning, so about 90 percent of the planning would also be solved.

The rest of it has to do with how much of the interchange schedules you are exchanging, which is outside your interchanges; that is, what happens if you are company A, and you're tied to B and C. Do you know the interchanges between B and C? And how do you fit that into your operations planning? So that's the issue, and that was mentioned in the San Diego blackout study recommendations.

And I bring up here one issue that comes up often is that the real time models that are used for doing the N minus 1 contingencies and the state estimator and so on, those models tend to be different than the planning model. And this is an age-old problem, and it hasn't been

satisfactorily tackled so that you make sure that what the operations planning people did on the planning model would have the same results when you run the N minus 1 contingencies on the real time data. So, again, the solutions are known. It's a matter of getting it done.

And this is, of course, kind of the bottom line of situational awareness, which is that real time data needs to be exchanged between neighbors. And the EMS data needs to be exchanged. There are good standards now exist for data for EMS. But here are some of the issues.

The question really is whether the operator sitting in a balancing authority, how much visibility they have of their models outside of their boundaries. And this comes back to the CIMS issues, which seems to always come up in these blackout studies.

And then finally I think the one that everybody loves to talk about, the future, is the real time exchange with PMU data. And actually the funny thing about this is that everybody is doing this right now. I mean, all the PMU data people have their exchanges. And part of the

reason, of course, is that there are only a few of them. I mean, it's not like you're exchanging a full set of SCADA data from one EMS to the next. That's a different kind of a ballgame than what is being done now. But the agreements and how to do this have been worked out.

The policy side on the PMU data has been worked out. But if we have a lot more PMUs out there -- I mean, we're thinking there'll be about 1,000, 1,200 of these things by another couple of years. But in three of four years' time, if you start looking at several thousand and then after tens of thousands in five years, we probably will have to do something about the communication schemes and the protocols to be able to handle that level of data. But this is now real situational awareness of the grid at millisecond rates.

So here's what I think. The planning and operations planning where things are relatively known and very standard should be -- if people want to do it, they can do it now. Some of the things that will require actual software changes at the EMS systems and so on, the real time

data exchange. So it takes a couple more years, and then finally the PMU data exchange can be probably done in the next six, seven years or so.

Actually that's all I have in terms of slides, and I'll open it up at this point. Actually I got an early start than what's on the schedule, so we have a few minutes. And this is for questions. Pat and I have talked about, you know, trying to engage as a facilitator from DoE. You heard the Secretary say earlier that he would like to have DoE kind of help with this kind of effort, and so that's what we're trying to do.

MR. COWART: David.

MR. NEVIUS: Anjan, I think you hit a lot of the really important points that were covered in the report and its recommendations. I think the most significant one is that this is really an implementation issue. A lot of this technology, a lot of this awareness and what to do and how to do it has been known for many, many years. And in many parts of the country, many parts of North America, it's already in place and being done.

So it's really more one of

implementation. Some of that is going to require some organizational changes, some governance changes, not necessarily a lot of technical issues that are new. They're known technical issues. Reaching agreement on the exchange of data is very important. There are a number of efforts that are underway in the West now to get a non-disclosure agreement signed by all the entities, so all this information can be known to all. But there are other implementation issues that are going to have to be faced and addressed to prevent a reoccurrence of this kind of an event.

You mentioned PMU data. I'll add at the request of Bob Cummings from our staff, you can never have enough PMU data. And the analysis of this event was made much, much easier because of the existence of the PMUs that were in place, not that we don't need more. Much easier than in 2003. We really struggled to really understand what had happened. This was easier to understand what happened, then the why it happened came later.

But, again, it's more of an implementation issue that's going to have to be

faced. And the question for the Department is, okay, what can it do to help in that regard, more so than in terms of technical issues, and data formats and exchange formats, and so on.

DR. BOSE: Precisely. I think we agree wholeheartedly. In fact, our purpose of bringing it up to this group is to hear from you what we can do and guidance on that.

MR. COWART: Merwin?

MR. BROWN: Anjan, maybe you said this. I didn't catch it. But could you elaborate on the distinction between the phase four and phase five on the real time data exchange?

DR. BOSE: Phase five was PMU data exchange. Phase four was the real time data exchange. That's just SCADA data.

MR. BROWN: Oh, okay.

DR. BOSE: Yeah. So phase four was just doing situational awareness without having to put in gigabytes of PMU data.

MR. BROWN: Okay. Fine. Okay, thank you.

MR. COWART: Great. Mike?

MR. HEYECK: I'm glad we had the meeting

this morning. In the Transmission Subcommittee, we're going to be looking at the next generation EMS. And some of this activity we'll have on our work plan, not the development of it, but to at least shape it. And some of this activity I believe is on NERC work plan, the NERC multiregional modeling group efforts and improving the quality of the low flow data that we transmit.

And as I spoke to Jay Caspary, I was on the exchange of power system analytical data representing NERC in the 80s. And I do believe we have a standard format. I guess it had never been adopted in exchanging power system analytical data. So I applaud you in addressing the gaps from decades before.

But the main question for me, Anjan, is how are we going to coordinate? We've got to because we have NERC. We have this group, and we have the grid tech team. How will we coordinate?

DR. BOSE: We have talked about all of these groups as being partnerships, I mean, especially somebody like NERC, who has the industry wide kind of connections on

unreliability. And also the power companies themselves, but especially the ISO, RTOs, the reliability coordinators comes first to our mind in terms of who see this problem, sort of absolutely first hand.

MR. HEYECK: Let me suggest that we -- at least the Transmission Subcommittee coordinate with the grid tech team, as we mentioned this morning. Maybe we'll have a special meeting to figure out what you're doing with respect to the overlap, and where we can be helpful because we're not overlapping. We just want to be helpful.

The last item I'll mention is I agree with you wholeheartedly. The number one risk, I believe, is that at the CIMS in real time operation.

MR. COWART: Actually I have a question to follow up on Mike's about the phases. When you put out the phases, which you've got Roman numerals on them and these dates.

DR. BOSE: Oh, I should've probably -- phase one and phase two are the planning type -- planning data exchanges. So that I put as the early part that can be done right now.

So if I go back to the schedule. So phase one and phase two would be 2015, and then phase three and phase four would be 2018. And then phase five, 2020.

MR. COWART: And what do the dates refer to? Are they dates for which to drive the internal DoE conversations?

DR. BOSE: The internal DoE conversations are almost meaningless here because the only thing that really counts is what the industry is going to do.

I think these are our aspirational dates which we think the industry can move at this rate. But, I mean, we understand the political and the institutional barriers that have to be surmounted to get here.

MR. COWART: All right, thank you. Billy?

MR. BALL: Anjan, on a little bit of a different topic, earlier you mentioned your efforts to try to think of things in a systems perspective, and I just wanted to encourage you there. I actually believe the concept of looking at grid flexibility in the long run will serve us

much better than trying to focus on integrating this particular technology or that technology because, who knows, 10 years from now, you know, if we're too specific, we may have missed the boat on some technology we're not even focused on today as far as generating technology or ancillary service type technology.

So I really like that concept. I think it'll serve us in the long term much better.

DR. BOSE: Thank you. Let me say that that is really the R&D aspect. It's really most of what we do with the grid tech team, and to lay out our goals and so on. And so, you know, as Mike said, looking at the future EMS. I mean, those are things that we love to do within the grid tech team, and you'll hear more from us.

But I thought that this one, which is more of an action plan for the industry, if DoE would like to do something, you know, this is the time to get it started and teed up because the blackout reports are out there. I know everybody from NERC to WECC regional committees and so on are all working on this stuff. And we are willing to step up to the plate and do our part to help.

MR. COWART: Ralph.

MR. CAVANAGH: I need no persuading also on the importance of a systems approach. I hope that one of the things the Electricity Advisory Committee can do is to help identify what some of the most promising initiatives are to do that rather than simply calling out the need for it. And I know there is and TBA would certainly be one of the places I would start.

But the question I had, Dave, I wanted to have a quick exchange with you. You, Delgado, and a gratifying number of people in this room were around a table in 1998 when a DoE inquiry on reliability identified significant institutional problems that were putting the grid at unacceptable risk. And we said that in an advisory report.

I take it that you don't think the problem now is institutional; that is, it isn't something that Congress needs to do. It's not that the responsibilities aren't clearly identified. It is, as you put it, an implementation problem. My question to you is, do you see a role for the Electricity Advisory

Committee in responding to the need you identified, because, I mean, the 2011 San Diego was not supposed to be possible in terms of the aspirations that the industry has and a number of efforts that lots of people in this room have been involved in.

What is the contribution you see at this point in terms of calling out a need, if there is one, that needs more public visibility?

MR. NEVIUS: I thought about that, Ralph. I'm not sure there is a real direct opportunity for this committee. It is an implementation issue. These are not unknown issues. They're not issues that haven't been faced and dealt with in other parts of North America. For a lot of reasons, they haven't been dealt with as effectively in the West; hence, this particular outage and a previous one or several previous ones in 2008 and earlier.

I think it's an effort that the industry needs to confront. To the extent that DoE can provide some support to those federal agencies in the West to be the leaders to address these implementation issues, to step up and take the lead, it's going to take a lot of coming together

of all of the entities, big ones, small ones, investor owned, public power, federal power, marketing agencies, to come together and realize they are operating an interconnected power system, and they can't do it with path rating and nomograms any longer.

MR. COWART: Gordon?

MR. VAN WELIE: So, Anjan, I'm just wanting to link a couple of things here. And I'm wondering about what DoE sees as a droll in terms of this effort. I think as a number of people have said, the early stages of this are all about execution, implementation. There's no great technology deficit to be solved.

And it seems to me we've got a governance structure for making this happen. We've just got to use it and at FERC, and NERC, and the RTOs, and the transmission operators around the country. So I think this is just going to take effort and it's going to require some oversight, and over time it'll be done.

So frankly I don't see much role for DoE in that. Where I do see a role for DoE, and linking back to what Mike Heyeck said, is that if you look

at the back end of that, sort of having energy management systems that can deal with the kind of data that is being originated by these PMUs, and being able to do something useful with it, to me there's a real technology deficit there.

So the current state of the art offerings from the various EMS vendors wouldn't know how to use that data. And the applications haven't been developed. And if you go back 20 or 30 years, you had a very strong, vibrant organization in the form of EPRI that had a lot of R&D funding coming from the utility industry, and they have very lean budgets these days.

So I wonder about who's going to put up the probably hundreds of millions of dollars' worth of R&D money to actually develop the next generation EMS system. So if there's a role for the DoE, I think it's in terms of sort of looking ahead and saying, you know, if we want to be where you want us to be in 2020, I can guarantee you we're not going to have the technology to be there unless somebody starts developing it today. And it's a non-trivial investment.

I worked for an EMS vendor for six years

back in the 90s, and I can tell you most of the EMS vendors don't make much money. They oscillate between barely going out of business and then maybe getting a big contract every now and then, and grimly hanging on for the next year. So there's no large bucket of R&D money to develop this kind of technology.

And so, it is one of the recommendations that Mike Heyeck will be teeing up for the EACC, but I think that's my reaction in terms of where you should focus.

DR. BOSE: That's all music to our ears. I mean, that's basically what on the R&D side we are recommending. And this thing about the systems viewpoint that we are trying to push out of the grid tech team, which is underfunded -- at least the grid tech team believes it's underfunded -- which includes the EMS, the future of the EMS and so on. That's all on our agenda to push, and I think if that becomes a major recommendation from the EAC, that probably will have some weight even internally to DoE.

MR. COWART: Are we dealing with legacy cards or new cards? Okay. Oh, Wanda. Yeah, sure.

MS. REDER: Yeah. Anjan, I'm going to switch this a little bit on you. A lot of this was transmission focused, and I think there are a lot of parallels in the distribution space right now. As we add, you know, storage, and plug-in vehicle, and photovoltics, et cetera, we're really starved for planning tools there as well. And I think the data piece and how to tie this stuff together.

Think in terms of systems of systems; think in terms of value streams rather than technology for technology sake. This conversation I really think spans both distribution and transmission.

DR. BOSE: You're absolutely right on the R&D side. Since I spent most of my time talking about what we need to do about visibility. It was more planning oriented, more transmission oriented. When I say "systems," it's distribution and transmission.

And, you know, if you think about the renewable integration problem, if solar starts pushing now very hard, you're going to see huge changes in the distribution system that we'll

have to deal with. And so that's very much on our radar screen, yes.

MS. HOFFMAN: And I think that fits very nicely into the micro grid work, and also the optimization of the distribution system. And as you look at where can we develop the tools and capability to optimize the portfolio. But going back to what Billy said is the flexibility and the distribution system and the capabilities of optimizing all those technology options.

MR. COWART: Bob?

MR. GRAMLICH: Thanks. I just quickly wanted to add my support for the grid flexibility framework. I like that. If you're talking about renewable integration, that's really, I think, more useful to talk about grid flexibility, which I understand to be -- I wanted to just clarify if we're talking about the same thing or if it's going to be one of these terms we all use and mean different things by. If you're talking about rapid response to balance the grid, the overall grid, that's how we usually use the term. Is that what you meant, Dr. Bose?

DR. BOSE: I think balancing is one part

of it. But to be able to do all of the rest of it, the reliability and the effective reliability, whether it be renewables or anything, any of the new technologies that are coming in. All of that comes into being handling flexibility.

Basically the system can be -- as it becomes more able to handle not just renewables, but all other things that are going on, including vehicles, including equipment, and so on.

MR. GRAMLICH: Great. I just want to agree with the Southern Company every time I get to. We're with you on that.

MR. COWART: We're running out of time. We have three cards up -- Jose, Bob, and Paul, and then we'll cut this one off. Thank you.

MR. DELGADO: Okay. Very briefly what I would like to do is go back to something that Ralph said. At the time when we were licensed in 2000, all the rules were voluntary, and there were no penalties for lack of operations. And that has changed, and it's really changed at the request of the industry because we became very much aware. So I would call that a sense of progress. We're not done with the implementation of that, but it's

very much progress.

And when we talked about the coordination of the industry and trying to implement something probably five or six years ago, transmission operators put together North American Transmission Forum, which right now virtually has all the transmission operators participating. And so from that perspective, there is a structure the industry has tried to put together in order to address the coordination issues.

I am going to support what has been said. I think Gordon put it best is that the EMS and the data, the next step in there is probably the one that will require some very significant effort. Traditionally the industry makes these efforts when there is a big threat, but the threat has to be something that really affects everybody. And we're apparently not as much aware of it as -- I mean, we have not identified this right.

But we do have the means now -- we have a lot of data, and we ought to be able to analyze it, and we do not have the algorithms to do it. As a consequence, we are wasting an opportunity.

I don't want to say we're wasting it because we are trying to learn how to do it, but I do think it does deserve an effort, a significant effort.

And as we were talking about the things that our committee can do and the DoE can do, I think that's an area which DoE opted to get deeply involved because it is not just a matter of funds, but it's a matter of focus of the industry. And it appears that that's an area which would be of great benefit.

MR. CURRY: Just quickly, and this may not be the right place to raise the question, but I thought of it earlier today, and I think you need to look at it and tell me where I'm wrong.

Looking at it from a regulator's standpoint, a lot of what we're focused on here among other ingredients is distributed generation. And at least in New York, what we're now looking at is ensuring that all distributed generation has the appropriate backup from the grid. So you're essentially ending up with duplicative exercises, so the grid and the distribution network has to be able to take care of distributed generation if the distributed

generation fails for some reason.

And, therefore, when we're looking at the transmission world as it gets closer to the distribution world, we have to rationalize enhanced costs to be able to afford -- that's the wrong word here, but to enable the achievement of the goals that we're now discussing.

Is this being touched on in your team, in the Transmission Subcommittee? How are we addressing the burden on rate payers, including how we rationalize it, how we sell it, how we approach it? Do I have this question right, or is this an engineering question that I should be asking somebody else?

MR. COWART: That's right. Mike, a reply?

MR. HEYECK: Let me try to answer some of that. I'm not sure I can answer all of it.

One of the assignments, Bob, that we'd like to tackle is to actually have someone sponsor how much the grid is aging and what will it cost to replace it, and translate that into the -- add that to the improvements that I believe EEI already has suggested. And that could easily draw

a line to a rate payer for customer impact.

I'm not sure this effort here -- I agree with Dave Nevius. This is more of an implementation issue. The technology leap is to go from seconds to milliseconds, which requires a lot of software development, a lot of R&D ahead of that, and hopefully a commercial then will take that up. I'm not sure that's going to be very costly to the average consumer. It's not going to be billions. It'll be maybe hundreds of millions, but not billions..

Let me stop there. Did I address some of the question or all of it?

MR. CURRY: Some of it, Mike, but what I'm trying to get to is essentially what we're looking at when you get to the ultimate reliability we seek to achieve, some of that is going to come in a world of distributive generation. It's going to come in a world of electric vehicles. It's going to come in a world where the provider of last resort has to be able to backstop, to use a bad word -- there's someone here from FERC, isn't there -- to backstop the processes that we're engaged. And all I'm looking

for is help in addressing the issue of who's going to pay for it, and, assuming that it's the appropriate cost, how we package and sell that, because a lot of what was discussed at the onset of this part of panel was, you know, how do we make this palatable for the rate payers ultimately.

And so hundreds of millions makes it easier to distribute it across the United States, so maybe you did answer the question, Mike.

MR. HEYECK: Well, I don't think Dr. Bose or myself could answer the totality of the question. I was just answering what we see as a Transmission Subcommittee moving to the next generation EMS, which would deal with all of those issues. But I think all of those issues really come from the states, or come from the federal government, or come from markets. But I think it is well beyond the scope of the great technical team.

DR. BOSE: But if you're talking about distributed generation and a lot more demand response, the amount of investment that is needed to beef up the distribution system is much more significant. I think numbers of hundreds of

billions are being put out. And so that is an issue that remains on the table to be looked at, yeah.

MR. COWART: And, Paul?

MR. CENTOLELLA: Okay. I'm going to come at these last comments in a little different direction in that I think perhaps the most important thing that will come out of this next decade in terms of improving the resilience and reliability of the grid will be happening at the distribution and customer level as opposed to at the transmission level.

My one concern when I hear this talked about as an implementation issue is that we will be developing and implementing a technology for the last generation of the grid that will not take into account the ability of what's happening in optimized -- in demand optimization and distributed generation and storage in reconfiguring the topology of the distribution grid. It won't take those things into account in the way the models are developed, and so we'll end up with models that were, you know, out of date by the time we finally implement them.

And so the challenge I would put out there is, is there a way that we can think forward about where we might expect the grid to be developing in 10 years and develop the right models for that implementation as opposed to trying to implement the models that we know how to implement today.

MR. PARKS: If I can step in, I think the key thing to pick up on from our previous two meeting discussions that we've had is this integrated systems approach because the key to this is to think about all of that and to make sure that we're not over burdening the consumer by making individual decisions in a vacuum relative to those other ones.

So I think what we're saying is it's much more imperative to make sure everything that we're thinking about is integrated in order to keep those costs as low as possible and knowing that we do have to make changes to make this system operate as we move forward for the next 100 years.

MR. COWART: So moving forward to the next 100 years, that turns us directly of course to the next topic on the agenda. And Bill is going

to lead it off.

MS. HOFFMAN: I guess I just want to add a little bit of introduction. Every so often we go through a strategic planning process for our organization, and I asked Bill to take the lead on the development of a strategic plan for OE.

And what we're truly trying to do is look at the value that the organization brings in, its facilitation role and its help, and whether it's through the R&D activities or it's actually facilitating dialogues and discussions on different topics to once again keep the ball moving forward.

One of the things that I would hate to see is having this meeting come together in another five years and us still saying, yeah, well, there's still an implementation issue that's going on, and we'd like to make sure that we continue to push and move things forward.

So Bill is going to go through at least where we're at in the strategic planning process for our organization, some of the things that we've come across that we think is a value that our organization provides, as well as some

opportunities maybe to look at in the future. So with that, I'll turn it to Bill.

MR. PARKS: And I'm just going to spend a minute. I'm going to turn it over to Peter. But what we talked about is these are complex times, and we have growing future uncertainty. I'm not talking about the election, I'm talking about the grid, right?

So the last couple of times we talked about a vision, and Jon talked to you how the grid tech team is evolving from where we first started talking to you about it. And I think this the significant thing to me is that we are seeing kind of building within DoE this coming together, a recognition that we need all the parts of DoE to truly work on this. And it's starting to have some real influence on decision making in the discussions directly with the Secretary, with the Undersecretary, that goes on. So I think this is a really important opportunity for us to take advantage of collectively, and getting your insight into how that should move forward is going to be very important.

As Pat said, at the same time we want

to look internal to OE, and there's a parallel process going on in energy efficiency, renewable energy to look at their strategic mission and to think about the planning from where they're headed. And I think what we're trying to do is to make sure that we really understand our mission and where we're going, how we can best utilize and align our resources, have impact, set priorities, and really integrate ourselves the same we're talking about having an integrated solution set to the grid situations.

So what we're looking for is some feedback from you as an external body to say are we thinking about this right. And Peter Bonner, he's a Senior Vice President with ICF, is going to walk through just a few slides to kind of tell you where we are. We're part way through this process. We're not claiming that we're there. But we really are interested in seeing how can we better, again, align our own resources to get integrated results. And I'll turn it over to Peter.

MR. BONNER: Thank you, Bill. Good afternoon, everyone. As Bill said, I'm Peter

Bonner. I'm one of the management consulting groups at ICF International. And as Bill said, we want to get two things out of this. One is to give you a snapshot, a point in time of where we are in the strategy development process because we're not nearly done. We're about a third of the way, maybe halfway through that process. And then engage you in some dialogue around what are the strategic challenges of the organization, what are the issues that OE faces, and get your opinion and feedback around some of those challenges and issues.

A mentor of mine when I first started doing strategic planning about 25 years ago said, the strategic planning process is always interesting. It's challenging. It's rewarding. But the problem is you're always wrong. And the reason he said is because as you cast yourself out into the future around strategy work, you're going to be off by some order of magnitude as you look at that.

He also said that you become less wrong when you develop an organization that can sense the changes in the environment and the strategic

thinking then adapts to the organization to that environment and some of those changes that you're facing.

And what we did in developing the strategic planning process, and I'll walk through just a couple of slides up front on the process, and then really dig into the OE mission and the challenges and issues that OE faces, okay?

So as we developed the process for doing this, we did an as is situation assessment and adapted SWOT kind of analysis. We're in the middle of looking at mission, vision, values, some of the strategic challenges, and then moving through from there into the goals, objectives. That center section around uncertainties, scenarios, and constraints is a critical one for OE.

We are in an election year. OE is an organization, as you've already started discussing, facing some significant strategic inflection points from a policy standpoint, from a resource standpoint, from how the organization is aligned and organized to achieve its objectives. So looking at the uncertainties,

looking at a set of scenarios as we look out into the future, and stress testing the strategies we come up with is a key part of this.

Moving into options and choices, performance measures and accountability, this is a federal organization. We're subject to the Government Performance Results Act and Modernization Act, and the requirements there. And so the performance measures are critical. The plan and then that phase two is just one box on here, but that's the critical piece, how we integrate, how we align the organization, how we change what we're doing in order to be successful, because the fundamentals and strategies creating a disproportionate investment around those strategies as you look to the future. So that's a snapshot of the process that we're using.

Let me talk for just a couple of seconds. In working with Pat and the leadership team at OE, we identified a couple of significant outcomes we're looking for in the strategic planning process. First is adaptive strategies that lead to a sustainable future, and adaptive because of the uncertainties that the organization faces as

it looks to that future. Alignment with both the tacit and explicit mission of DoE obviously, making sure we're in service to the Department overall. Collaboration across key programs and initiatives.

Another key part, and it is part of what is significant about OE, is building the next level of leadership around strategic thinking so that they can have that sensing mechanism in the organization, and look at adapting to the future. Common leadership and staff language, direction, values, and shared operating principles. So these are some of the objectives we're after.

The third piece around process is we've organized the development of the strategic planning process into really two primary work streams. One is working with the OE executive leadership team, and the second is working with a group of professionals and managers in the organization that we're calling the core strategy team. One of the objectives we're after is to build greater sustainability in the organization and the next level of leadership within OE.

The core strategy team is doing the

heavy lifting in looking at the trends out into the future, looking at where the strategic inflection points are, what the public policy issues are, what the technology and regulatory issues are, and formulating what the strategic challenges and what the strategic objectives need to be, and then working with the executive leadership team. Both pieces have the leadership development aspect to it because it's in the development of that strategic thinking that's going to sustain the organization over time.

This is just a notional chart around timeline and what the activities are over the next couple of months. This will go into July in terms of the development of the plan. We anticipate having at least a working draft in early July and moving it forward.

So those slides are really just about the process we're using to develop the plan. A key part of this is to articulate or better articulate as you look to the future OE's mission. Now mission is defined as the core purpose of the organization, its raison d'etre, why it is here. So EPA's mission is to protect human health and

the environment. Nuclear Regulatory Commission's mission is to regulate and oversee the civilian use of nuclear power in the United States. Google's mission is to organize the world's information and make it universally accessible and useful. So it defines the core purpose of the organization.

As we look at OE's mission, and this is still very much a work in progress, some of the concepts that the core strategy team and the executive leadership team are discussing and are talking about are clearly the development of the grid being critical to that mission, being a key part of it, protecting and securing energy infrastructure and mitigating the impacts of disruptions, reliable, resilient, efficient, flexible electrical power for everyone in the United States, all sectors of the economy, leading and coordinating the national efforts about this and about the previous items.

Before we get into the strategic challenges and issues, let's stop here for a second. And as you look at the list of the components of what may form the mission statement

for OE, what resonates with you?

MR. COWART: Other people will surely chime in, but I'm drawn first to the third bullet, recognizing that the second bullet and perhaps the first one are really necessary to achieve the third one.

MR. BONNER: Okay. So you see the cause and effect between the first two and number three.

MR. COWART: Number three seems to me to be the outcome that you're really aiming for, and the other two are -- well, the second bullet is absolutely necessary to it, and the first bullet is subsidiary to the third.

MR. BONNER: Thank you. Others? Susan?

MS. KELLY: I would just note that in bullet three, I don't see anything about at what cost. And I just would caution one that you need to take into account how much it's going to cost to have reliable, resilient, efficient, flexible power for everyone in all sectors. You know, that's a laudable goal, but there's a cost to everything.

MR. BONNER: I will note that the debate among the core strategy team and the executive

leadership team was really robust around cost effectiveness. And I left that off the slide because they have moved past that, but it was a big conversation.

MR. CAVANAGH: The fourth bullet suggests that there is a national effort, and everyone around this table knows that there isn't. And it would probably wise for DoE to acknowledge that and to try to fit itself effectively into what are regional and statewide conversations. But I think that that's what they'll get you for before anything else.

MS. HOFFMAN: We had that discussion, too.

MR. CAVANAGH: Very good.

MR. PARKS: We did have that discussion, and I think part of it still needs to go on, and maybe more here is, does there need to be some kind of national effort? And I think that question needs to be at least lined through. We would absolutely agree that there's a lot more ability to move in regional space right now and an opportunity to do so.

MR. CAVANAGH: Yeah, it connects

you -- there was several years ago, remember, an obsession with a national grid, and I kind of thought we got past that and decided that we had big regional grids, and they were plenty big enough. And we really didn't need to overlay that on top of everything else we were doing. And I think that's where you get into trouble. It looks like you're taking sides.

MR. PARKS: Taking sides. Taking sides meaning states versus federal?

MR. CAVANAGH: No. First of all, you are not acknowledging the multiple stakeholders and the equal partnerships, and, second, that you are implicitly putting your thumb on this deal of a national grid, which I don't think you mean to do.

MR. PARKS: Very interesting. Thank you.

MR. COWART: Billy?

MR. BALL: Two things. I agree with everything Mr. Cavanagh just said.

MR. CAVANAGH: It happens all the time.

MR. BALL: It's two things for southern today.

MR. CAVANAGH: Wow, I didn't know I was so hard to get along with.

MR. BALL: I guess the thing that jumped out at me, and maybe it's just my lack of understanding, I don't see the word "research" in there at all. And that's one of the things I know we value at the Department of Energy is the place that is really heavily involved in not just tomorrow, but 20 years from now.

And, I mean, I think different folks around the table would define the third bullet differently, but you might say a lot of that doesn't really require a lot of R&D. That's just what we should be doing anyway. So that's the thing that jumped out to me, Bill.

MR. PARKS: Bill, very helpful point. One thing we discussed, and it gets back to our mission, our current mission, which we did not put up here and maybe should've, really reflects the three parts of our office that deals with institutional issues, the policy, the PSA type office, R&D as being one of the three, and infrastructure security issues.

And so those are embedded in our office now. And one thing we're looking to do is how do

we integrate those better because they don't work in isolation. And we can't just do R&D in the absence of an understanding of what the institutional and security issues are, as an example.

MR. BONNER: It was also a way to avoid starting to list all the functions of the organization instead of what brings it together as a core purpose of the organization.

MR. COWART: Jose?

MR. DELGADO: I would like to make two comments. One is that the industry has always been looking at a third bullet if we are forecasting and trying to meet the needs of the consumer, the customer, whether it be a generator or a user.

I'm surprised that you do not look at your mission at trying to do the impossible, which means trying to forecast the need of policy, because the needs of the customers are fairly foreseeable. And we have fairly impact and insight on them. But the needs of policy are very, very difficult to foresee. And I would expect DoE to try to get us through that. I think it'll be

a futile attempt, but put this it this way. I am surprised it is not there.

The flexibility of the system to take into account policy is something that I'm surprised you haven't thought of it.

MR. PARKS: Jose, I think it's embedded in here. I don't see how we could develop the grid in the absence of policy. That doesn't meant that's a national policy, but it's a set of policies to understand work through. And so it gets back to the point it's hard for us to see it as just R&D.

MR. COWART: Michael.

MR. HEYECK: If I'm a street sweeper, I want reliable, resilient, efficient, flexible streets. So I agree with Ralph and I agree with Billy and some others that you have a very broad statement there, and it needs to be narrow.

But for me, number one, and there may be three statements. But number one is security of energy infrastructure period. You own it. The government should own it, and that's your job, and make it your job. The second is that what you facilitate with public policy both at the federal

and state level. And the third is that pillar that you have that is your foundation, and that's the research and development of your staff and the staff of the labs. And that's really the three pillars.

MR. PARKS: Thank you.

MR. COWART: Joe?

MR. KELLIHER: I would think that OE's mission should be bounded or guided or at least somehow related to OE's authority and function. And the first item, you know, sort of confuses me because if rate making is at FERC, and cost allocation is at FERC, and citing is at the state and local level, and the money is running out on interconnection wide planning, other than sort of the R&D function, I'm not clear what OE can do to encourage development of the grid.

MR. BONNER: Let me handle those in two separate questions. In terms of the --

MR. KELLIHER: And I also realize the Department has -- it's charged with energy policy, in some cases without the ability to execute the energy policy. So that could be the explanation, that we have a policymaking function that's

divorced from authority. But I just -- to me there should be some, like, boundaries around what the OE mission is.

MR. BONNER: And in any public sector strategy document, we would include all of the authorities that legislative, regulatory, budgetary authorities that form the boundaries in which we work. So that's a key part. It doesn't get reflected in the mission statement, but it's in the preamble to it usually.

MR. KELLIHER: But there should be actions that -- a mission statement should drive certain actions. So does number one mean you're going to use the citing authority that you were given by Congress seven years ago? Does it mean you're going to use R&D authority differently?

MR. PARKS: All good questions. And I think what we're trying to do is capture what is our role to help this happen? We're not saying that we're going to cause all the development of the grid. By no means is that the case. And I think we all recognize that.

You know, probably the primary thing that we see across our office, the thing that

jumped out first is that no matter what function we're doing, we're facilitating it, and we're facilitating that development of the grid activities. And I think you do see a lot of that in R&D, you see that in policy, and you see that in the security activities that we have underway. And so it's supporting that mission statement with an understanding of what's the context within that will become very important if we're to get it right, because we do not do everything, and that's absolutely true.

MR. COWART: Okay. We have time to maybe deal with the cards that are now up, and I'll just take them in this order. Commissioner LaFleur? Gordon first. Gordon was first..

MR. VAN WELIE: So I wonder if it wouldn't help -- I was having the same concerns that Joe had, so I don't want to repeat what he said. But a though occurred to me after he spoke, which is I wonder if you would restate this somehow in terms of what you are able to do, because what I was sitting here wondering about was how are you going to execute your mission? How are you going to accomplish your mission, because

in the end you don't control -- for the most part you don't control the purse strings. Whoever controls the purse strings is actually going to have the impact, and the purse strings are controlled by the state regulators and by the FERC.

So is your role not one of being an enabler rather than the manager? The enabler is sort of looking forward to saying where are the gaps from a technology point of view that would have to be addressed so that by the time the people who wanted to spend the money wanted to spend the money, the solutions are in place for them to utilize, as opposed to sort of framing it as the DoE is responsible for the development of the grid, protecting the energy infrastructure, and so forth.

So I think the way you've sort of written it out there gives the impression that you're wanting to take the lead on managing the effort. And maybe you do, but then I'd say there's sort of an iteration there where you need to go and check to see whether you've got the wherewithal to do that.

COMMISSIONER LAFLEUR: I have a couple of comments that I think in large measure echo some of the things I've heard from colleagues around the table.

First of all, almost all energy issues, and certainly when you evaluate the grid, come down to trying to co-optimize or trade off the core values of reliability and security, cost, and the impact on the environment. And the way this is written is very much geared to reliability and security, which are unquestionably kind of number one when it comes to the grid.

But as I observe the things that DoE works on, you're also working on things that are structured toward improving the efficiency of the grid, reducing cost, or improving the environment. So I don't see those captured yet. I see them in the organization.

But then the second thing is once you get the -- in all the strategic plans I've ever done, I still don't know the difference between mission, vision, strategy, so I use them interchangeably. But once you get these kinds of goods that you're working toward, I do think it's

critical to articulate in one of those nouns how you're going to address them. What is the role? Because I find -- well, I already knew nobody knew what FERC did outside our little community, but I also as I go out on the road finding people maybe know even less about what DoE does. And often things it doesn't do, but doesn't know about the things it really does do.

So I think it's important for the public relations or whatever we call that -- that has a different word now, too, communications. What are the parts of OE that are going to make this happen?

MR. BONNER: That's helpful.

MR. COWART: Barry?

MR. LAWSON: I'll try not to be duplicative of what everyone has said here. But when I look at the first three bullets up there, I'm thinking through some combination of industry, NERC AND FERC, that's being done. I don't look at DoE to do that. I look at DoE to provide, what we've heard a number of times, R&D and new and better technologies to help industry and others do those things. And that's what's not here.

And so I would like for it to be more focused on what it does to help others do those things. And of course collaborate with industry -- NERC, FERC -- where it helps to make those R&D and technology products, you know, better, where it helps to inform that process.

But the whole R&D and new technologies thing is missing from this and really needs to be there.

MR. PARKS: It's interesting, and it's extremely helpful because it's interesting that the different views around the room of what our role is, and that they're not consistent even though a lot of you have worked with us for sometimes decades. And so I think that's something that we'll take back.

But I think it's really important, again, for us to stress that you can't do R&D in a vacuum, and it has to be related to what's actually happening out there. And it has to be and it gets linked to policy whether we want it to or not.

And so we have to look at how those boundaries intersect and what our roles in those

boundaries are, because in some ways, and especially if you look at things like emergency response or cyber security, requirements are growing on us, not shrinking, when it comes to this. Thank you.

MR. COWART: Now at our time for the break. We had so much fun discussing the mission.

MR. PARKS: Last slide. I just want to give you a feel for the --

MR. BONNER: The core strategy team and executive team came up with a number of key strategic challenges off of which they're going to have the conversation around, okay, now what do we do about these? And it ranges from the dynamic asymmetric environment that OE lives in, its broad mandate versus limited budget, difficulty communicating the results based on the range of things that OE does, building policy leadership, fostering this enabler facilitator role, which I think a number of you brought out as you talked about the mission statement, evaluating the impact of the ARRA initiatives and OE's role in that, and measurement. How do you measure the results of something that doesn't

happen, which is another piece of it..

So these are the strategic challenges we'll be working with as we move forward. I guess the message is stay tuned for the next BAC meeting where you'll see a complete version of the strategic plan.

MR. PARKS: Thank you very much. Thank you.

MR. COWART: Thank you both. We now have time for a very short break, a 10-minute break. And please come back quickly. I hope in future meetings we'll be able to say the coffee is right outside. We can't say that today.

MS. HOFFMAN: We missed that today.

MR. LAWSON: Will we receive these slides, or will they be posted?

MR. COWART: Yeah. It's customary that they're going to be posted. They'll be available to you.

(Recess)

MR. COWART: All right, folks. Please take your seats. I'd like to get us going, and it's good to officially recognize the fact that Wanda Reder, who has been heading up the

discussion on workforce development issues, has actually -- was standing at the podium just waiting for us all to get going very kindly. Thank you very much, Wanda.

MS. REDER: Yep, you're welcome, Rich. I recognize many of you are new around the table, so I'm going to give a little bit of context to why we created the Workforce Ad Hoc Committee within the EAC, and then tee up a panel.

We're joined here today for this panel discussion with Barbara Kenny with NSF, Ann Randazzo, Center for Energy Workforce Development, and Gil Bindewald with DoE. So following my comments, they will each have their own respectively, and then we'll try and leave some time for Q&A afterwards.

We actually voted on creating an ad hoc at the last meeting, and there was a lot of discussion around it in terms of why does DoE care about workforce. And ultimately it came down to if it's tied to reliability and the evolving competencies in order to achieve our vision and aspirations going forward, then we have every right to care.

And so the question really comes, you know, do we know what we have going on? Is it visible? Is it connected? Are we collaborating both internally and then with others as well? So that's really the essence of why we're here today is to better understand that and then tee up for our white paper position at the end of the year.

This effort is vice chaired with Tom Sloan. We have several within DoE that have been helpful: David Meyer, Gil, Anjan, and of course there's others that have been contributing here in conference calls going forward.

I do encourage those of you that are interested to get involved, so that's my little recruitment statement for those of you that are new.

We have several drivers right now that are impacting the workforce, and I think this is probably worthwhile to spend a little time pondering in terms of the demand growing, the electrification is there to serve a digital economy, which is different, aging infrastructure, which we all know. Ann will quite a bit about retirements and attrition rates that

are coming out of survey work that she does. So all of this really is evolving to a point of workforce readiness and preparedness.

It probably isn't going to be what it has been in the past. The question is where are we? Are we doing what need to in order to be positioned for the future and in lieu of many landscape changes? In addition, of course, to the significant attrition rates, it's just a lot of business change that's ultimately going to be before us, and actually many of it is right now.

We're trying to gather and understand what's happening in lieu of the economic impact and resulting trends that are before us right now. We know that workers have delayed their retirements, so in some respects it may be creating a bit of a tsunami. Ann can talk about, you know, the numbers that are painting that picture. Jobs that we thought might be there may not be there because of the economic impact. Outsourcing becoming more prevalent than in the past, so all of these ultimately have implications on where we are and where we're going.

I think it is important to know that a lot has been done, and we need to recognize that. But in many cases we don't all know what all has been done, so to the extent that we can leverage, collaborate, and better connect our efforts for a better grandiose outcome as compared to individual initiatives, that certainly would serve us all.

And the other thing that I wanted to make sure and talk about, since we don't have necessarily the academic site at the panel, but there's some perspectives around the table, is just the recognition that in the academic piece, we also have aging faculty. In many cases, the curriculums aren't offered that used to be offered, and so we need to have kind of an understanding of where that foundation is going. Are we building it appropriately relative to where we need it to be? And is what is being produced out of that meeting the needs of the future?

This report was actually authored by -- IEEE Power and Energy Society with many others that contributed from an oversight

perspective in April of 2009, suggesting six different really objectives for the future of power and energy engineering. The first three suggested that we needed to double the output of undergraduate engineers focused in power in order to anticipate retirement attrition, other attrition, and emerging work needs. And then the last four were more around research and building the foundation for education.

So one of the things that PES has done is created a scholarship internship program to attract the best and brightest undergraduate engineers into the power sector. This was rolled out in 2011. If we have folks that join as sophomores, they're eligible for up to $7,000 through their -- through the time in engineering, $2,000, $2,000, $3,000 a year, as long as they maintain a 3.0 at an accredited university and a U.S. citizen or a permanent resident.

We have in 2011, the first year that it was launched, 93 recipients from 51 universities throughout the United States. So I think this is one step certainly to increasing the interest and bringing the best and brightest into our industry.

We need to continue to fuel this in order to make, you know, a sustained effort.

This is a picture of where all those awards went. They are certainly geographically distributed. We have a, you know, regional infrastructure now established in order to administer this, a website, et cetera. We're actually seeking funding from industry and foundations. We've gotten $3.7 million raised out of a $10 million goal over a three-year period. I got to say finding the money has been a challenge, and so that's certainly, you know, out there as well.

We do intersperse it with career experiences, which I think is important. We use PES- careers as a way to match employers with students. This is used in general, but it's also used to administer the career experience with the scholarship plus effort. So it's PES-careers.org.

And that kind of, I guess, tees up then for some of the questions that I would like to challenge the panel to think about, and that is, you know, what do we know about attrition? What

are the changing landscapes and the impacts? What are the new programs? Should we be stressed out over this stuff or not? Have the recommendations that we've put in place in the past made a difference? If so, how? Where are the remaining gaps? How can we better coordinate? And are collaboration efforts effective or even underway to the extent that they're needed?

So those are a few things. Again, the panel is here, and Barbara's going to be the first one then that presents her comments from NSF.

MS. KENNY: Thank you, and thank you to Wanda for the invitation to come speak.

I'm interested in this because I like the idea of collaboration, and I think it's really important a lot of times, even within an agency, even within a known division, the left hand doesn't know what the right hand is doing, let alone across agencies and across, you know, the country and everything.

So my goal here is to just give you a snapshot of some of the things that are going on at NSF, and so it'll be quick because there's a lot of things. And we don't focus specifically

on any one technology area. It's very broad-based across several, but you can always find little nuggets of whatever you're looking for -- in this case, power and energy related work. So that's what I've tried to do for the presentation today.

So, first, a quick little bit about NSF. So we've been around since 1950 and with the same mission, which you can see there. And this is our vision. We just went through a strategic planning exercise a couple of years on our cycle at NSF. And the thing I want to point out here is that this integration of research and education has always been part of what NSF does. So we don't only do the research piece, but educating the next generation not only in the college crowd, the college group, but the K-12 as well has also been part of our mission.

This is a org chart. We have nine directorates based on discipline mainly, and I sit in the engineering directorate. Going down from the engineering directorate, we have five divisions within the engineering directorate. The three in the middle are discipline-specific ones, and the two on the end are more

cross-cutting. And I'm in the one on the left, which is the Engineering, Education, and Centers Division, and my primary role is in engineering centers. Engineering research centers is where I do most of the work -- most of my work.

The other division that I have highlighted here is the Electrical Communications and Cyber Systems Division. This is where a lot of the funding, especially for single investigators, one university faculty member, one or two students, comes from in the power area. There's an energy, power, and adaptive systems program within that. It's about $18 million a year, something like that. And that's, like I said, about a one student, one faculty, $100,000 a year type grant out of that division.

So now I wanted to do, as I said, was to do kind of a cross cut across NSF. And first I wanted to take a look at the center's program. There's several at NSF, but there's two in particular in the engineering directorate. Human resource development program, curriculum development, and then what we're doing in

engineering education research.

So first in the center's program, this program was initiated in 1985, and it was actually the result of some concern that students that were coming out of Ph.D. programs at academia were too narrowly trained, and it took industry too long to train them up into how to function in an industry environment where they had to work with other people in other disciplines and understand how their focused area of research fit into the bigger picture.

So the centers, this Engineering Research Center Program was started, and one of the defining features of it is that a center has to have a systems or an engineered systems vision. So it's a collection or an integration of projects from different disciplines so the students understand how what they're doing fits into a bigger picture.

Engineering research centers also have industry partners, industry members who pay a membership fee to belong so that membership fee augments the NSF budget. They're fairly well funded at $4 million a year. Their partnerships

between universities has to be at least two universities in partnership and up to five -- up to 10 years of funding. And we also have a k-12 outreach component and a university education component with curriculum development, and taking research results from the Engineering Research Center into the curriculum.

And in our latest iteration of centers that we've funded, we've also asked them to add components on entrepreneurship and innovation to the student's educational experience.

We have 17 centers funded at the moment, and two are joint with DoE, one with this Office of Electricity and the other one with EERE. EERE is the other one it's with.

So the 17 within the ERC program, we have two that are related to the power grid. This one was funded in 2008, and it's at North Carolina State. And they're basically focused on the distribution system. You can see their goal here is to have an energy Internet type thing with sort of a plug and play interface.

A lot of their research is focused on the solid state transformer, which you can see

there, and the fault interruption device. And they have a big effort in power electronic devices as well. And the partner universities, you can Arizona State, Florida State University, Missouri, and Florida, FAMU.

The second one we have in the Engineering Research Center Program related to power was just funded in 2011, and this is the one that's co-funded by DoE. And it's headquartered at the University of Tennessee, and Northeastern, Tuskegee, and Rensselaer are partners with this one. And this one is focused more on the transmission system.

And one of the interesting leveraging things here was that they wanted to take some of the data that's going to be available from the PMUs and see how they can better use it to understand the system for the visualization and also for the -- possibly for control and feedback, that type of thing. So that fit nicely with the DoD efforts, which were funding some of these. It was sort of a nice research arm to that effort. So we actually haven't funded -- co-funded an engineering research center before with another

agency, so this is the first that we've done this.

The second type of center is the Industrial University Cooperative Research Center, and this is a smaller investment from an NSF perspective. And it's very much focused on industry partnerships. It's very much driven by industry. So there's a consortium with industry members, and the projects are focused on what the industry members want them to do. The NSF funding is very small -- you can see between $60 to $80 per year as opposed to the $4 million per year on the ERC side. So the NSF money is really a catalyst. This is very much focused on the industry needs.

And, again, within those, about 60 that are funded. We have two that are in the power area, and this one I imagine most of you have heard of. It's the PSERC, which is now headquartered at Arizona State University, and they do research in these areas listed here. And they have about 50 graduate students that they're supporting at the moment.

And then a new one that was just funded in 2009 is -- they have a cute acronym, GRAPES.

And they work on power electronics more, power electronic interfaces to connect to the distribution level. And this is the University of Arkansas and University of South Carolina.

So that's the centers program, and I now I want to move to the human resource development programs and activities, and take a cross-cut look at that.

A big program at NSF is the Graduate Research Fellowship Program. As you can see, we give quite a few of those per year. It's almost a $200 million a year program when you count everybody who's under support because it's a three-year support.

I wasn't able to find out -- we don't list them specifically by what they study, but this goes to the individual student. So any student that's applying for a Ph.D. or wants to work on a Ph.D. could be eligible for this type of grant.

The next one down, the IGERT Program, this is almost like a mini center, and it's focused on providing an educational experience for students that is interdisciplinary. And it's

smaller; it's $3 million for up to five years. There's about 20 students over the five years that will come out of this -- 20, 25 on that order. And two of the recent ones that are currently in this area of smart grid, University of Texas at Austin and University of Vermont just was announced last week, these two in the IGERT area.

We also have research experiences for undergraduates, teachers, and veterans. And what these programs are is it allows those different groups of people to come into a university environment and participate in research in the lab with the faculty. There are some sample grid-related projects as you can see here that I was able to find. The Cleveland one is related to wind power -- Texas A&M, Drexel, and the University of Notre Dame.

We also have supplement grants, so these are sites where we actually give them money to organize a site, and they take it. It's about 10 to 15 participants every summer that will come in for an eight- to 10-week experience. We also can give a supplement, for example, to some of our center awards, and then they can take one, or two,

or three students or teachers to come in and participate in the research in that center under their research experiences for teachers, undergraduates, or veterans.

In the area of program curriculum development out of Education and Human Resources Directorate, we have these two programs. The first one is aimed more at curriculum development at the undergraduate level called TUES, and the second one is the Advanced Technology Education Program, and that's aimed at community colleges for technician training.

And some sample grid-related projects there. In the curriculum development one, there's one at the University of Arkansas that you can see. And then the technician training, I think they weren't specifically smart grid or power systems, but it was more about sustainability and renewable energy. Those are two that are currently active.

Then in addition, the division -- the Energy Power and Adaptive System Group that I had mentioned earlier that funds a lot of the power systems work, they also have been funding these

faculty workshops in power education. And Ned Mohan, who many of you may know from University of Minnesota, has been doing this for at least a decade at the undergraduate level trying to work on making curriculum more updated, more interesting to students. He was working on integrating computer programming back 10 years ago so students would be more interested in studying power systems.

Originally he was funded through Office of Naval Research and NASA, and I know that because I used to work for NASA, and I was there when he was originally funded. And he's also gotten funding from NSF over that time, but mainly it's been ONR who's been really very much staying with him for this whole time and supporting that effort. And he has workshops once a year that attract 50 to 100 faculty.

Then at the NSF side, there's a group, the Electrical Computer Engineering Department Head Association. And last year they had a workshop at Georgia Tech for about a week to train faculty to try to cross-train faculty so they could teach power courses. And they plan to do

another one this summer.

And finally in the engineering education activities, this is more research on how people best learn engineering. And these are some topic areas that my colleague has asked for proposals in -- diversifying pathways for engineering degree programs. How can you get more people into the pipeline? And the graph that I have on the side is actually a study that talked about that. The largest bars on there are the persistence, and that is the number of students that start in engineering, stay in engineering. And that's about on the order about 75 percent.

But then the light blue bar down below are the people that migrate in into engineering or migrate into science, technology, and math, or whatever. And you can see the folks that migrate in are -- in the engineering area are smaller than the percentages that migrate into other fields.

So the question is, is there a way to be able to allow more people to migrate into engineering even if they don't start off as an engineering major in college? And then these other topics here -- exploring credentialing in

engineering education, and then understanding how to scale. This is the idea that if people have found good ways to teach in one university setting, how do you disseminate that information more broadly and share it?

My last chart here -- as I said, I appreciate the opportunity to think about collaborating and leveraging what everyone is doing. Another thing that I thought was interesting was Boeing had come in to see us last fall, and they're very concerned about the same sort of workforce issues. And this was the chart that he had presented up. I bet the Power and Utility Company Workforce probably looks very similar to this. And right at the leading edge of that curve is at, I'd say, about 55 to 59 point. And he said that that average age of retirement in the aerospace industry is 61, so they're facing something very similar to this as well.

And my third bullet there is an effort that they have started -- Boeing and SRI International -- because what they're saying is that this whole STEM education system that we have, it's not just a linear pipeline. There are a lot

of different players, a lot of different programs going on. And where should you make investments that would be best suited for the objectives that you want to achieve? So they're trying to do some research on how do you best model this as a system so you can learn how to best direct your research dollars.

And that's it. So thank you.

(Applause)

MS. RANDAZZO: Hi there. I'm Ann Randazzo. I'm the Executive Director of the Center for Energy Workforce Development. And I want to give you just a little bit of an idea who we are and how we operate, and then I'm going to talk about some of the numbers and some of the processes that we have in place.

The Center was formed back in March of 2006. We came together as utilities to focus on what was then a critical issue with the aging workforce and the fact that construction was booming, and we couldn't find people to fill positions. Of course five years have passed. Lots have happened in the meantime. But we are still in a situation where we have an aging

workforce, and we need to find people to fill those positions. So much of what we do is to figure out what works and package it in a way that it can be quickly scaled across the country.

We work in four different areas: Career awareness. We work in education and workforce planning, and metrics structure and support. So just to give you a little bit of an idea, CEWD is a non- profit. We're a 501(c)(3). We are entirely funded by the energy industry. Our members are electric and natural gas utilities across the country, along with energy companies like Arriva. We have trade associations -- Edison Electric Institute, the Nuclear Energy Institute, American Gas Association, NRACA, which are also members, so they fund our efforts, with one exception. We got a great grant from the Bill and Melinda Gates Foundation a couple of years ago to take our process and to adapt it to low income young adults.

So we're funded by the industry. We enable our members to very quickly pick up things and move them and make them work, whether it's at the state or regional level.

So for career awareness, we have a national brand, Get Into Energy, and we've taken that, created a website. We've also created a good bit of branding material so that our members can pick it up. You put your own logo on it. Basically take a jump start for them so that they can use the material quickly going out to elementary, middle, high schools, community colleges, or at the university level.

On the education side, we focus on the entire education continuum. We're looking at what the best types of curriculum are and the best way to train this next generation of workers.

And workforce planning and metrics, we do surveys, but we collect a lot of information from other sources, and that's used to help do the planning for what the workforce is going to look like. And then we work at the regional level. We actually pull together our members and their education partners and government partners regionally. But we primarily work at the state level. We have state energy workforce consortia that are like many CEWDs with educators, and utilities, and government all working together to

figure out the best way to fill the workforce needs in that state.

And we found that if work at the state level, because of all the differences in education with the differences in the government agencies are set up, it really makes for a much more efficient process.

So let's talk a little bit about the numbers. The total industry jobs have decreased since we did our last survey in 2009. We focus on technicians and engineers, four different job categories, primary line workers, technicians of all types of generation, NTND, and then power generation for power plant operators, and then finally, engineers in all the disciplines.

And this information comes from a combination of sources. We look at the census data and at BLS, but then we layer that with the knowledge that we have on what's actually happening in the industry with retirements and attrition and other.

We dropped, as you can see, almost 11,000 jobs over the period since 2009. If you look at where those jobs are, I think this is kind

of interesting. Half of all of the electric and natural gas utility jobs are in just nine states. So of course they are congregated where the population is. But when we look at our workforce in total, that's where they are.

We spend a lot of time looking at retirements and replacements. Kind of scary to me, but if we look at the total industry, not just our key jobs, but all the corporate jobs and everything else that's out there, we will retain a little less than 40 percent by 2020. It's kind of a frightening number when you look at it. And it breaks out in terms of a five-year non-retirement attrition. Those are the people that are going to leave just because they're going to leave. They get a better offer. They go someplace else. Every year a certain number of people are going to leave.

On top of that, though, we have nine percent of our employees who are ready to walk out the door at any minute. So these are people that are over age 58 with 25 years in service, which is kind of the break that's most commonly used for retirement, or they're people that are already in

that category. And it's kind of interesting. We're in more than one meeting these days where we have people saying, don't make me mad, I can walk out at any time. So we have quite a few sitting in our companies now that have a great deal of knowledge and the experience, and at any point in time they can leave.

Add to that those who will be eligible to retire in one to five years, and we just calculate that by moving those numbers out, and then six to 10 years. And that's the way we come up with this.

When you just look, though, at those key jobs, those critical jobs, it looks a little better, but it's primarily because we have fewer people who are just going to leave to find another job. Not hard to understand. If you think about being a lien worker, there are not that many other places where you can go. If you're a very specialized technician, you're pretty much going to stay in the industry. But other than that, the numbers look pretty much the same.

So what does it look like when we project them out? You can see when we started with

this particular survey in 2008, you see the difference between the actual retirements and the actual non- retirement attrition that we've begun looking at. And the line is the number of hires. So back in 2008, we were hiring to replace. We were hiring into training positions. We were really doing pretty well. And then in 2009 when the economy tanked, hiring stopped or was drastically reduced. We dipped down on that, and you can see that it has never really moved much above that level.

When you look at that big turquoise bar that's 4N, that's that big tsunami. That's the ready now. And we left it in that year, in 2011, because they are sitting there ready to go at any point in time.

We've looked at these numbers for all the different job categories, the differences between hiring for engineers, hiring for technicians. One of the things that's kind of interesting is that we do replace engineers almost one for one, and the forecaster going out that we will do that. But for the line workers, it's almost one for two, very different. So

that's one of the things that we are dealing with as an industry is that as people are leaving, they are not being replaced. And that more than anything else is what accounts for that dip in the total number of people in the industry.

So all we have to figure out is how many we're going to need in each one of those job categories, when we're going to need them, and where they're going to be. What we have seen is that they are not transferrable in the sense that you can't just train a bunch of line workers and then just deploy them wherever you want them to be. They really have to be grown, and they have to be grown in the area that they want to live in. People are not as likely to pack up and move across the country for a technician position.

For engineers it's a little bit different, but particularly when you're talking about technicians, they're going to pick the place that they want to live, and then they're going to stay there. And you might be able to recruit them a state or two states over, and they will be trained. They'll take your dollars, their training dollars, and then as soon as a job opens

up at home, they go back home. So we're kind of in that cycle. That's the focus on grow your own, creating programs within a state, within the community college or technical school system, that will really help us to build that workforce in place so that it can be sustainable.

The way the numbers come out, nuclear is separate. They actually focus through NEI on a nuclear uniform curriculum program. They have a task force focused on that, so this includes technicians and plant operators. For technicians, these are all types of technicians, whether it's instrument control substation relay, any type of technician, they kind of fall in that bucket. And then line workers, plant operators, and engineers.

So you look at the 22,000. Let's just talk about line workers for a minute. You look at them. The only thing you have to figure out is where and exactly when you're going to need them. So 22,000 doesn't seem like that big a number, particularly when you compare it to some of the other industries where they're going to need millions of people to replace their aging

workforce.

But for us, this is a very cost intensive training effort. It costs somewhere around $200,000 to train a liner worker over a period of about five years in an apprenticeship. For some it's a little less, maybe it's a four-year apprentice. But it's about $200,000, which is about the equivalent really of a Harvard education. So you take that number and multiply it by $200,000. This is a $6 billion training effort just for line workers between now and 2020.

So a fairly significant effort, which is why we work so much with the community college system because as much as this as we can get through the public education system, then it decreases our internal cost. It gives the community colleges a great system and a great program that will entice students in, and it reduces the amount of time that we need to train them on the other end.

So what does this look like in terms of numbers over the next five to 10 years? You can see the percentages for potential attrition and retirement. Spreading them out, it's about the

biggest bulk is, of course, in the next five years. Actually less than five now up through 2015. And that's because of all those people who didn't retire, that can retire at any point in time.

If you look, though, just at engineers, that's where we have those numbers that you saw before. But think about where the students are going to be coming from. For the most part, these are students who are already in school. So we're not talking about building a whole bunch of new programs for power engineering. We're talking about a conversion effort here, which is a lot of what's happened with power engineering and the power engineering society. That's the purpose of programs like the scholarship program that Wanda talked about. It's a way to get students who are already in school to look at us and to say that would be a good place to go work; I'm going to learn about that. So we're not talking about starting over here, with the exception of some of these out towards 2010 where there might be a chance to put in some new programs and get them through. It also means that we have to think very critically about taking engineers with a current

set of skills and turning them into power engineers, or nuclear engineers, or electrical engineers with a power focus.

So how do we balance this with the education supply? This is just our little chart, the way that we look at it. Because we have a lot of companies that will say, you know what, we're not hiring, so we're really not going to invest much in workforce development. But it's a very short-term strategy. If you have jobs that are ready now, that's the ones that are currently open, then your source for those become the military, a great source for our jobs. We have a wonderful new initiative called Troops to Energy Jobs that focuses on that. It's also people who have already graduated from a community college program in utility technology or power technology. It might be students that have just recently graduated from an energy career academy that will train you for our jobs.

Those who are going to be the jobs that we're going to fill in the next one to two years are students who are currently in a community college program. Again, it's not a matter of

going out and starting a bunch of new programs. It's getting them in place with the right skills so they can move in.

Three to five years, those are existing programs. But you have a chance of putting some new ones in. Those are for students -- we'll fill that with students who are currently in high school, which is why we focus so much on high school in terms of career and technical education, getting the right skills at the right time so that they can move into programs pretty quickly, getting them to understand what our jobs are and what great careers these are.

For the ones that are in that six- to 10- year slot that we're focusing on in the 2015 to 2020, those are kids that are currently in grade school and middle school, and the fourth grade is particularly critical when we talk about girls. Girls make a decision the fourth grade whether or not they're going to be good in math or not. So if we don't catch them in the fourth grade, then they are taking another track and we will never get them back on our track in terms of academics.

I said we work at the state level. We have states now that are represented by state energy and workforce consortia. These are those collaborations of utilities, educators, and others. These are utilities from the very large ones to very small ones. The consortia are made up of municipalities, cooperatives, large shareholder owned. They all work together to figure out how many they're going to need because if there's one thing that we have learned it's that having a program where there is one utility in one school is almost destined to die at some point. A company cannot sustain on their own. If they don't hire everybody coming out of that program, then it can't be sustained over the long run. So where many companies join together, including construction or manufacturing within a state that needs similar skills, then those programs can stay alive. It really focuses on having common skills, common competencies so that we can keep the programs alive in the long term, and they'll provide the pipeline of students that we need.

We have created what we call the Get

Into Energy Career Pathways Model. I'm just giving you a piece of it here. There's lot more information out on our website. But we started with a competency model that we worked with USDOL on that identified what are those basic skills that everybody in the industry needs to know, and then builds it up so that it's successively more job specific. In the tiers one through three, those are things like basic academic requirements, the math, reading, finding and locating information that you need to move into a program of study, personal effectiveness skills, things like the ability to learn interpersonal skills, workplace requirements, safety, teamwork, that kind of thing.

And then moving into industry fundamentals. These are the basics of the way that our industry operates whether you're talking about environmental, safety considerations, the regulatory environment that we work in. And then above that are the job specific skills. Are you going to be a technician? And then even more specifically, the difference between a wind technician and an INC tech. So it begins from this

broad base and then goes up. And we have identified credentials that stack on top of each other so that you can get a credential and then move on.

And what it means is that you can go pretty far in a program before you have to make a decision, again, on whether you're going to be a relay tech or an INC tech. So the programs can be structured that way.

This is our career pathways model. We focus on five different demographics: Youth -- and that's where a lot of our Get Into Energy, original Get Into Energy work is; military, that's the Troops to Energy Jobs initiative; women -- we have a Get Into Energy Women initiative particularly focused at bringing women into non-traditional jobs and also engineering; low income young adults is our initiative that's funded by the Gates Foundation to bring low income young adults 16 to 26 into these great careers. And then the final is transitioning adults. That might be someone who actually lost their job and is moving in. But it might also be that conversion that we talked about

where you've got somebody who's in a job in one place and wants to become someone in ours.

We've broken it up into the different skill levels that they need, and we have boot camps in place, like a math boot camp, that can really help you build the skills to actually pass the pre-employment test and get the job.

The particular type of curriculum depends on the job for line workers. It looks more like a boot camp, a six- to eight-week boot camp, and then an apprenticeship for utility technicians. It's an associate degree or some combination of prior learning plus the credits to move towards an associate degree.

So our website is www.cewd.org. I gave you a little bit more detail on the survey, our executive summary. And also our executive newsletter that gives you an idea about some of the things we're working on. Lots more information out there or feel free to call me or send me a note, and I can give you as much information as you want. Thank you.

(Applause)

MR. BINDEWALD: Good afternoon. It's

an honor to be here. I do not have slides actually. I have more questions than I have slides.

As Wanda mentioned earlier, my name is Gil Bindewald. I'm involved in some of the ARRA smart grid workforce training projects within the Office of Electricity. I'm not going to go into detail today about the specific projects. What I'm going to try to do is briefly talk about some of the trends that we've seen in those projects, and then share some of the questions that we've been struggling with as part of those projects.

Fifty-four projects were awarded. All of these are described in smartgrid.gov, and so I'd recommend going there to be able to find out more about them. They include industry, universities, community colleges, manufacturers, utilities, training institutions, a breadth of them.

As part of the requirements when we went through it, all of them had to submit some type of a gap analysis. We did not dictate to them this is the type of training you need to pursue. We said, okay, we understand that workforce issues are often very local and regional, and, therefore,

we leave it to you to think about what the challenges that you face in the coming decades and how programs at the university level and within industry might be able to be developed that meet your needs.

The other part that we asked for was letters of commitment. We did not want university programs or training institutions developing people or training people just to train people. We wanted to say, hey, how do you connect with those that are actually using or hiring or developing research opportunities? How do we do this? How do we couple this all together?

So how have some of these projects changed since 2009 when we began this process? I'll start with some of the utility side. I would say sort of mirrored by some of the statistics that Ann raised, there's a little more inward focus than what was originally anticipated back then. There's a lot more looking at it and saying, how do we use the staff that we have? How do we retrain them? How do reposition them to give them opportunities for longer-term growth than what was maybe originally anticipated based on

retiring trends, based on other expectations.

The other one I would say is in 2009 there were thoughts about what does a smart grid mean to the workforce? Does it require significant specific technical skills, and new positions, and new jobs? And I've seen over and over again where, yes, you need some layers of skill sets, and I think this comes a lot to Ann's credentialing model and sort of layering model. But as a whole, the conversations I've had, it's been about give me somebody that has strong technical skills. Give me somebody that can communicate. Give me somebody that has business experience. Give me somebody that knows project management. And a lot of the programs, what their strength was is in helping identify people that could be taught, that could develop skills that were applicable to the energy industry. And I think that was something that has shifted a little bit from back three or four years ago.

From a university perspective, there have been universities that have struggled, and there have been those that have succeeded. And I would say some of the areas, the differentiators

were did they have a single industry partner? There were some that said, okay, we have this regional partner, and that is who we're focusing on, and that is who our program is for, and we are there to serve their needs. Well, that individual utility or manufacturer said my hiring trends changed. All of a sudden the university is saying, wait, we were bringing people through a two- year program. We were bringing people through an 18- month program.

They didn't realize that it's more about a relationship with the individual regional entities. They didn't think about how they could complement it across manufacturers, and utilities, and others that may have similar skill sets that these programs would be producing.

The other one I would say that's a differentiator is the pipeline challenge. Some of the universities focused only on, well, we have a pipeline, and we take students in and we produce graduates, and they have certain skill sets. What they didn't see, and which I think comes out quite well in some of the work the NSF is doing and some of the work that Ann talked about, is saying, well,

there's a whole history there before those students enter the program. And the more that you can engage with the community, the more than you can engage at the K through 12 level, the more that you can engage the teachers, engage people in fellowship programs, the more likely you're going to get individuals with the skill sets, get the sort of the workforce that would be required or is a challenge coming out.

Finally I would say one of the big differentiators was also the -- some of the universities were their own worst enemy, and I mean that in a nice way, if there can be a nice way. Some of them -- they had as part of the partnerships that they would share curriculum. It took two plus years to share -- to sign a memorandum of understanding between the universities to say, we'll share the curriculum.

Some of them the registrar said, you know, we like those courses, but we're under budget restraints, and the more courses we offer, the more it dilutes our resources because we need more student -- more faculty to be able to teach these. So we're only going to offer these classes

at a 9/9/9 level, for example, where that is, it's a temporary offering or an optional course. But students can only take one of those courses, and so if a student wants to pursue an energy-based focus on a few of these classes, well, they'll have to double up on their courses. They'll have to take extra time, extra courses to do it. And so all of a sudden, students' interest was, okay, how do we do this? How can we manage what the program and what the requirements are for graduation and some of the other challenges?

So that said, there's been a lot of successes. You see that in the letters from students who have done internships. I mean, this isn't DoE. This is about the partners. It's about the utilities. It's about the people who have given these students the internships, the fellowships. It's about the hiring. It's about returning students who had been struggling to find jobs, who have now been connected to something they said, oh, we weren't even aware about this. I think that's a lot about where I see the successes about the people, about the faces and the opportunities that they saw that

they would not have seen.

Some of the questions I'm wrestling with, and one of them came up earlier today was, we at DoE are often dictated that we have a research mandate. That is our job. And I think it came up earlier that, well, it's also reliability. So what is DoE's specific role in workforce related to reliability or to research in this area?

University centers of excellence. Wanda mentioned the 2009 center -- the study. There have been a lot of great centers that have come out -- current center focused on a wide area of visibility. The Freedom Center focused a lot on the distribution side. PSIRC, power systems as a whole. ESIF at NREL, looking at a lot of renewables issues. I can go down the list. What other centers is the industry looking for? What other topics would be relevant to meeting the challenges that you face going forward?

If we're pre-positioning something for five, years out and these centers are developing the students that you need to hire afterwards, what is it you're looking for? Science has one

going out now dealing with math, and data, and computation, and how that all integrates into power systems. There's another one. What do these look like?

The other one I've heard from several utility friends, industry friends is, there's so many great opportunities. I want to be involved in them all, but I don't have the time to be able to actively participate in each of these. And the question that I have then is, how do we put in place a mechanism, a new business environment, a business approach, that would allow those that are interested in these issues to stay informed of the variety of centers research, the centers opportunities, these other projects that are occurring within the R&D side?

And I'm not just talking monetary. The time element, the commitment that's really there in terms of investing in the research priorities, investing in what's happening is really critical.

The other one that came up, and Ann touched on this, is the state issue. A lot of the focus at the federal level is federal, but a lot of the workforce issues really start going down

into the state level. I think OE plays a very unique role in terms of their relationship between the federal and the state, but in the workforce area, are there opportunities that we need to be thinking about in our agency or interrelationships between federal and state entities to make these collaborations successful?

And then finally, one of the things that came up quite a bit is the flexibility in the workforce training side that's needed. One of the things that came up on a university that I visited that I won't name, but it's basically they said -- I said, how many applicants do you get as part of your graduate program, Ph.D., let's say? Well, about 100 applications that are worthwhile, but only five of those are from domestic students.

And so the question is, and I don't slam the domestic/international ratio, but how do we adjust to get students that may be graduating from their masters? They see great opportunities. Is it something that just occurs within the utilities or the industry itself, that continuing training? Are there mechanisms that we need to

be thinking about that would help promote this flexibility in workforce enrichment that's going to be required as we go forward as well?

And that same theme as I went further on some of these site visits, that same ratio kept coming up over and over again. And so how do we create something that meets your needs and balances against the reality that we're facing now?

So on that, I'll be quiet and turn it back over to Wanda. Thank you for your time.

(Applause)

MS. REDER: All right. Well, I know we're pushing up against the clock, Rich, but it sure would be great to get some questions. Pat has some comments. That's great.

MR. COWART: Pat.

MS. HOFFMAN: I don't if I have any questions, but I guess a couple of comments.

I mean, one of the things we wanted to do was actually, going off of what Gil started, was where are some of the centers in excellence that we want to make sure that we stay ahead of the game on in building capabilities? And I know

the ones that were already mentioned, but one to add to the list, I believe, is a joint DoE with NSF is the cybersecurity, the TCIP Center.

And when we start thinking about where is DoE trying to develop or encourage you to look at where some of the jobs are heading and some of the demands are is very, very much predominantly in the cybersecurity area. And might want to, you know, think about that as you look for opportunities, especially in the re-training area of looking at the demands that are out there from a cybersecurity point of view.

And then the other thing, just moving forward, you know, I leave it on the table is as we look forward, if the Department actually is able to do any sort of hub solicitation going back to that regional nature, is how do you look at involving universities as part of, you know, funding opportunity announcement that we do on, like, a hub in a regional kind of electric grid focus.

But I guess the last question I have for Gil, I think these awards are done in --

MR. BINDEWALD: The awards are

finishing up in 2013, as a whole, yeah.

MS. HOFFMAN: Okay. They're finishing up. You know, as we take a hard look at some of the activities that are up on the website, is there anything we can do to improve some of those projects or leverage those projects to a greater extent? I mean, with the Recovery Act, we put $100 million into workforce development, training. You know, are we maximizing the potential of what DoE has put forth in that area? So those were just some of the thoughts I had.

MR. COWART: So I've seen cards. I'll take them in this order: Merwin, Mike, Sonny, and David.

MR. BROWN: Thank you. This builds a little bit on what has been said, but I'd like to expand the scope of it. And it's, I think, a question.

I've been in a number of forums that say the future workforce in this industry is more than just taking on some new items, such as cybersecurity. It actually requires some fundamental differences in the type of people that's going to be required, such as more of a

supervisory nature in the technical area because it'll be dealing more with perhaps robotics with automated systems and things like this. And we've already mentioned a number of times the huge amounts of information, the data, that's going to start driving the system more than ever. And so that's going to require another type of talent.

So I guess I'd turn that into a question by saying, is that correct, or is that getting way too out in the future and getting -- if we went that direction, would we be leaving a lot of people in the dust that are still needed in the more classic kinds of education?

MS. REDER: Any of you on the panel want to take that one?

MS. RANDAZZO: I'll address that. You're right, it does take a different type of person. And what we've seen just in the six years that CEWD has been around is whereas originally we were looking at students coming out of high schools that could enter the programs, now what we're seeing is you need some level of post-secondary. And for the technicians, it's an associate degree of some level.

So you're replacing people that came in with high school educations and many years of on-the-job training with ones who have better skills or better knowledge from the beginning, and then add to that. And I think for -- when we look at the challenges that we have ahead of us, and we call them game changers in a lot of the strategic planning, just the grid modernization means you've got to have somebody that can go with you on it.

It's a different type -- the technician skills are basically the same for now, but you've got to have somebody who can stick with you as the grid changes and as we move to a different place.

MS. REDER: I might add a couple of comments to that. I think that, you know, what we're going to see in the workforce is going to be a lot more multidisciplinary in nature. We recognize that some in the education process, but not to the extent that it's going to be realized as it, you know, kind of goes out.

You know, I think that you're right in that, you know, how we manage people. I think there's going to be a little bit of a culture shift

probably because, you know, we've developed the industry, and the business, and our organizational structure very siloed in nature. And we kind of educate that way, too. And we're actually headed down a path where, you know, we're having to figure out how to cut through those silos. And that, in some respects, takes a little bit different mentality in order to ask the questions and be inviting. And almost pursue the areas that you don't know very well so you can make sure that you have the right knowledge at the table. Excellent point..

MR. BROWN: A comment and a question. I look at this, and I feel very glad I got into the industry when I did because it's obviously -- I couldn't have done it today.

The question is for Ann. Out of 11,000 jobs, do you know specifically where they're disappearing from or which categories?

MS. RANDAZZO: That was our first question, and we started looking at it. It spread across the country, and we think it has to do a lot with reduction in hiring. We thought for a minute, there's, like, a huge drop in hydro, but

it was just a reclassification. So it follows very much the -- you know, when you look at those states that had the biggest numbers and the drop was the biggest there. So we haven't found any specific company or place where, you know, there was a big change. It's just that not filling the vacancies. And when you go back and compare the hiring numbers, it's pretty close.

MR. BROWN: Yeah, I kind of wondered if it was a lot alignment because with the smart meters that are going in and the other remote, that's one part of the industry that's disappeared.

MS. RANDAZZO: We have seen a reduction in meter readers, but some of them have been absorbed back into the companies in different positions. We have companies now that are not hiring externally until they have retrained and replaced. But the line workers for the most part -- they're just a growing need and have such an extensive apprenticeship to come up to speed. It's a huge issue..

MR. POPOWSKY: Yeah. I guess my question is for Ann also. You didn't talk

about -- at least I didn't hear you talk about the unions. In Pennsylvania, this is a big union issue is training. And does your organization work with the IBEW, other unions, particularly the line workers?

MS. RANDAZZO: Mm-hmm, absolutely. President Hill is on our board. Both IBEW and UWA are part CEWD. It's going to take everybody to do the training. IBEW has regional training centers that they've started, and we've worked closely with them. The NJT curriculum that's available is part of what we look at.

But it takes everybody to do this. So we're looking at all types of models. Primarily for the line workers, it's that boot camp that I talked about. It's, like, an eight-week program that can be either delivered at a IBEW regional training center, at a technical school, at a community college where you learn to climb. You learn all about what it really means to work outside and to be there for your fellow line workers. You really get a good dose. And then a week on the job to make sure that you can adapt, and then from there you're actually hired and move

into an apprenticeship, internal apprenticeship. So, yeah, the union is very involved in what we're doing.

MR. POPOWSKY: And I guess, Wanda, I would just recommend that as we go forward with this, maybe we could get some contact with the IBEW or the working group.

MR. NEVIUS: Wanda, building on a comment that was made much earlier about a systems approach to the issues confronting the industry, there is this Energy Systems Engineering Institute. I know you're familiar with it. I've spoken to one of their graduate classes at Lehigh University twice now. I don't know how many other colleges or universities have picked up on this as another form of center of excellence. But it trains people -- kind of cross- trains really innovative students in not just the power system itself, but how the entire system of reliability and economics and environment work together, and a lot of the issues that we talked about have all those dimensions associated with them.

MS. REDER: Yeah. I don't know how many systems or systems-type curriculums out there are

being built. And if nobody else does, it does add to a comment. I think what Ann has done on the survey work as far as the jobs and having an owner that's kind of officially taking surveys and getting the numbers out there has done a phenomenal amount of good for us to understand and quantify the situation.

We really don't have that very well on the academic side. And so as we ask that question and we look around the room, we kind of get that, you know. And one of the things that IEEE-PES is doing is we're making the survey that we've done on the academic side online so that we'll get regular, you know, annual feedback on the curriculums, the number of programs, the professors, students, all of that.

There's still a question of who analyzes that data because that's a volunteer organization, and it's very much focused on higher education. So I think that that's a gap as far as really understanding the trends of the academics that are -- academic infrastructure that's out there.

MS. RANDAZZO: And if I could add to that,

it's really a big issue in education in total to be able to count the number of people who come out because of the lack of that kind of longitudinal data. So when we look at the supply side of that equation, many times what we have to do is go to our education partners, the ones that are affiliated with a utility or consortia, and just ask them how many people do you have in this program and how many do you think are going to be graduating. And that's the only way that we can find out how many students are actually in that pipeline to come out.

That's what tells us do we need to build another program or two programs within the state. And it's very much a manual effort.

MR. COWART: Okay, Mike and then we'll come over to this side.

MR. HEYECK: Ann, we're very much involved American Electric Power, with CEWD.

Just a question on the data. I know one company totally outsourced their T&D. Their employees were moved to one of the providers like Quanta Services. And I don't know how that data reflects that since the workers are still

working.

Just two other comments. I'm on the advisory board for the Computer and Electrical Engineering at Ohio State University, and a lot of the issues of foreign students is that they pay full freight, and when states have budgetary problems they pay full freight. So they're inviting, so they're at about a 70 percent rate.

And yesterday I just attended the Ohio State University graduation, 10,636 graduates. Most of the Ph.D.s were foreign. That's a comment, but when we do try to hire some foreign, it is really hard to get through the visa process and the green card process and so on. Given 9/11, it's really hard to do that. And if there's some way to facilitate that, some of these folks actually do want to work in the United States, but it is really tough for a utility or one small entity to actually try to do that.

So a question on the data.

MS. RANDAZZO: So what we do is poll our members and ask them very specific questions about retirement, attrition, that type of thing. We focus only on utility employees, not on

supplemental labor contractors. So what we see over time is if someone has outsourced a particular type of job, then it shows up in the numbers over time.

But one of the things that we're working on, we have the Workforce Planning Council with NCEWD made up of our utility members. And we are focusing on a whole strategic workforce planning effort, so all of that type of thing is what has to be factored in when you're talking about the ultimate need. We're looking at a very kind of just net level with these numbers that you see. It could be higher, it could be lower, but we don't have any way of knowing, unless we get to that level in the company where you're really looking at those internal and external decisions and how they're going to affect your workforce and what the implications are going through.

So we're creating a model with the help of our members and filling in as we do with templates all along the way so that AEP can use it to develop their plans, and then we can roll that up into a national plan.

We have a metrics toolkit. We've

identified six key metrics for workforce development, and the summer is the first time that we're asking people to actually show us the numbers on that, hires against plan, that kind of thing.

So, yeah, it's kind of a gross figure, but it's as close as we can come at this point.

MS. REDER: Ann, how about the outsourcing trend?

MS. RANDAZZO: Yeah, of course we see that, and, you know, when we talk about these game changers, this uncertainty in the industry is one of the things that makes it more difficult than ever to project the numbers. So what some companies are doing as outsourcing is kind of a way to protect against not knowing how many you're going to need, what type you're going to need, where they're going to come from. So, yeah, we see it over time, but through the workforce planning initiative, that's where we're hoping to nail a little bit more of who's doing more of that.

We have seen companies outsource an entire line worker staff. Just hedging the bets is really what it amounts to.

MR. ROBERTS: I just wanted to echo some of the things Mike said. Earlier this year I joined the Deans Advisory Committee for the College of Electrical Engineering for the University of Florida. And I spoke to the graduate students a month or so ago, six weeks ago. And I used some of Wanda's slides about some of the -- she was kind enough to send me some of that -- used some of that stuff, and they had no idea that some of those things existed.

And there's some incredible work going on there in the energy storage materials that'll be very vital for energy storage that I wasn't even aware of. So I look forward to working with them in trying to circle the wagons here to figure out how this communication gets better going forward. And to look at the budget issues and how they try to deal with them at the college level is just amazing, and how much their revenue has gone down from the state over the last five years is just amazing.

DR. BOSE: Just a slightly different perspective for the committee to think about. You know, there's been a lot of activity in trying to

look at the demand and the supply and what to do, what can be changed to match up the two things. And because there have been all these programs of CEWD and of DoE's smart grid workforce program, there has been a lot of activity in this area.

But the one thing that has also happened is that, both at the university level as well as the community college level, there have been hiring of permanent faculty members. I mean, every engineering college recently have hired power engineering faculty. And let me tell you that this has almost nothing to do with these activities in the area of developing these programs.

The reason engineering universities hire faculty is that they feel there is going to be more R&D funding in those areas. And so if the R&D funding dries up, no more power engineering faculty will be hired. So the sustainability of these programs is an issue.

MR. COWART: The ecosystems approach to funding universities.

MR. CENTOLELLA: Picking up on that last comment, in Ohio we put together our utilities,

some of our manufacturing and economic folks with 10 different universities in Ohio and western Pennsylvania in a smart grid cluster to look at both research and workforce development issues. And I guess my question to the panel is really, is there a role for DoE or for others at the state level, you know, to really understand and communicate best practices regarding the development of academic curriculum? And if so, what can this committee to do to try to foster that?

MS. REDER: You guys want to take that? I mean, I'd be glad to, but it would be good to hear your comments.

MS. RANDAZZO: Yes, there is a role. The sharing of best practices, taking curriculum, and, as Gil was talking about, actively getting it shared is very, very difficult. A lot of times faculty feel like they own it, and in many cases they do. And universities or community colleges feel like it's proprietary, like somebody is going to come across the country just to take that particular curriculum.

What we find is that's not the reason

people will go to a community college. So the more we can take curriculum that we know works, there's great examples in the utility and technology area. Ivy Tech, which is the community college system in Indiana, recently just redid all of their utility technology curriculum. It's there. It's great. Being able to pick that up and move it someplace else without spending money on developing is a great idea.

And through CEWD, we actually have a structure. We have a curriculum center where you can do that. But it's the getting the word out that we're not going to pay for a whole lot more curriculum development. We want to pay for implementation of the curriculum, not the development and more.

MR. BINDEWALD: And one other thing I just wanted to highlight briefly was the EERE, another sister office of ours, has done a great job of putting together basically a web portal that allows the exchange of information, especially with the renewable side, so weatherization, wind, manufacturers, or installers. I'm not familiar with all the details

and what's up there right now, but I think that's an important path forward is creating not only the curriculum itself and encouraging the sharing of it, but also creating a mechanism that allows the exchange of that, whether it's CEWD or some other entity to serve that role.

MR. CENTOLELLA: If I can just follow up with one question about this that has occurred to me as I was listening to this, and I'm not sure to what extent it's applicable. But you see in some fields, for example, in information technology, where there is really interesting stuff happening with remote learning, courses at Stanford that have 40,000 students worldwide enrolled in them.

Are there things like that that you U.S. Universities could do in power engineering that could have a significant international market for them, given that there are lots of countries around the world where power demand is growing five, six, seven more percent a year? And is that an opportunity that we should be highlighting for universities?

MS. KENNY: That wasn't the question I

was going to answer. Let me just comment on your previous one and the best practices angle.

I know in the Engineering Research Center Program, we have a best practices manual that has been developed since 1985 of the best practices from the Center's point of view as to organize themselves as a center and operate as a center.

On the curriculum side, also within my division, the engineering education research piece that they're doing. They are trying to answer some of those questions in terms of once a better pedagogy is discovered or developed, how to pass that on.

On the open source question, I think -- I don't know a lot about that. I think there is a trend in that direction to putting the courses out there. Didn't Harvard just do that? They just went ahead, and MIT has already done it, too, as well. So there is a trend in that direction for that. I haven't seen it at our centers, and I would echo what Gil had said. I have seen the difficulty in getting courses shared across the campuses because that's one of

the things we tried to do with the centers is if they're developed at one campus, to have them offered. And there's all kinds of issues with credits and how much you pay for the credit. It comes down to the money thing again.

So I don't know if anyone else wants to take the international question.

MS. RANDAZZO: I can address the remote education. I think it's definitely part of the answer. You know, when you think about that so many students need common skills, and then you have a few that need very specific, that's where the remote education comes in as much as anything.

There's a great example in Connecticut with Northeast Utilities, again, on the technician side. But students in Connecticut don't want to move across Connecticut. It doesn't seem like it's that far. But they don't even want to move the two hours to the other side. So they've created this incredible program where you go to any community college. You get all the gen ed and the common curriculum, and then they offer through -- this happens to be through FCM in Bismarck -- the very specific technical education

online..

So the students enroll. They're in a class with 10, 15 other students from all around the country. They get their degree and their diploma from that state school, so they graduate in Connecticut, but they have a very specific education. And that's the way that Northeast is filling the one that they need here to here, one in the southern part without having to put a whole class together in Connecticut. It's a great way to really distribute the education.

MS. REDER: EPCE has done some pretty good online work. They've done some higher education work at Clemson. I know Michigan Tech has some online offerings. So I think it's evolving. We probably do need a place that, you know, you can go see what all is available, and it very well could be an opportunity to market abroad.

MR. COWART: So, Wanda, by way of closing this discussion -- oh, sorry, Ralph. Sorry.

MR. MASIELLO: Well, maybe we should skip this question.

You know, in 2008, I think, I'm guilty of having drafted the Grid Wise Alliance's report on smart grid is going to create a lot of jobs, something I try to forget these days.

I was struck by the numbers that are presented that it looks like a -- I'm going to call it a static analysis. Here are how many people there are in the workforce, and then we look at rates of change against the idea that that workforce is constant, which begs two questions, I guess. First, are there any statistics out there or knowledge about productivity in the technician and the lineman type workforce?

And then second, if you coupled what we saw with the billions that have to be spent replacing aging infrastructure. You know, I know anecdotally talking to various utility executives, if they had the money and they spent it, that would trigger -- there's got to be more people, right? So I'm just throwing out the question.

And then finally, does it lead to maybe we should be looking at research at improving productivity in some of these spaces, right, as

opposed to simply saying we've got to gear up to add 100,000 people.

MR. COWART: A good comment.

MS. REDER: Interesting thought, yeah. We're pushing on time, aren't we, Rich?

MR. COWART: Yeah, we are pushing on time.

MS. REDER: All right.

MR. COWART: But I thought that I would ask you anyway or the panelists perhaps just in a very brief way to suggest to the committee things that you think, though, the workforce working group really ought to be doing. And so to take it from the very general, here's the national picture, to what is the work that maybe we could do.

MS. REDER: Right. Actually, at some point we need to improve on the outline for the committee through the end of the year. In there, you know, we kind of build up in the outline to set up hypothetical recommendations.

I really boil it down to really kind of a handful. One is to the extent that we can make visible the programs and initiatives that are out

there and better connect them and increase the collaboration so that we can scale and leverage activities both at the state and federal level and across agencies, I think that's a big one. And that in itself, you know, I think is good.

I think connecting research to education needs is important. Matching supply and demand, figuring out a way that we can actually get visibility on both pieces, and attempt to manage so that we have an outcome to meet our future needs.

And the last one, to the extent that we can get it, I think it's desperately is scenario analysis around different -- you know, kind of what you think about is, you know, the big one this way, the big one that way, and the difference and implications of what you do right now.

So that's how I would boil it down in terms of what's needed.

MR. COWART: Thank you. And I think the committee will have an opportunity to discuss the work plan.

MS. REDER: And, Rich, there's another thought I've been having since I have a foot in

the smart grid campus well, and that is to the extent that we can be extrapolating lessons learned around the workforce from those individual projects, incrementally it's not much. It's just a few questions. But the learnings that we can gather from that can really be helpful to build and understand what we're going to have to create in the future.

MR. COWART: I sense there are some comments from the panel here as we close. Is that right?

MS. RANDAZZO: I'll be glad to. I certainly agree with everything Wanda has said. I think, you know, just from the questions that you have about the data, those are the things that we struggle with. This is a steady state kind of projection based on what we know now. And having some sort of a planning tool, doing the scenario planning so we could begin to look at the what ifs. You know, what if it goes this way compared to that for some of these big issues would be very helpful.

Being able to put in some productivity gains and look at what kind of impact that would

have on the workforce. Just doing it in a much more specific way than what we do now would be -- I think would be helpful to all of us. Whether it's looking at the technician side or the engineering side, all of us need that.

MR. BINDEWALD: The mic was passed to me. I think I summed it up in my closing comments as well. I think the big question that I see is not only the what needs to be focused on in terms of the research objectives, but understanding who's going to be doing that, and whether they have both the capabilities at present to achieve those outcomes.

MR. COWART: All right.

MS. REDER: I think I don't have any additional comments.

MR. COWART: All right. Thank you all very much. Thanks, Wanda.

MS. REDER: Yep.

(Applause)

MR. COWART: Just in closing, two announcements. We will be passing around a signup sheet for members to sign up to indicate their preferences for subcommittees. I don't think

I'll do that right now, although the sheet -- now it's sitting in front of Gordon, and he was ready to pick up a pen, so we never want to deny you the right to sign in. But it'll be here if you want to sign up on your way out of the room. But we'll have plenty of time tomorrow for you to contemplate that list.

The second announcement has to do with dinner. For anybody who's from DoE or the committee who is joining us for dinner, there's a map that shows how to get from the Hilton to the restaurant at the table in the corner over there. And in addition, we'll just be assembling in the lobby at 6:05 or 6:00 actually, and then we'll leave at 6:05 just to walk a few blocks to the restaurant. How far is it?

SEPAKER: Not far.

MR. COWART: A couple of blocks? Yeah, okay. Anyhow, a really short walk. So if we meet each other in the lobby right at six, we can wander over together. Otherwise, if you're going to come separately, get a map.

MR. POPOWSKY: Rich, do we need to vote on Wanda's -- on the workforce report, or do we

do that tomorrow?

MR. COWART: I'm guessing we should do that tomorrow.

All right. Thank you very much. We are adjourned.

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CERTIFICATE OF NOTARY PUBLIC

DISTRICT OF COLUMBIA

I, Irene Gray, notary public in and for the District of Columbia, do hereby certify that the forgoing PROCEEDING was duly recorded and thereafter reduced to print under my direction; that the witnesses were sworn to tell the truth under penalty of perjury; that said transcript is a true record of the testimony given by witnesses; that I am neither counsel for, related to, nor employed by any of the parties to the action in which this proceeding was called; and, furthermore, that I am not a relative or employee of any attorney or counsel employed by the parties hereto, nor financially or otherwise interested in the outcome of this action.

(Signature and Seal on File)

Notary Public in and for the District of Columbia

My Commission Expires: April 30, 2016