UNITED STATES DEPARTMENT OF ENERGY

ELECTRICITY ADVISORY COMMITTEE MEETING

Arlington, Virginia

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P R O C E E D I N G S

(8:10 a.m.)

CHAIRMAN COWART: Good morning, folks. Please take your seats and let's get going.

Following our panel discussion yesterday afternoon and the extended discussion following, we have had to adjust the schedule for this morning a little bit. It's all going to work, I think. We will begin where we left off yesterday with Smart Grid Subcommittees and approval on the storage paper.

Paul?

MR. CENTOLELLA: Rich, we're going to start with Merwin Brown talking the distributed storage paper, and hopefully people have had a chance to review that, and that's coming up for a vote in the full committee.

MR. BROWN: Actually, Carlos Coe was supposed to be here doing this. He's the one who led this effort. He had a family emergency at the last minute and couldn't make it. I'm going to try to stumble through this with his presentation,

so I'm not totally familiar with it.

What I'm going to do is give you a brief overview of the project and the paper itself and the recommendations, and then open the floor for questions, comments, et cetera, and then I'd like to take a vote on this, about approving the paper.

Let's have the first slide, please. Oh, it is up there, sorry. The title is the "Distributed Energy Storage White Paper." Let's go to the next slide. This was a combined product of the Smart Grid and Energy Storage Subcommittees, a joint effort, as I said, led by Carlos Coe. In a minute I'd also remind you who in the working group was on this particular effort.

Carlos has provided some summary here, kind of background of the paper. One was the definition of what "distributed energy storage" is, for this purpose, and there are probably other definitions out there, the one we used is "Energy storage that is located at or downstream of distribution substations." It includes behind the

meter applications, thermal energy storage, but as you will see in a moment, we didn't really include that in our analysis because of limited scope.

We ended up using electricity in and electricity out as a further definition of the scope that we were looking at, but in the paper, there is an appendix that looks into thermal energy storage as a distributed energy storage resource.

I'm not sure why it has microgrids there except I think energy storage in microgrids counts in this definition.

The scope of the effort looked at distributed energy storage in the context of markets, the regulatory construct, I guess, being able to interconnect distributed energy storage into the distribution system or in the customer's facility that is connected to the distribution system.

We looked at the technology and its applications of distributed energy storage benefits, benefits from distributed energy storage

and codes and safety, and then in the appendix I mentioned, it covers a broader subject of distributed energy resources, including this thermal energy storage that I mentioned earlier.

Then there are recommendations. The main recommendations are in the document to DOE on what we gleamed out of this study, and in the appendix is a recommendation for some follow on work that came to our attention while this project was underway.

I want to give special thanks to Clark Gellings, Paul Roberti, Ramteen Sioshansi, and Tim Mount. There were a few other people who contributed to this as well, and people who provided edited comments. It was actually a fairly good size working group in total. The real kudos, I guess, goes to Carlos Coe for putting this together.

I think it is one of the better papers that has come forward from this group, and my only claim to fame in this is I picked Carlos to lead this effort, because I was supposed to do it, and

then I got appointed to Chair of the Energy Storage Subcommittee, and felt I would divide my attention too much, so I turned to Carlos and asked if he would lead it, but I stayed with him and helped him where I could.

I think this team did a great job, in my opinion, of pulling this together.

Carlos used this particular graphic that shows location of distributed energy storage projects on a map of the United States, what was known at the time, and I don't remember the date but it's in the paper, it seems to me it was like 2014, the date on which this report was released, and he used this really as an example of how much distributed energy storage has grown. It has been a fairly rapid penetration into the electric grid.

A little bit of background, I remember when the Energy Storage Subcommittee was working on an earlier paper on energy storage strategy for North America. We were focusing on utility scale energy storage -- excuse me, we focused on utility scale storage because we felt distributed energy

storage was still a way behind, and wouldn't have much significance for quite a while.

While we were working on that, it became evident that things were moving fast in this area of distributed energy storage, and in part, I think, kind of drove this effort to do this study.

One of the mechanisms for doing this study was a number of interviews of stakeholders that would have something to with distributed energy storage in one way or another. I happen to personally be involved in most of these, so I have some background, some idea what took place here.

It covers a pretty wide spectrum of vendors and service providers, the distributed energy storage utilities of various kinds, and then some public agencies, government types, et cetera. I think it covered a fairly broad spectrum. It seemed to be a fairly rich resource for pulling these recommendations together. I would say it was probably the main driver for the recommendations.

What weren't covered -- as I kind of

alluded to in the beginning, this thermal storage wasn't included in our scope at this point, and there were also not true energies, per se, but we did get some information in a sort of personal interview, if you will, or communications from the automobile industry regarding using EV batteries as DES, but that was not, if you will, an official interview process.

The proposed recommendations are summarized here more or less in title format. If you have the paper handy, you might want to have it in front of you, because it adds a little bit of additional information on this. I guess I'll go just a high level with this unless we need to dig deeper.

One of the recommendations is that we recommend DOE do what they can to enable the access and tracking of the lessons learned from projects and the market development activities in distributed energy storage. I think that's fairly clear what's being asked there.

Then there are three recommendations

here that sort of fall into a group, and it has to do with model development. The first one is to develop advanced market and cost based market models for DES. This came out loud and clear in the interviews, and by the way, it came out fairly loud and clear in yesterday's panel, for distributed energy resources that we really don't have the mechanisms to understand the value of these factors or elements being deployed into the distribution system -- well, as far as that goes, even its impact on the whole wide area interconnection.

The second form of models here would be to develop advanced modern grid physical models for DES. This is in the context of putting them in the distribution system and how that might affect -- how the models could be used to design the architecture, the infrastructure, et cetera, to optimize the value of distributed energy storage.

The third one is operational models that can be used for operating the grid with

distributed energy storage in it, again, for optimization, and for advanced controls in the distribution system.

I guess the rest of these pretty much fall into a category of what I'd loosely call "codes and standards of safety." The next recommendation was for DOE to look at existing utility scale codes and standards, other codes and standards, that exist now for distributed generation, and to see how they apply to the smaller scale distributed storage. In other words, what can we gleam from the existing codes and standards that apply in the distributed energy storage area.

Also, building on this is a recommendation that DOE build or leverage its unique role as an unbiased arbitrator with technical expertise in the deployment of the DES. Here again, the main focus was helping with this thing of selecting the codes and standards going forward that would best apply to distributed energy storage.

The next recommendation, again in a similar vein, is where needed, DOE assist in the deployment of new standards and codes for distributed energy storage. It is really in a similar vein to the recommendation right before that.

The last one is a bit different than the rest of them, but it's a tried and true role for DOE, which is develop technologies that increase the performance, cost effectiveness, and safety of distributed energy storage systems.

Those are the recommendations at a very high level, and let's see what is next on his slides. Let's open it up for discussion, and then I recommend at least this paper be approved for distribution by this committee. I might add there are a few typos in here. We will get those corrected. Other than that, I think it's prepared to go. I'll open it for discussion, questions, comments.

CHAIRMAN COWART: Chris?

MR. SHELTON: I would vote to approve

the paper today, so I will second the motion to approve it. Merwin mentioned this is going very quickly, so one of the things we realized is we could get new information every month to make the paper accurate, but then it would be out of date a month later. We wanted to make sure we brought it and got it out, and we can revisit this in different ways going forward.

I just wanted to say that was a concern of the committee, and I really want to applaud Carlos' approach to doing the interviews, spent a lot of time on the phone with people getting on the ground input.

Again, that is all changing rapidly as well, but that technique was very effective. I would applaud that, and also a lot of feedback was given on committee calls, and he incorporated it splendidly. Thanks.

CHAIRMAN COWART: I will take it we have a motion from Merwin and a second from Chris, and we are now in discussion. Anything further? Mark?

MR. LAUBY: Yes, thank you. I think it was a very good paper. I feel a little bit like the engineer, I can't change the laws of physics, but here we seem to be circumventing them. I am wondering if we might want to change that sentence, theoretically circumventing the current limitations dictated by the laws of physics.

MR. BROWN: Where is this?

MR. LAUBY: Number two, first sentence. It is a game changer, no doubt about it, but as the engineer said to the captain, maybe we can circumvent them but we can't change them.

MR. BROWN: I need to look at the context here. The people who wrote this know better.

MR. LAUBY: I would change the sentence. That's all.

MR. BROWN: I still haven't found it, I'm sorry. Is it page two?

MR. LAUBY: Page six, Section 2.

MR. BROWN: Which paragraph on that page?

MR. LAUBY: First paragraph, first sentence.

MR. BROWN: I suppose the missing word is "seemingly." (Laughter) It needs to be corrected somehow.

MR. LAUBY: Appreciate it. The paper is very good at laying out what are some of the benefits of storage, distributed or otherwise, and one of the challenges I saw, which I guess we talked about yesterday, and I don't know if we want to add a paragraph on this or not, I don't want to put something in the spokes of progress, but control and visibility, you do talk about physical models here. There is not a lot of material in the report itself about that, but I understand you can probably pick that up in the interviews and you didn't want to make it a real techy paper.

The whole idea of observability, controllability, which will increase the value even more, I think is something to be thought about, too. Other than that, I loved the paper.

MR. BROWN: I'm not clear. Are you saying it's not in there or it's implied?

MR. LAUBY: Not that I could see. Maybe someone can point it out to me. I didn't see that aspect of it that we talked about yesterday, good control and allow the dispatcher either a DSO or ISO dispatch for balancing and/or regulation.

For example, storage can be one thing at one point in time, and then you could turn around and use it for something else another time. You have to have all those connected --

MR. BROWN: Yes, correct. I think, judging from the conversations that went on, it's in there. In spirit, whether or not it's in there in writing.

MR. LAUBY: Understood, the spirit is there.

MR. BROWN: Yes. If you require it, we can put something in. My recommendation is if you are okay with it, we can proceed with the paper the way it is.

MR. LAUBY: Okay.

CHAIRMAN COWART: There is a suggestion that comment could be put in the cover letter without having to adjust the paper.

MR. LAUBY: I like that.

CHAIRMAN COWART: Can I make a suggestion to deal with Scotty's problem, that if we could just change the language, instead of saying "theoretically circumvent the current limitations," say "flexibly adjust to the limitations dictated by the laws of physics."

MR. LAUBY: You are really able to take advantage of the laws of physics, you can't change them, you are putting them to work for you.

MR. BROWN: Yes. Have those words been captured by our editors? Also, in order to make sure it gets into the letter, your words, would you mind sending a little note on those?

MR. LAUBY: Yeah.

MR. BROWN: Thank you. Any others? I don't see any tents put in the vertical position.

CHAIRMAN COWART: Ready for a vote?

MR. BROWN: Call for a vote.

CHAIRMAN COWART: Those in favor of accepting the paper as adjusted in one place, please say aye. (Chorus of ayes.)

CHAIRMAN COWART: Any opposed? (No response.)

CHAIRMAN COWART: All right. The paper is approved.

MR. BROWN: Thank you.

CHAIRMAN COWART: Thank you, Merwin, and thanks to the folks that put this together, Carlos and the team. I agree, it's a very nice piece of work.

MR. CENTOLELLA: I want to just briefly summarize, if we can get that slide up, the other things that have been going on in the Smart Grid Subcommittee, and certainly invite the participation of any others who would like to join in the activities of the Smart Grid Subcommittee as we go forward.

In addition to the distributed energy storage paper that we just adopted, we have taken

up two topics to focus on for this year. The first, you saw some evidence of yesterday, which is this question of how to look at the evaluation and integration of distributed energy resources.

So, over the last few months, we have started by trying to establish a baseline understanding of activities going on within DOE already, so we have taken a look at some of the activities going on in the Office of Electricity, we had a briefing on the Grid Modernization Lab Consortium, and the programs that are coming out from that, including some of the foundational programs, some of the work on valuation, some of the work on architecture and control theory, all of which is relevant to this question of you value and integrate DER.

We had a very brief discussion, and I look forward to hearing more about what's going on in EPSA where they do have a project ongoing on the valuation of DER as part of the QER 1.2, and we also had a briefing on the new ARPA-E NODES Project, which is looking at and has a series of

research projects looking at the creation of synthetic inertial response, synthetic spinning reserves, and synthetic ramping, using various kinds of DER. There is a research program going on there as well.

We have done that. We heard the presentations yesterday of some of the folks who are doing some of the leading thinking about how to value DER and put it into the distribution system, and we are really at a kind of next step of figuring out what the committee can now contribute to a dialogue of understanding direction, potential gaps in DOE's current effort, and begin to formulate some thoughts about recommendations going forward of things that the committee might suggest that DOE look at to prioritize or supplement the significant ongoing work that is there already. That is our next step in that process.

The other thing that we have started looking at are implications of this concept of the Internet of Things, and what does that mean for

power systems.

A few months ago we had an initial scoping discussion identifying some potential areas of interest within the subcommittee, and getting a better understanding of what's happening in the field, looking at implications in terms of interoperability standards, cyber security, and what are the potential benefits to the power system of being able to integrate a greater level of connectivity of electricity using devices with the way the power system is operating, and we are targeting a potential panel at the fall EAC meeting on that topic.

Now, I would add that at the leadership meeting yesterday it was decided that we would try to have a panel on transactive energy at the June meeting which I guess our subcommittee will at least be contributing to how that is put together, so we are going to have a call next Thursday at 2:00 to replace what would have otherwise have been our normal call yesterday, and in which we will talk about that panel and then pick up on

these other topics at our next meeting in April.

That's the activities. We would really welcome participation, both on next Thursday's call, if people are particularly interested in transactive energy, and broader participation in the subcommittee as we go forward on these two topics of valuation and integration of DER and the implication of the Internet of Things.

I'm going to stop there and see if there are any questions. If there aren't, we can certainly pick up this discussion later in future meetings and at the breaks.

CHAIRMAN COWART: Thanks, Paul. One thing that I want to emphasize is that we have only a short time period to plan for the June meeting, and therefore, I will encourage the subcommittee to get right on it.

MR. CENTOLELLA: Well, we're going to have the call next Thursday, and people who have really been thinking about transactive energy, I would encourage you to join us, and we will see what we can do about putting together a panel,

even though this wasn't initially on our agenda, but we will do our best to help the committee put something together.

CHAIRMAN COWART: Thank you. Chris?

MR. SHELTON: There is so much overlap between the panel yesterday, distributed energy storage discussion, what the Smart Grid Subcommittee is doing. We are talking about transactive energy and we are talking about the Internet of Things. Yesterday we were talking about distribution level granularity, and then later today we are talking about we have issues of market jurisdiction or regulatory jurisdiction that overlap all of that.

I enjoy these topics, but it seems like we are all over the place, and I feel this strong desire that we somehow pull it altogether or we hear from someone who is pulling it altogether. I don't know as we think about the panels if we need some panel that sort of tries to pull everything together, like what are the different views out there about how all this fits together in 15

years, right?

So, frameworks, something like that, and maybe DOE is doing that, so maybe it makes sense to have DOE come and share a vision, a cohesive vision. I don't know. It's hitting me as every topic we have had on this agenda seems to have this, and it's not just a program vision from DOE. I'm talking about actual work product that is out there.

CHAIRMAN COWART: Thank you. Audrey?

MS. ZIBELMAN: Hi. Good morning, everybody. Sorry I missed yesterday, we were in sessions. I agree with Chris. We had actually a good conversation last night at dinner about maybe moving the dialogue along, with the idea that what we are moving towards obviously, what we are thinking about, you have transactive energy at the distribution level with the role of the platform provider is a manager of load, and that market needs to be essentially coupled with the wholesale market so that you are really creating a seamless integration from the high side to the low side of

the meter.

I was suggesting that one of the things we might want to start introducing into our vernaculars is this concept that they use in Europe about market coupling, and that really what we effectively are going to be talking about in the U.S. Is the fact that you are going to want to couple the distribution markets, which are going to be dynamic around local reliability as well as in our case load optimization with the wholesale market, using LMP, and then DLMP as sort of the basis to make sure that you're not over procuring or under procuring, and you are essentially optimizing in the end.

I think a panel that talks about market coupling -- I had a recent conversation with some folks in Europe who are really talking about the same thing. It would be an interesting idea of talking about DER and pricing DER, but really talking about what is this future market, and that also, I think, will help clarify some of the jurisdictional issues that folks are starting to

grapple with, that I heard Cheryl mentioned yesterday.

I don't think it's a gray area. I just think it's an undefined area, and that we in this group could start maybe defining the role of the retail distribution provider versus the wholesale transmission provider, and how these things can work.

I would welcome a conversation like that, because obviously it's top of mind for us.

MS. HOFFMAN: I guess I would just add to that, in order to get what you are going after, Chris, I think we have to pick a region or pick an area that we can pull these pieces together, so the lab consortium and grid modernization activities, recognizing all the regions are different.

They are starting from a different point, so integration, whether you are talking transactive loads or how people are looking at it is going to vary, so that's why it also is so scattered because if we want to have a cohesive

conversation around this, I think we have to pick a region and start building it up and doing a panel session saying how does this capability, this tool, fit into this current structure, and look at different structures.

So, that is something to think about as well.

MS. ZIBELMAN: Are you volunteering for it?

MS. HOFFMAN: Yes.

MR. CENTOLELLA: Just to respond a little bit, Chris, I mean you heard some of this yesterday in some of the presentations about thinking about a different architecture for the grid that involves some level of semi-autonomous distributed control, some level of local markets, and some amount of continuing dispatch on a security constrained basis of existing resources.

I think one of the real questions for DOE is how does all of that fit together, both in terms of federating those different activities, and also what is the right balance.

I think these are questions that we don't yet know the answers to. I think that was part of our rationale for looking at distributed energy resources, understanding that we are also talking about control theory, we're talking about architecture, we're talking about markets, and how do all those things fit together.

Welcome your participation on these questions as we begin to look at them further.

MR. SHELTON: Again, my comments were focused on content of future panels, right, and trying to pull this together. I would say one thing we keep hearing from the market, and if we're representing the market to DOE, then what the market wants is cohesion of some kind, you know, Pat's comments about you have to narrow it down probably, you know, that makes sense. You have to confine some dimension, every dimension can't be open.

MR. CENTOLELLA: Okay.

CHAIRMAN COWART: Anne?

MS. PRAMAGIORRE: Thanks, Richard.

Chris, I completely support your comment. I think that was the discussion we were having at dinner last night, what does the big picture look like.

The question I posed to the panel yesterday was what does a roadmap look like, what are the critical elements of a roadmap. I think one of the things in previous discussions we have talked about is the fact there is so much fragmentation in this industry, states are doing different things, regions are doing different things, RTOs are doing different things.

I think we are never going to get past the political issues of trying to create cohesion, but we have to do it from an influential standpoint, and that is why I think models that work are important, and I think to the extent if we can put together a roadmap, and it may be there is a technical roadmap and there is a policy and regulatory and economic roadmap as well, it seems to me -- those of us out in the industry who are trying to sort of actually operationalize all this, you know, we are looking for that, where is

the model, what's the roadmap look like.

I think something in that framework might be helpful, too, but I agree with your comment.

MR. CENTOLELLA: Paula?

MS. CARMODY: Thanks. Sort of a caveat that I would have with these discussions, and I agree with the thrust of the discussions, but as you are looking to the models, the roadmaps, the region, to acknowledge that the reality is that there isn't a singular kind of region. So, if you're building it up, even the notion of coupling, you know, kind of the distribution markets or wholesale market, might be easier to do in the State of New York with the ISO in New York because there may be more cohesion not only technical but the policy level. It does not exist in many parts of the country.

I think you want to be careful in choosing -- you may need eventually to look at multiple models, how does it work in kind of a cohesive kind of area, and what do you need to do

from a technical point of view in areas where you're not going to have that policy base, because I can tell you, at the state level, whether it's blurred, gray, there are certain disconnects that may not be technical, may not be operational, but they are going to be interference, and you're trying to figure out how do you work in that kind of messier area.

It's not a cautionary note to say don't go down that path, but I think you want to kind of take that into account that those blurred lines are going to kind of be there, so how are you functionally going to get it.

I think frankly the bulk of the country, even as you are moving, certainly with the markets we were talking about yesterday, there has been a tremendous kind of change over the last couple of years of wholesale markets. You still don't want to just overly that notion because technically things look like they're feasible. I think at the ground level there are going to be some interruptive kind of factors, I think the most

helpful thing is to try to figure out how do you do this but in a messier environment. That's my only comment.

CHAIRMAN COWART: Audrey?

MS. ZIBELMAN: I'm not doing a rebuttal. I agree that because we don't have uniform policies and while we have been aching for an uniform approach and non-segmented industry, it's not going to happen, so we shouldn't even waste our time thinking about it.

What I was thinking about is we are certainly focusing on optimization, and I think we could start with that as sort of the objective, and certainly I am happy to talk about our roadmap and how we are thinking about it, and then maybe have other folks talk about so, how do you do this, where you have not a single state ISO, where you might have an ISO serving multiple states, some of which have restructured, some haven't, how does that work.

How does it work in an area where there is no restructuring, and you have vertically

integrated utilities, because the physics will remain the same. It's just the operating characteristics and the actors may change. I think that would be a useful conversation.

Most states, I would think, are looking increasingly -- at least when I go to NARUC -- at the reality of increasing levels of distributed energy resources and the implications that means to the system. So, thinking about the policies that follow from that may be a good approach, but certainly I would set New York up as one approach, not the approach.

CHAIRMAN COWART: All right. I see we have a conversation going here. Tim and then Carl, and then I think we may need to move on to the next topic.

MR. MOUNT: Tim Mount, Cornell. I'm a little bit nervous of a roadmap. I think there are a number of new players that may well enter the market, and we don't want to exclude them. I'm very nervous about the status quo, keeping things going the way they are, and just making

very small incremental improvements as opposed to looking at things particularly on the demand side.

I think there are opportunities to have a genuine two-sided market which would be very different from the type of market that we have at the moment.

MR. ZICHELLA: In keeping with this idea of trying to find some sort of commonality, it seems like what we might be able to do is to identify best practices in the various places, wherein as Audrey just described, situations that are different from each other, whether you have multi-states, single state, or areas that don't have organized markets.

The physics will be the same, but there will be best practices, I think, that we can learn from. New York may not be the example, but I think speaking from California, a western perspective, I think there is a lot that can be learned as entities like New York take these situations from the theoretical into the practical. They are actually doing a lot of this.

We can learn a great deal from how they are approaching some of these problems. They are not that dissimilar regardless of the construct you are operating in, and to learn best practices, I think, would be very helpful, and we're looking at distributed system operator constructs in California as well. I just wanted to point that out.

If we could put our finger on the common themes, the things that could work in almost any setting, that would be a pretty useful outcome.

MS. HOFFMAN: I was going to say I thought we did something similar to this when we were looking at energy storage. We said how do you value energy storage with a vertically integrated kind of region. How we looked at energy storage in a competitive market region.

I think we can characterize the different types of regions and then start thinking about what would be the best practices, roadmap, core competencies, you know, building blocks in each of those areas, and then take the lessons

learned from New York as just a case study, and look at a couple of case studies, it might be a way to start pulling this conversation together a little bit more.

CHAIRMAN COWART: All right. Thank you, Paul.

MR. CENTOLELLA: Thanks for all the input and discussion. This is great.

CHAIRMAN COWART: We are ready now for the report from the Storage Subcommittee. I think, Merwin, you are up again.

MR. BROWN: Today we have reports from two working groups, one of them on the white paper, on the high penetration energy storage question, what happens if we get high penetrations of energy storage, what happens to the electric grid, what does that mean, good, bad, indifferent, and particularly what kind of gaps need to be closed, particularly technological, because that's what we would like to make recommendations to DOE about.

The second work product being worked on

is the biennial energy storage assessment. That one is required by law/legislation, every two years. The leads on this, I'm going to introduce in just a moment, but before we do that, last night at dinner, the continental plate shifted somewhat on this.

Also, there is another legislative requirement that this subcommittee and therefore the full committee put out also a five year strategic plan that is given to DOE on what they should be doing or what we think they should be doing in energy storage.

That is due in 2017. By the way, the following year, there would be another two year, so that would be three years in a row there would be a deliverable required by the legislation.

Maybe we need to do some efficiency moves here. They all have their minuses and their pluses. One that we are looking at right now would be to go ahead and take the activities that we are working on right now, that would be the biennial assessment that is ongoing, and you will

hear more about it in a minute, and also the high penetration energy storage effort, both of those could reveal some guidance to us, and therefore to DOE, on what could be a five year plan.

We would attempt to do those simultaneously now, the five year plan and the two year evaluation. The issues that crop up, one, the target date for the two year plan for now is to get it before this committee in September. That is not that far off. In order to get approval within this year.

There is also an alternative -- the issue is can we do a five year strategic plan in the same period of time and have both of them on the table in the September meeting.

If we can't, there are alternatives. One of them is, and we have done this in the past, we could have a later convening of this group through a WebEx for specifically the purpose of looking at and potentially approving those two documents, say December, January, February, something like that, and still, I think, be timely

enough to meet the spirit of the law.

That's one thing that we could do. The other one is we put everything off until next year, which means we miss the deadline for the biennial. There are a couple of issues with that, but probably the biggest one is as we have already mentioned a number of times, this is a fast moving industry, and we're doing interviews for the biennial study/report, and we are afraid the freshness will go stale if we wait very long before we get the report out.

So, at the moment, what I'm proposing to this group, at least what we want to attempt to do from the Energy Storage Subcommittee, is we're going to proceed with the two work products that we have, and while we're doing them, we're going to also be doing them in the context that we want to get the five year strategy out yet this year. If we find we can't do it, then we go to Plan B, whatever that is. At least we will have made progress.

Now, there is another caveat. One of

the things we would like to do is to have a panel -- we have talked about having a panel of people in the industry trying to make energy storage work, and have run into frustrations, both at the utility scale and the distributed energy scale. We thought that would be a good place to start to begin to get ideas of where the gaps are, where the holes are, for us to be able to offer some projections into the five year time frame.

If we move up the schedule for the five year plan, it means we need to move up the schedule for the panel, and June is probably the best date for that. Two problems with that. One, there have already been identified a number of things for the June meeting, which means something would have to be displaced, and secondly, we would have to scramble to get together the panel, find out who would be on it.

The former issue might be the greater problem of the two, I don't know. I just put that in your minds as we hear the updates on these two work products. At the end, if there is any

advice/guidance going forward, we would appreciate that. I've hopefully described our situation here and what I'm trying to do with this.

With that, on our agenda, the first item is Chris Shelton, to bring us up to date on the High Penetration of Energy Storage Working Group.

MR. SHELTON: Sorry, I just got this update. I wasn't at dinner. (Laughter) This is a real time conference, sorry about that.

MR. BROWN: Surprise. (Laughter)

MR. SHELTON: A quick update here. I know we are trying to compress the time a little bit. The High Penetration Energy Storage work product, wanted to give a quick update. You all were here for the panel. We had a panel at the last session, and then after that panel, we had another working session, and then this year, we also had a working session online, virtual, video working session, and we reviewed all the prior work that we had done and that we had received from various parties, including the comments from the panel.

We had the minutes from the panel discussion. We reviewed and boiled down the different perspectives that were coming out of the panel that we had at the last in person EAC meeting.

We discussed finalizing the drivers for candidate scenario's, I'm going to talk a little bit about that, and we reviewed a first draft of the outline. We have another working session today. It is across the street. We're going to explore and reset the given's that we started with.

We are going to choose base scenarios that we are going to use to illuminate the high penetration of storage cases, review the draft outline and actually launch work assignments here, and we are targeting to have the final draft in the second half of this year. The initial target, we will have to incorporate it into everything we just heard from Merwin, and likely would be approved in the spring of 2017 at this current pace and given the other constraints.

Quickly, to set clear our focus. The idea here sprung out of the good work that was done on renewables, as renewables were growing and in their infancy, government groups as well as the market, did a lot of studies on what would happen if you had a lot of renewables on the system, and if they were exploratory in nature, and they would focus on different aspects of what the impact would be of a lot of renewables.

That good work allows us to have the insane pace of adoption that we are seeing right now in renewables. It was quite an effective way to think about the future. We posited at the beginning of last year that perhaps that type of thinking should be applied to energy storage, so we could see the implications of a high penetration of storage as sort of a new category of activity happening, that was in the past only really seen as pumped hydro on one edge of the grid, and now has the potential to grow from its relatively stable position in the pumped hydro realm into this flourishing new category

throughout the system.

That's the idea. I won't read this. The idea of encouraging DOE to take this exploratory approach, so what we have proposed is to do some scenario's so that we are not prescribing one way to look at it, or one set of implications. We're going to do some scenario thinking.

Just to tease out here for the committee, some ways that we are looking at making the scenario's, we are just using simple 2 by 2s, two independent variables, that we think may define different futures. Things up here in quote, this is all draft work product. I'm just trying to give you a quick way to think about what we are talking about.

We could have the dimension of whether this is a strongly policy driven future or a market driven future. On the other dimension, high penetration of variable renewables or moderate level. These might point out different architype futures, and then we can explore what

the role storage will be playing in those futures.

Here is another set that we have talked about. We set the policy dimension, we have locked that one in, but we are looking also at loose integration versus high control visibility and integrated planning, right. You can have a very high touch environment or a loosely integrated model.

What we found is these really resonate. I mean we challenged ourselves to do the 2 by 2 first, and then we saw examples already in the marketplace that represent this. I mean you can see a highly policy driven approach to energy storage that is loosely integrated, SGIP in California. A lot of storage got deployed, but there is not a ton of control and visibility of that storage, it's just out there.

Or if you look at something that's market driven and highly controlled and visible, it's not storage but it's a model that represents what could happen with storage. You see in the upper right-hand quadrant, it is like PJM's demand

response, where they have visibility, they have control, they have verification, it is playing throughout the value chain, not just on the demand side but throughout the whole value chain, and you can also see the implications of that are what we just saw in the courts around the DR case.

We want to envision that in relation to storage. What we will do is pick probably three scenarios, either from this 2 by 2 or the other one. We are going to nail that down today. Then talk about pathways, which will feed into a five year thinking perhaps for a five year paper that Merwin mentioned.

In terms of a draft outline, we really want to frame the comparison or the gaps here between the modeling of storage and the modeling that had been done in the past on renewables, and see what the gaps are, and maybe use that as a very instructive comparison as to why we really should do this kind of work, and we will define key questions that we might suggest DOE consider, then we will look at the drivers and scenarios

that we just talked about, and then we will direct DOE to certain potential modeling and top five areas of focus, so it is meant to be very quick hit. We don't expect it to be a long work product. That's it.

Any questions or comments or direction on that?

CHAIRMAN COWART: Any questions? By the way, I think the 2 by 2 organizational approach looks really promising.

MR. SHELTON: Good, thank you. At first, I think we talked about what exactly -- Merwin suggested it, at first we were really, but it is really resonating. That's great.

CHAIRMAN COWART: Okay. If there is nothing further, the meeting is this afternoon, right?

MR. SHELTON: Yes. Thanks.

MR. BROWN: I want to thank Chris and his company also for hosting us. This is actually very valuable. This kind of work, scenario planning, is very difficult to do over the phone.

Its valuable. Thank you.

Next up is Ramteen on the Biennial Energy Storage Assessment.

MR. SIOSHANSI: All right. Just to give a quick update on the biennial storage program assessment, Merwin already mentioned, I guess, the timing issue that has come up with the two statutory requirements.

One is that every five years, we are supposed to develop a five year sort of strategic plan with goals for DOE's energy storage RD&D programs, and every two years, we are supposed to do in some sense, I guess, more of a backward looking assessment of how DOE is doing in meeting its goals.

So, in terms of what the recent work products have been, 2012, the two requirements lined up, and there was a single product that met both of the requirements, and then in 2014, we produced the biennial assessment, and per the time line, we are now in 2016, and another biennial assessment is due, and then as Merwin said, if we

do things by the book, in 2017, there is a five year strategic plan and goals that needs to be produced, and then in 2018, we get to do another biennial storage assessment.

Obviously, there has been conversation about combining some of these to reduce the amount of work and I'm not sure how useful an assessment in 2018 is going to be, if in 2017 we're giving DOE new goals and strategic plans. Maybe they will do what we tell them to do in one year, and then we can give them a pat on the back for that.

Just wanted to mention a few changes in terms of what we are doing with this year's assessment compared to what we did in 2014. One is we are trying to sort of simplify and streamline the assessment this year compared to what we produced two years ago.

The 2014 assessment, I felt and Merwin, I hope you agree, and other people that I have spoken to agree, we went into a lot of detail recapping what DOE's storage goals and strategy are, and we probably don't need to spend 10 or 15

pages telling DOE what it is doing, it hopefully knows what it is doing.

In terms of the assessment, I think we made the mistake of burying recommendations throughout the text as opposed to just being succinct and having a one or two page executive summary with the recommendations up front, and then if necessary, have follow up text that provides more detail or context for the recommendations that are provided. I think there is something to be said for brevity.

The other thing that we are doing is we're trying to -- we are doing outside interviews. The interviews are with what are termed here "users and implementers of DOE's storage program." The thinking behind this is that there may be other people with useful information that would be good to go into this assessment.

In terms of the types of interviewees, I have just listed up here some of the categories of interviewee's that we have identified, and then

we have gone and actually filled in organizations and the names of people within organizations associated with these categories.

This is sort of supposed to represent the range of people in organizations that would either be carrying out DOE's storage mission or would be a direct beneficiary or user of the research development and deployment programs.

In terms of our plans or the steps we are going through, the first two, we have done. I have constricted people to work as sort of the core working group, and as I said, we have put together actually a list of organizations and names and alternate organizations and names associated with those different types of interviewee's.

We are currently in the process of scheduling and conducting interviews. I think we have done on the order of about six of these now. We have another one on Monday. I can't remember if we have others next week.

Anyway, they are continuing the pace.

My feeling is that by and large the overwhelming majority of these, there has been very good feedback, and we have gotten comments on things that I would not have thought of without talking to the people that we have.

Once we have done that, we will probably talk to DOE personnel to sort of get some feedback on some of the findings that we came up with in the interviews, and then we will proceed to discussion amongst the working group members, input from the subcommittee on what our assessment and recommendations will be, draft and revise the report, and then submit the report with September as being for me the gold deadline.

As Merwin said, the main reason for that is I firmly believe that a lot of the feedback that we are getting in the interviews will not necessarily be as pertinent if we wait until 2017 to put this out.

I want to get this out as soon as we can, and of course, getting it in September means we also meet the statutory requirement, which is

probably not a bad thing.

As Merwin said, right now the thinking is we are going to do this, having in mind that if we get the types of feedback that we want to be able to combine the five year strategic goals in this report. We will kind of play that by ear and see if we feel that we have the feedback that we need to be able to do that. That way, we reduce the number of work products that we have to produce.

With that, I'm happy to take any questions, comments, or ideally, agreement.

CHAIRMAN COWART: Any questions or comments? Paul?

MR. ROBERTI: Just briefly. It strikes me that doing an assessment of the program today is a different exercise from doing a projection of what goals should be five years out and suggests there may be different sorts of people who you should be talking to, different types of input you should be getting. I'm just curious of how you are balancing the two.

MR. SIOSHANSI: The answer is we are not balancing that because this just came up last night. (Laughter) I will say we have sort of a standard list of questions that we go through in these interviews, and I think a number of them get towards what the interviewee thinks DOE is doing well or if the interviewee feels things should be prioritized in a different way than they are, or if there are developments that he or she sees in the industry that DOE should be getting ahead of.

I think we're getting a little bit of that. We probably need as a working group to get together and have a quick conversation as to whether we want to (a) change the interview questions, and then (b) supplement the list of interviewees, if we don't feel we are getting the right type, or if we are not getting the right type of people.

MR. ROBERTI: It just occurs to me that this is a very dynamic field and the chemistries are changing, the players are changing. As you think forward, you may need to expand a little bit

what you might otherwise have done.

MR. SIOSHANSI: Yes. Billy?

MR. BALL: Just a practical question, when you started, you talked about the two and the five year, and you're going to have these things one after the other each year, but as I listened to the further conversation, I mean is there really anything you can do about that?

Especially with Paul's question, it almost sounds like we are kind of locked into having to fulfill the two year item this year, and there is probably not time or it doesn't sound like it can be easily combined with the five year item, which even if you did, doesn't seem to resolve having to do the two year item again the following year. Is there really a way to make the schedule easier or is it just the frustration that it is?

MR. SIOSHANSI: Well, as far as making it easier, I think mathematically because five is not divisible by two, we will have this issue every 10 years. We can always ask the Congress to

change the five to a number divisible by two.

(Laughter)

CHAIRMAN COWART: When I was at the podium -- sorry for going out of tent order but I think it's relevant to the question and being on the committee -- Merwin mentioned it is due in 2017, the five year, right. That does mean, unless I'm missing something, it could be resolved in the spring, right, so then we could take the high penetration activity, take that paper and feed it back into the five year, and do those in parallel. This is all happening in real time here.

MR. BROWN: Can we take this particular discussion and I'll handle it at the wrap up here? If that is okay with everyone, and go back to specific questions for Ramteen on the two year, if that's okay.

CHAIRMAN COWART: Carl?

MR. ZICHELLA: Just a comment. Having done some of the interviews, I just wanted to say I think some of the responses are very

prospective, so they do lend themselves into looking ahead, especially questions that relate to what might you be doing differently or might you add to the list kind of questions.

The conversations that flowed from those were very illuminating, I thought. I think it is unfortunate that they stack up the way they do, but I think we have been somewhat lucky in that the questions Ramteen put together did kind of head us in a more forward looking discussion. It wasn't all retrospective in how we looked at this.

I do think there is some pretty good diversity among the people we interviewed. I take your point, Paul, we may want to add some others. I do want to say having been part of those interviews, I thought they actually do help us, I think, to the next level, too.

MR. SIOSHANSI: Yes. Some of the questions are backward looking in the sense of like do you think DOE sort of hit the goals correctly in terms of what it has done, in terms of implementing its storage RDD&D programs, but

some are forward looking in the sense of, for instance, asking storage developers what do you see as developments in the energy storage sphere that DOE should be supporting or paying attention to, or is not adequately addressing, or you know, otherwise do you think DOE is doing a good job of getting ahead of things that you see developing in the industry.

That's an example of a lot of these interviews, getting both backward looking and forward looking information from the people that we have spoken to.

CHAIRMAN COWART: All right. Thank you. We need to move this along, Merwin.

MR. BROWN: Thank you, Ramteen and Chris. I think you are doing great jobs. You have taken on some herculean tasks here, I think, particularly as of late last night.

To make some clarification again, particularly stimulated by Billy's question, one, this year we are supposed to produce a biennial or two year post-review of what DOE has done, and

then next year we are supposed to create and submit as a committee a five year looking forward plan, and then the next year, we have another two year biennial. That just intuitively doesn't seem to make the best use of our time.

We had a number of options, but the one that seemed to make the best use of our time and the most use to DOE, I think, was to try to move up the five year plan to this year, and combine it with the effort on the two year review document.

We did that for 2012, I believe it was. It presents some issues, the biggest one is can we do it, sort of adding this new task in the middle of what we have been doing. I think as you have heard, we are fairly optimistic we can do it for various reasons, and it may be we just need to add, for example, to the list of people being interviewed. I leave that up to the capable hands of the working group to do that.

Also, remember the interviews are not the sole source of either the evaluation for the two year period or for the strategic plan. It is

input. It is up to us to come up with going forward.

We are going to try to do this all by September. Plan B, we may have to put the review from this committee off until later by a few months and do it in an outside WebEx type meeting. I would prefer not to do that, but that is Plan B.

Plan C, if we run into problems, we would need to move it into next year, both of them perhaps, or maybe we could go back to the not so good method of doing them separately. I don't want to talk much about Plan C.

The other issue that we need to take up in discussion with the leadership team soon, is to have a panel in June that we hopefully can put together that I feel would be pretty important and critical, particularly for the five year effort, of having people come and tell us what their experiences have been at both the utility scale and distributed scale storage. I think it is one good way of seeing where there are potential gaps that DOE might be able to help fill.

I guess what I'm going to say is that's the plan, if anyone around the table here has any questions or other advice, I'm open to it. That's the plan going forward. Anyone have a question or to say about that?

One last thing I'd like to say, I like Ramteen's style, it's very succinct, to the point, but I would like to make one clarification amendment to one statement. He said we will tell DOE what to do. I think it is better said that we will tell DOE what we think they should do. That's more in the tone of a recommendation.

With that, I think I'm done.

CHAIRMAN COWART: Mr. Secretary, you're excused. (Laughter) Now the Power Delivery Subcommittee report. Gordon?

MR. VAN WELIE: Good morning, everyone. I'm going to do a very poor imitation of David Till. In fact, I don't think I could do an imitation of David Till.

I have two items to report on. The first was the value of our paper, which has been a

work in progress now for just under a year, I think. David uses "As nearing completion" at this point. I have seen an earlier version of the paper. I think it's in really good shape. I think he wants to put the finishing touches on it through a Webinar fairly soon. I think his goal is to try to get this done by the June meeting.

Any questions on that? (No response.) The other item that I wanted to just alert you to is that there has been a discussion about some future work products, one of the topics that has come up is a look at high penetration of electric vehicles.

There has been some discussion that this was looked at by the committee about five years ago, but I think the consensus view was the world has moved on substantially in the last five years, and it might be a good thing to look at this issue again.

I think the last time the committee looked at it, and I know the ISO has looked at this issue about five or six years ago as well, it

was very much viewed as being sort of a distribution system issue. The thing Ake had raised was that he thought there might be an opportunity to think about from a policy point of view the connection between sort of moving towards a higher penetration of electric vehicles and the policy implications in terms of supplying renewable energy to those vehicles, so there is a grid implication there as well.

It also struck me listening to yesterday's discussion around distributed energy resources that there is obviously a very strong connection there and the world has moved forward dramatically in the last five years with regard to DER.

I think the committee hasn't taken a final decision or the subcommittee hasn't taken a final decision yet as to who will own this and take the leadership on it, but it is certainly the most promising idea on the table at the moment.

Perhaps I should just pause and see if there are any reactions to that.

CHAIRMAN COWART: Any comments? Chris?

MR. SHELTON: I think there would be a lot of overlap of that with high penetration of energy storage, so I don't know what we do about that. There will be a lot of thinking on the general, sort of generic thought process that would feed into that. It may help, I guess, it may not. It may be a launching pad for that and it may allow this committee to focus on the specifics on power delivery.

MR. VAN WELIE: I think there will definitely be an overlap. There are sort of two dimensions to this. One dimension is how do you create the right incentives for the vehicle owner to charge and discharge at the right time, to the retail pricing issue, and I think that plays right into the same question that is going to be asked, I think, with regard to distributed storage and distributed resources in general.

The other one which is less directly connected is this issue of presumably the point of electric vehicles is to de-carbonize, so you want

to bring them renewable energy, so there is a grid implication to that, under the assumption that renewable energy is required in order to supply that energy. I think that's the other dimension to it.

CHAIRMAN COWART: Thanks very much.

MS. ZIBELMAN: Just a question for Gordon. As part of your discussions, are you also going to be looking at sort of the broader issue of hosting capability on the grid? To me, that could be where it could be complimentary, and the issue is in terms of sort of the levels of penetration, what things can we be doing, how do electrical vehicles play into this, how does VAR optimization play into it.

When you think about roadmaps and what we are beginning to think about, at some point we are saying maybe it's 20 percent, now folks are saying it could be as high as 30 percent, and it seems like there is going to be some combination of elements to think about when we are looking at these resources and how they can create a

portfolio to develop much more hosting capability and flexibility in the system, and that, I would think, would help with the storage penetration because it sort of starts to say why are we looking at things and how do they work together.

MR. VAN WELIE: I think those are all good points. I think it would be useful to have a conversation with Chris on this, to see whether we can dovetail. To Chris' earlier point, there are a lot of conversations springing up around the table that I think folks have a specific interest, but these things are all interconnected in some way.

MS. ZIBELMAN: Right.

MR. VAN WELIE: I think what is a little difficult about this is that in order to examine a specific dimension of the problem, you have to keep it narrow, yet there is a tendency for all of us to sort of say how does this all piece together.

I do think to Chris' earlier point we need to find a way of coalescing this.

MS. ZIBELMAN: It would be interesting to me, I like simplifying things, and I can keep it in my head, if there is a way we can tie in DER penetration on the sort of supplier side equals things like hosting capability on the delivery side, so that the two policies are not just trying to do this, we can start telling the story how they do interrelate.

MR. VAN WELIE: The good news is Ake is normally on the lead on this one, I will be saying good-bye in June, so I'll check in occasionally to see how it is going. Anything else? Rich? Oh, sorry.

CHAIRMAN COWART: Anne has a comment.

MS. PRAMAGIORRE: I have a question on the hosting capacity, does that become part of the transactive discussion? That may be a place to pick it up as well, just a thought.

MR. VAN WELIE: I think the first thing we have to do is -- I don't know if Ake is going to have the time to follow through on this. I think this is a conversation we need to have with

him when he is back here in June.

MS. ZIBELMAN: Ake is not here today, is he?

MR. VAN WELIE: No.

MS. ZIBELMAN: Maybe we can have a follow up conversation and think about how that can interrelate. I think it is a bit of everything, it is transactive, it is software, it is hardware. We should think about it in a more holistic way.

MR. VAN WELIE: Just one thought that occurs to me on the fly here, you may want to divide this specific topic into two and say let the distribution element of this be handled in a different forum, and let the question of how do you supply the renewable energy be handled separately. Maybe that is one way of sort of splitting this.

CHAIRMAN COWART: Paul?

MR. CENTOLELLA: I hadn't thought about this before, but it does strike me there is a third element here as well, and that is the

transportation sector is changing or proposed to change in some fairly dramatic ways in terms of becoming smarter and having much more intelligence within the transportation system as a whole, and how does that then fit with thinking about power delivery.

I hadn't really thought about it, but it strikes me you can't really think about what's changing in terms of electric vehicles without looking forward to the broader changes within transportation.

MR. VAN WELIE: It strikes me that yesterday we were talking about the Internet of Things, I think the vehicle is going to be the smartest appliance out there. That is really where we are heading.

CHAIRMAN COWART: Isn't it great whenever we start having one of these conversations, we want to connect it up to three others. (Laughter) It is inherently part of the job of this committee. We never escape it. Thank you, Gordon.

CHAIRMAN COWART: We have time now to take a 15 minute break. We will start the panel at 9:50. (Recess)

CHAIRMAN COWART: As we begin this next session, I'll announce again that at the conclusion of our business today, there is a time for public comments. Are there any members of the public who have signed up to address the Committee? I see there are none. I just want to make sure. We are now ready for our next panel. And I think the introduction will be done by Gordon van Welie.

MR. VAN WELIE: Good morning, everyone. Thank you, once again, for joining us. And I thank a special thank you to our panel, and I'll tell you a bit more about them in a moment, but we have a very distinguished panel here with a diverse set of -- a deliberately diverse set of perspectives on the issue. So I'll come back to that in a moment. So, just reflecting on yesterday, was thrilled actually, this wasn't coordinated at all, but to have Commissioner LaFleur sort of recognize

some of the issues that we will be discussing on this panel today. And so I'm paraphrasing, and I'm just focusing on sort of the market policy to action aspects of her comments, but she said a few things that struck a chord with me. The first was, the point that markets are expanding, and she talked at some length on that.

She also said that the market designs are obviously different across the country, and they are all being stress-tested with this rapid transformation that's happening on the grid. And she recognized that harmonizing wholesale markets and public policy objectives are one of the big challenges facing wholesale markets. And I think, finally, she also keyed out the question of, how do we pay for the resources that are needed to back up weather- dependent renewable resources. And I think that's one of the key issues at the heart of this concern.

So, the central objective of the panel today is to provide information to the EAC on the challenges related to achieving carbon emission

reductions in the electricity sector in a way that is compatible with wholesale electricity markets. So you may have seen in your materials, I wrote a memo to the panelists just to give them some context for this discussion, and I'll briefly cover some of the main points from that memo just to, sort of, give us a grounding for this conversation this morning.

I think if you sort of look at this from the 30,000-foot level, policymakers have articulate two major public policy goals. The first is achieving grid reliability through competitive wholesale markets, and the second is achieving reductions in carbon emissions, and by implication, increases in renewable energy. So this first policy goal led to restructuring of the electricity industry in approximately two-thirds of the country.

Wholesale markets in these regions have two primary objectives, to use the principles of competition transparency and resource neutrality to select the most efficient set of power

resources to achieve reliable service. And the second objective was to shift the long- term investment risk in the electricity production technology away from consumers and towards private investors in the marketplace. And I think implied within the understanding that this will allow for efficient technology renewal, but all of this is against the backdrop of ensuring grid reliability is to be maintained.

The second policy goal which is the reduction in carbon emissions has led to state level carbon reduction targets, and various mechanisms at the state level, and at the Federal level to the Clean Power Plan. And of course here the primary objective is to lower carbon emissions without affecting reliability.

So balancing these policy goals can raise a range of questions depending on which wholesale market and regulatory structure is in place. And as Commissioner LaFleur indicated yesterday, the design of these markets varies amongst the regions that have embraced wholesale

restructuring. So the memorandum sort of lays out what the different forms are across the country in a very summary form. I'm not going to cover all of that, but I'd recommend you take a look at it, if you haven't already.

So here is the problem. The renewable resources with low to no fuel costs and out of market financial incentives, can offer to produce energy at lower prices than conventional resources. So as the penetration of these renewable resources increases, one should expect that the revenues in the energy market are going to increase. And if you sort of project this scenario forward to its logical conclusion, if we are going to see an 80 percent reduction on carbon emissions, well, we are going to be producing electricity from resources that have very low energy prices.

And so the energy market revenues are going to disappear over time, and the question that then gets raised is, how does one sort of sustain the system as a whole? So, in one

implication, it's to remain economically viable, conventional resources will increasingly rely on the capacity market, or other forms of out-of-market support, and in the long run any merchant resource, whether it be a conventional resource, or even a renewable resource, is going to end up needing some form of out-of-market support, or support through the capacity market if the energy market can't produce the revenue stream that's necessary in order to recoup the capital investment.

So the way I look at it I think policymakers and market designers have a real challenge here. How do we ensure that carbon reduction goals and grid reliability achieved and how we do this, I think it's going to determine whether wholesale markets continue to be successful or whether, ultimately, we are going to be forced to return back to some kind of cost-of-service model for all resources on the system.

So with that, sort of a challenging

introduction to the panelists, because I know we are going to have answer to this problem by the end of panel, and we won't even need to write a recommendation to the DOE.

Let me introduce the panel. We have four panelists, and they'll speak from left to right. The first is Bob Ethier, he works at ISO New England, he is the current VP of Market Operations, and prior to that was the VP of Market Development. He holds a B.A. in Economics from Yale University, and an M.S. and PhD in Applied Economics from Cornell.

Joe Dominguez, who is just to his right, he is Executive Vice President at Exelon, and he leads the development and implementation of Federal State and Regional Government Regulatory and Public Policy strategies for Exelon which, as you know, is one of the largest utilities in the country. He holds an Undergraduate Degree with honors in Mechanical Engineering from the New Jersey Institute of Technology, and he is a graduate of Rutgers University School of Law with

high honors. So, an engineer and a lawyer in one package; so happy to have you, Joe.

Rob Gramlich, just to his right, he is a Senior Vice President with AWEA, the American Wind Energy Association. He joined AWEA in 2005 and overseas the organizational research, state policy, regulatory and public affairs programs. Rob and I met back in 2001 when he was working with Pat Wood, so he is somewhat a father of some of these wholesale markets, so he got the ball rolling on a lot of this. You can expand on that later on, Rob. He holds a Master's Degree in Public Policy from UC Berkeley, and a B.A. with honors and distinction in Economics from Colby College.

And last we have Beverly Heydinger, who is the Chair of the Public Utilities Commission for Minnesota. She was appointed by Governor Mark Dayton in July 2012. She's a Member of NERUC and its Committee on electricity, and the Mid America Regulatory Conference. The Chair of the Executive Council of the Administrative Law section, of the

Minnesota State Bar Association, and a Member of Minnesota Women Lawyers; she holds a B.A. from Carlton College and a J.D. from the University of Michigan Law School.

So as you can see, a very distinguished panel, and with that introduction I'll turn it over to Bob, to sort of give the perspective from not only ISO New England, but from an economist's point of view.

MR. ETHIER: Thanks, Gordon. I actually have some slides. I'm not quite sure how to -- Someone is doing that for me, wow, this is slick.

Thanks for the introduction, and since you brought up where I went to undergrad, I have to say congratulations to the Yale Basketball Team, 54 years without a win is a long time, so we'll take what we can get. It's not often we have athletic achievements to brag about, that's for sure.

But thanks for the opportunity to be here this morning, and talk about an issue that's certainly very important to us in New England. We

are really going through the early stages, or maybe the mid stages, of addressing the issues that Gordon talked about. How do you keep the wholesale markets functioning well while addressing states that have very real and pressing policy initiatives that they want to implement.

So, if we can go to slide 3. Oh. Can I use this now? There we go. I just had to figure which of the many buttons it was. So, New England has had a lot of organic change in its infrastructure over the last decade or so. Or, really 15 years, if you look at these slides, the interesting pieces are the oil as a percentage of production in New England has fallen from 22 percent to about 2 percent. Coal has fallen from 18 percent to 4 percent, and natural gas has taken up the slack, they've increased from 15 to 49 percent. So, we've seen a huge shift in New England away from coal and oil to natural gas, largely market-driven. But there's been a lot of turnover in our fleet in that period of time, you have a lot of -- now you have lots of old, what

used to be base-load resources that are really operated on a few cold days and a few hot days every year; so, a lot of change there.

And what we projected going forward we are going to see even more retirements. So, we've seen 3,200 megawatts -- we saw 3,200 megawatts retire in the 15 years concluding in 2012. We've already seen 4,200 megawatts retire in the last three years, with more projected going forward. So, we are seeing this natural, big turnover in our markets, and what's important about that is, what is shows is, at least to me, is that it's very important that our markets be structured in a way to reliably incent new resources when we need them.

Today I think the evidence is good, that is, we have seen a lot of retirements, and we've actually seen new resources come in based on market-based pricing, come into the market to meet our reliability and energy needs over time. So, you know, these slides demonstrate the need, I think, for a well-functioning wholesale market,

and I think to date we've got that.

But we've got new challenges coming forward. Not only do we have additional retirements that we expect, and if you sort of look at the fine print on this, you'll see that we did a study in 2012, and we looked at likely retirements and we came up with an 8,300 megawatt number. That didn't include nuclear units. What are we seeing now? We've seen two nuclear units either retire or announce their retirement in the last couple of years. That wasn't on the drawing board for us, and at least in part, driven by market conditions, particularly, well, natural gas prices.

So, not only do we have the retirements that we sort of expected with these 40- 50- 60-year-old, relatively inefficient units, but it's also, we have these new market- driven retirements that we weren't necessarily anticipating. On top of that, what we have are aggressive state goals to both increase renewable energy and simultaneously reduce greenhouse gas

emissions. So you can see the states have a pretty substantial RPS goal, so that they want large percentages of their electricity generated by renewable resources by 2020, and they've already started working on that.

We've had a renewable portfolio standard in New England for a number of years now, and they also want to reduced their greenhouse gas emissions as you can see on the right-hand side. And so these goals are such that when the clean power plan was announced, the sort of view in New England, by and large, from what I could tell among the state folks was, it's about time. It wasn't; oh, my, goodness, how are we going to react. We are on track to do this, we may actually be exceeding these levels, you know, let's get it done. It's about time other people got on board with this.

So, you know, we, as a region have a lot of policy-driven change coming our way. And as operators of the wholesale market, we need to make sure that the markets work well to accommodate

that. For example, you can see the wind. We have about 800 megawatts of existing wind. This is name plate, so this is, you know, sort of what you see when you see the press releases.

We have about 4,200 megawatts proposed, huge increase when our peak loads these days are 27,000 megawatts, and we are looking at 5,000 megawatts of wind to meet that peak load, for example. Solar is also growing rapidly despite the substantial cloud cover that we have in New England. So we are getting a lot of solar, and energy efficiency, the states are pouring a lot of money. The number I hear often is a billion dollars a year is going into energy efficiency, largely through the utilities.

And it's making a difference. Our load forecasts have gone from steady upward climbs to basically flat, when you include all these things. So there are a lot of -- There's a lot of motion here in New England, and we need to make sure that the markets work well, because that's the system that we, in New England have adopted.

So, what's the problem with that? Well, there are inherent problems that just, there are some realities. When you add lots of wind, when you add lots of solar, and you add lots of energy efficiency, it tends to reduce electricity prices, and it also reduces margins for the existing resources in the electricity market. Yet, I just said, we need lots of new resources to come in and make up for the retired resources.

How is that going to happen? That's why we have a capacity market. What happens when you lower the energy market revenues, and the energy market margins for resources, is it puts more pressure on the capacity market, raises prices in the capacity market to levels that are -- that you need to incent new resources to come into the market. It's critical for us. In our last capacity auction, going just last month, we needed some new resources, and we got over 1,200 megawatts of new generation based on market price signals. And that is, those are reflecting the lower energy market expectations that we see going

forward.

We have, you know, what Gordon sort of teed up was this sort of conflict, potentially, between state policies and running fair and efficient electricity markets. And I just want to go into a little more depth on that right now. So, wholesale electricity markets have actually a fairly limited objective, which is short and long-term reliability at basically the most efficient outcome and at competitive prices.

There are some critical market design elements, these include, clearly defining reliability services, unambiguous performance expectations. I think the last time I was here I talked about performance expectations and how important it is to have clear rules for participants and financial consequences if folks don't like up to those expectations.

A key one is appropriate price formation in all the markets and that's really what the issue that we are going to talk about today is appropriate price formation particularly in the

capacity market; and then pay-for- performance which gets the unambiguous performance expectations. Our belief is that our current market design should ensure adequate resources to meet the liability standards, and that the appropriate -- the resulting resource mix is going to complement the operational capabilities and needs that we see when we get these renewables come into the market.

So we don't have a concern, at least at this point that the new resources that we are getting aren't going to mesh well with the renewable resources that we also see being added to the system. Actually, the new resources we see come in are pretty flexible, which is what you need to complement the renewables, so that's not our concern now. Or probably our biggest concern is that, what's the consequence if policymakers seek very specific market outcomes through out-of-market actions.

And that's a problem, because if you have out-of- market actions taken by the states,

for example, that undermine the price formation, particularly in the capacity market, at least in New England, you run the risk that you are not going to be able to get the new resources that you need to meet your renewable goals. So, the capacity market will make up for, in our view at least, and in our experience, will address deficiencies in energy market revenues, but only if the capacity market functions well.

And how could it not function well? Well, the problem that we are seeing is that states want to go sign long-term contracts for large chunks of new capacity, and then have them come bit into the capacity market at zero. Unfortunately, the capacity market design is such that, to get long-term pricing, those that are going to incent new recourses to enter, you really need all the new resources to offer at their true competitive levels, not some level that reflects a long-term contract and the fact that they actually don't need those capacity market revenues going forward.

So that's the tension that we have right now in New England. That's not to say that there aren't good ways for state policymakers to achieve their policy goals, while still allowing the competitive markets to work well. We actually have lots of good examples in New England already. We have SO_2 trading, we have NO_X trading, and we have the regional greenhouse gas initiative. All those things are in place for a number of years, and they each work well with our current market design.

When the SO_2 and NO_X seasons come and go, you can actually see the bidding of the resources change on that day, so on a Tuesday they won't reflect SOx and NOx prices, and then on Wednesday when the season starts, they'll reflect those prices, work seamlessly in our market; RGGI is the same way. The generators that are required to be a part of -- you know, buy CO2 credits, they do so, it's reflected in their offer. It works seamlessly.

So I think we have good examples of

environmental policies, implemented in a way that allows our markets to work well, and thereby ensure long-term reliability. The problem we have is emerging actions to meet these policy goals through things such as long-term contracts with wind power in the Northern New England states, or large-scale hydro in New England; the problem that we are going to run into is that if we -- if these long-term contracts get signed by new resources, and then if these new resources want to come into the market, they are going to depress the market clearing price in the capacity market, and undermine the ability of a new entrant to come in, and meet reliability needs in that market in the long run.

And if the states go down a path of wanting to do so over the long term, it really puts the viability of our current capacity market construct into doubt. We might have to come up with a new approach to doing that. You know, we do have a rule in place, and I won't get into the gory details, but it's called the minimum offer

price rule, it's intended to address long-term contracts. On one level, the rule is effective as written in that it will prevent the capacity market prices from being distorted by long-term contracts for new resources that cause them to bid below competitive levels.

But the reality of it is actually much more complicated. It's kind of difficult and complex to implement, and probably even more important, it creates a lot of frictions with the states when you tell them that their shiny, new wind power up in Maine is not allowed participate in one of our markets because it didn't follow the rules that we've set up to sort of address those sorts of issues.

So, I think it's a real question whether the MOPR is going to be a long-term construct that is successful ensuring the viability of our capacity market, both because we are getting pressure from within New England, over the MOPR, and also because it's currently in the courts. There's a very similar case in Maryland, and PJM

that's addressing this issue, and that courts could well invalidate this rule and say, no, go back to the drawing board.

So, that's sort of the issue I wanted to tee up, and how I wanted to leave it with you all, and I know my fellow panelists have some views on this, and they may not be quite in accord with mine, so it should be a fun discussion. Thank you.

MR. VAN WELIE: Joe?

MR. DOMINGUEZ: Thanks, Gordon. Good morning everyone. Gordon's intro reminds me that I left a once- promising career as an engineer, and an equally promising career as a lawyer, to find myself in this morning's predicament. So, thank you for that, Gordon.

This has been teed up so well that I'm going to -- I'm just going to bucket my comments, and then let's kind of move to the questions or to the other panelists, and then to the questions quickly.

First of all, as Bob said, there's no

inherent conflict between environmental objectives and wholesale markets, obviously when the cost is internalized and the polluter pays, those costs get reflected in the market and we see that every day with SO_2 allowances, NO_X allowances, carbon allowances that get easily priced into energy price formation and the wholesale markets. When we talk about fixed capitalized units whether they be scrubbers or cooling towers or whatever, those things could be priced and priced into the capacity markets.

So the nature of the problem here, if we could just draw some boundaries around it, is really in the arena of policies that don't have the polluter pay, but rather reward attributes for clean generation prepayments outside of the markets, so that's the conflict. In terms of the problem it creates, I'm going to speak from a -- particularly from a nuclear technology perspective. Bob already talked about a couple plants, announcing the retirement, New England, Chairman Zibelman is confronting the same

situation in New York.

In NYISO we've had this situation with Duane Arnold, and we are certainly seeing this issue around PJM. And the challenges for the nuclear operators are really three-fold. We have very low gas prices that are driving very low power prices. Quite obviously that's probably the most significant effect. We have some out-of-market incentives, along the lines that Bob talked about, that are creating distortions in the energy market, that's a very important market for nuclear operators, that's where they receive about 90 percent of the needed revenues.

And so when you see distortions in those markets they have a particular effect on nuclear resources that don't have the same effect on resources that dispatch around these lower price or in the case of our Midwest units, persistent negative price events. And I think the FERC recently approved, allowing negative prices to fall to negative 160 hours or --

SPEAKER: 150, yeah.

MR. DOMINGUEZ: Negative $150 in New England, so obviously that reeks havoc, for a nuclear power plant that is paying $150 per megawatt hour to put power on the system. And the third problem is that as we've developed these criteria for those resources that we are going to give out- of-market support, as a general matter we have left nuclear out of that equation. Under the impression, I think it was an accurate impression for a long time, that nuclear simply didn't need it, and the reality is, as we are saying right now, that nuclear, in fact, does need it.

So, having defined the problem that way, I think the effect we are seeing, and I think Rob is right, we are doing some things in the capacity market, in different places. We don't have a capacity market in ERCOT, in California, not the same type of capacity market, certainly in MISO, but in those states that do rely on a capacity market for resource adequacy, we are seeing some

problems, and those problems have been addressed through some capacity performance reforms that we've heard about, but those aren't really long-term solutions.

So, teeing up, Gordon, where I think you are going in your questions, and you've all read the memo, I think we can kind of try to think about this in three different ways. If we want to have functioning wholesale markets, then eventually we need to migrate to putting the price of pollution in that market. And in the case of CO2, what we are talking about is putting a price on carbon. That's been a very difficult thing, obviously, to accomplish legislatively, but something we very much have to have in our mind, as we thinking about clean power plant compliance, because EPA has given the states a couple of different options.

One is a mass-based approach, where cooperation between states, along the lines we see in New York and the other RGGI states could work those things that are consistent with the market

as Bob said. We could try to mitigate the payments; that's the other option here, and Bob talked about the MOPR, and I think we've gotten ourselves into thinking that mitigation should always apply in the capacity market, irrespective of whether the impact of the out-of-market payment is principally felt in that market or on the energy side.

And I wanted to tease out for you today, and perhaps open your minds to thinking about, is that it is not a natural thing to mitigate payments that are essentially variable adders in the capacity market. Remember we have, in those states that have the capacity market, we have a functioning energy market, and there we are bidding in all variable costs of making electricity. The variable fuel costs, the variable O&M costs, and then we have capacity market that deals with the fixed capital costs of operating the plant. Those costs that don't change based on the output of the plant.

When we are talking about out-of-market

adders, whether they are RPS payments, whether they are production tax credits, or whether or not the types of things we are talking about in New York for nuclear. They are essentially payments that are adders to the energy market. So if mitigation is going to occur, it's not clear that that mitigation, through a Minimum Offer Price Rule in the capacity market, makes the most sense. Perhaps where that mitigation needs to occur, is in the bids in the energy market. And if you think about this from the perspective of all the RTOs across the country -- ERCOT, California where you are really seeing the manifestation of these issues, do not have capacity markets, and where you really need to think, if you are going to go down the road of mitigation, is whether we are going to start mitigating energy bids so we don't have negative prices, negative $150 prices simply driven because somebody is going to get a subsidy for producing electricity at that time, or an out-of-market payment for an attribute.

So, mitigation is a complicated issue,

we tend to think about it only in the capacity market design, I'm suggesting this morning that that's a blunt object or a blunt instrument for this particular problem if we are going to go down that road.

The third way we could start thinking about this is to simply recognize that we are going to have a hybrid. Where states are going to be focused on a number of resources that are going to be important to the states, and the balance of the market could address those resources that lie outside of the zero carbon or clean energy realm. So, it is entirely appropriate, I think, to start thinking about this as a market where we could start bifurcating the wholesale market or the capacity markets, into a market that deals with capacity resources, that are emitting resources, and capacity resources that are not emitting resources. And we have two markets that are clear together, but you clear their clean energy part of that first, and we've done that.

In capacity markets we've tiered things

like demand response, and other things, so that's certainly one approach here, and I think we are going to, you know, eventually tumble into an area where most all of the zero carbon resources in the market, and I'm going to suggest to you today, that in the fullness of time, that's going to include nuclear, are going to count on out-of-market support, and what the wholesale market may end up doing is being a residual market for gas fire generation in the fullness of time, and obviously we are going to have, as we evolve out of coal, we are not building more coal, so I'm talking about gas fire generation, as that part of the resource mix that is going to be dealt with through these wholesale markets.

MR. GRAMLICH: Okay. Good morning. Again, Rob Gramlich with American Wind Energy Association, and it was enjoyable to work with Gordon and Bob in the market design days of RTO and ISO development in standard market design, and thought they did a great job in their market, but the markets are changing, and so we do need to

focus on the new challenges, and I am -- we are diving right into this discussion, so I'm actually -- (inaudible) speakers do this, I'm not going to do the slides.

If you want to see them, there are some updates on sort wind and integration into the grid, and I'll just give three facts and move on right into the questions here. A couple of things, wind cost have fallen by about two-thirds in the last six years. We are at 75 gigawatts of wind around the country. We were at about four when I started in this 11 years ago, so obviously dramatic growth where it -- on an annual basis we have exceeded 30 percent of Iowa's electricity, and we are nearing that in some other states.

So, in terms of just sort of the simple, you know, can we do this reliably, clearly some areas are doing it, both in the U.S. and abroad, and we can, you know, talk about how exactly that's done when we have more time to focus on that. So, let me focus on the questions Gordon teed up, and that Bob and Joe got to.

It strikes me that New England is a region with a lot of retail competition and a capacity planning issue. And that capacity planning and retail competition have been a challenge from the get-go; and I was honored to serve on this Electricity Advisory Committee in the mid-2000s, and that exact issue was what we or Pat and Rich, and others may remember, in that, you know, 10 or more years ago.

This is what we are talking about, how do we do, and at that time it was pre-2008 market dive, so there were expectations of, you know, need for rapid capacity expansion, and how the heck are we going to do it. Capacity remarks, retail competition. So that problem still exists, and I don't think anything about renewables or carbon reductions, makes that any harder or easier, it's just a challenge, and honestly I haven't been following it that much recently, because it's sort of not our issue.

And I also don't think that the heads of the New York, MISO, ERCOT, California SPP, or the

other ISOs have quite the same issues. We'll, hear from Chair Heydinger about what's happening in the Midwest, but in some regions where you have vertically-integrated utilities, with a PUC that oversees capacity planning, they do capacity planning, that way that's how they do it, and whether MISO develops or doesn't develop a capacity market as sort of a residual for trading, you know, that's fine, that's up to the region.

ERCOT does it differently, they do it with a high energy price, and they have, you know, maybe that's -- maybe it's time again, I don't even want necessarily suggest the solution, because I haven't been focused on this, but there are other areas that don't have -- you know, rely on centralized capacity markets with a lot of retail competition. You know, just a different issue.

So I understand you have a challenge there, but I think it's somewhat unique to the region, and it's not exacerbated by renewable energy. There are issues across the country with

low wholesale prices affecting generation, and nobody is, you know, more conscious of that, than Joe and Exelon but, you know, everybody, all of us, every supply side source is dealing with the fracking, the shale gas revolution, and low gas prices affect all sources of supply and that's, you know, an issue for the economics of all sources.

If you look at the market monitor and reports for New England, it's almost perfect correlation between gas prices and power market prices, which the monitor says is a great indication of how competitive the market is. I mean that's what's happened. The prices are based on natural gas, wind and renewables aren't setting the price, and so again, that's the -- you know, that's a sort of separate issued, unrelated to renewables.

On the question of whether markets need to be altered in any kind of fundamental way to deal with the new twin challenges of, you know, competition and carbon reductions, I would say no,

you know, in my personal opinion. I think the markets are fairly robust in their design, you'll want to adequately compensate capacity, energy and flexibility or, say, ancillary services, and there has been a continuing need to address those, and I think every RTO market, you know, has an annual marketing monitoring assessment, and sometimes they say, hey, wait a minute.

As with New England, I think the recent report say, short-term flexibility, the ramp is not being adequately compensated, so we need to alter the market design, or create a better market that rewards ramp, fast ramping. And see Mark with a -- there have been a lot of comments from NERC about, hey, we have some important reliability needs, somebody should pay for it, and it's not NERC's role to say you should pay for it through markets or some other way.

But it should be compensated. We totally agree with the frequency response. You know, our preference for all these things, as real would be as through a market, the markets do work.

They are the most efficient way to procure these services on a competitive and fair and open basis, and so we can say that but, you know, NERC would say, get the services, and I think the RTOs would say, you know, we need the services, and we want to procure them competitively, so let's develop the markets.

I think there are issues with the capacity market design to make sure adequate capacity is being paid for. I think you are probably right that over the long term with carbon reduction policies, there would be potentially more reliance on capacity markets relative to energy markets. There is some of that in Germany, I think, and that may be fine. I mean, if you have a whole lot of low, variable cost resources coming into a market, power prices may be lower over the long term, and capacity prices might be, you know, if you are -- say, you are gas combined cycle, and you want to provide the capacity and flexibility, you might rely relatively more on capacity and ancillary service market prices.

And that may be fine, that may be the efficient outcome. So I think that's okay, and I can understand capacity markets are hard for everybody to deal with. And I don't envy your job, Gordon, going to states and talking about why these capacity markets -- Everybody hates capacity markets. You know, it's a public good, reliability is a public good, and everybody wants somebody else to pay for it, that's just the reality with public goods, and infrastructure. And if you ride the DC Metro, you are facing that every day these days. Everybody wants -- I'm in Maryland, I want Virginia to pay for that improved system. You know, so that's just the issue with capacity markets. We are not going to get away from that.

And final point, long-term contracts, I think, we don't want to throw the baby out with the bathwater. Long- term contracts are efficient for suppliers and for consumers. And I'm looking at Roy here, because this was something that we always understand the market design RTOs. We in

Pat Wood's office always said, yeah, you should do long-term, short-term, mid-term, you should have free choice, consumer choice of what types of contracts you want to do, and the RTOs should be designed compatible with that, and it didn't always work in the Northeast that well, and so it's a continuing issue.

But long-term contracts, particularly for renewables, because they are 100 percent capital, zero percent variable cost, the weighted average cost to capital is a huge deal on the end-use consumer price. If we want to get low carbon or zero carbon resources to consumers, on a cost-effective basis as a nation, we've got to be looking at long-term contracts, because that weighted average cost of capital will massively reduce the cost to consumers. So, we need to preserve a market and allow somebody to plan, and then that gets back-to-back the -- now we are in this kind of do loop here.

Well, okay, if you are in a retail access area, you know, the load serving entity

doesn't know who they are serving, 3, 5, 10 years out, so they don't -- So are you placing the obligation on them, or who are you putting the obligation on? So it gets back to his, fundamentally it's about retail competition and capacity planning. And again, smarter minds than mine need to worry about that, but that's not a renewable specific, or a carbon reduction issue. So I'll leave it there, and looking forward to our Chairman, actually doing some of the stuff in the Midwest.

CHAIR HEYDINGER: Thank you. As introduced, I'm Beverly Heydinger, and I'm Chair of the Minnesota Public Utilities Commission, and I'd like to give a special shout out to my colleagues here; Commissioner Roberti and Commissioner Zibelman, nice to see you. Very nice to be invited and, you know, I am the alien from the alternative universe here.

I think my whole perspective is quite different. First, because I'm not an expert on the markets, and as a missionary in a vertically

integrated state, we are very much aware of, and participants in MISO, and among the organization of MISO states, play a role in helping shape the policies there, but we have several distinguishing features, I think. And part of the way I look at it is that the wholesale market, when you are coming from a vertically integrated state, is really there to serve the expansion of open markets, and to look at how those vertically integrated states can work even better within that construct rather than starting with an open market, and then figuring out how can the states work better -- do their job better within that starting point.

So, it's as if you are really starting in two different places, but over time, I think what we can see is that we are getting to adjustments coming from those two directions that lead us in many ways to similar, different but similar results. And, so just to step back again to say, that in a state like Minnesota, I guess you could say we are unusual in a lot of respects.

We do have a very robust integrated research planning process, all of our investor-owned utilities have now for many years, come to the Commission every two to three years with their 15-year plans for how they are going to -- what they anticipate their load will be, and what the resources are that they are going to have to meet them. At the same time, Minnesota has had very aggressive renewable portfolio standards, greenhouse gas reduction standards, aggressive energy efficiency standards, but again, we are not at -- you know, this is very Midwestern. We are not at the lead here, but we are at the top of the pack I guess you could say.

So, all of that has factored into our integrated resource planning over a number of years, particularly since 2007 when, our New Generation Energy Act came into place. So, because we work with our utilities at that level of resource planning, they have had the opportunity over time to plan for this transition, and to provide some of the certainty, I think,

that the other speakers have spoken about.

They may not always like the path they going along, it causes some additional dislocations for them, but there is a certainly level of certainty about it, and a commitment, if you will, on the part of the Commission that rates will be structured in a way that will allow them to recover those investments. And so I think those are really significant and important components of how things work in a state like Minnesota.

Having said that, participation in the MISO market certainly provides many benefits to us, and I want to be clear about that. First of course is just the equal and nondiscriminatory access then that our utilities on a day- to-day operational basis, to participate in a much larger footprint, which can facilitate the maximum use of the cost- effective resources. And additionally, MISO does an excellent job of assuring reliability across a much larger footprint.

So, again, as we look at planning, and

look at peaks and coincident peaks and so forth, peaks in -- the coincident peaks for our utilities are not necessarily those of the MISO region which are at a different time, that can allow us savings for planning for those peaks as well. Lower-cost unit commitments and dispatch to handle congestion, and another key component, I think, which distinguishes Minnesota in some ways, is that we are a net energy importer.

So, again, out utilities, as generators and power purchasers, don't necessarily have access to resources that they must sell into a market in order to assure that their costs are met. We are able to provide -- I don't want to say -- We don't provide financial incentives, per se, to add renewable resources into the mix of our investor-owned utilities, but by virtue of setting rates which include capital costs, and reviewing the prudency and reasonableness of those capital costs they do, again, have some assurance, that their longer-term investment costs are going to be met.

Again, too, within my MISO there are 23 balancing authorities, and I think that two (inaudible) state like Minnesota to assure that reliability and that planning, and that lower cost, there are ways to hedge against congestion in the system is necessary, and all of those are benefits that we have of participating in MISO.

How that then affects? Let's take nuclear, we have two large nuclear units in Minnesota, and because their capacity costs are essentially built into rates, they can afford to be price-takers in the MISO market, and if the load expectations are low, they can bid in a range of their capacity that's available to produce energy, the available energy that's available. And set the price to take at the lowest otherwise set cost within that MISO market.

And then they are available to continue to provide that energy as the load increases -- rise. So, similarly that is true for the wind, and particular in Minnesota, and as you may know, our solar is still in infinitesimal, growing. But

wind is a big player, and it's so cost- effective from an energy point of view, that our utilities are going out and purchasing more wind in order to, again, offer it at that lower cost, but it helps take away some of their additional marginal cost of running more expensive natural gas, or coal, above the minimum that they are required to operate.

The other pieces of the markets that are very important to use, are the auxiliary service markets, because it's true that all the players in the MISO markets are bearing a portion of the cost for those reserves, both those that must be instantaneous, and those that can be called on us, like the longer timeframe.

But that socialization, I guess you would say, of all of those costs can keep the cost for the Minnesota rate pairs relatively low to have that assurance, that reliability and that reserve, if you will, to buttress the overall system. So I think there is very much a role for the market, even within the vertically-integrated

states, but I do think as we go forward, and we look at decreasing carbon, and increasing reliance on renewable resources, in some respects the model of having vertically integrated resources works very well for us. Now, I don't want to speak for our investor-owned utilities, but I think the certainty for them, has allowed them to do some pretty robust planning.

Do we have challenges? Absolutely! Demand response, for example, in Minnesota we have not permitted third-party aggregators to work in that market, and instead we require our utilities to take it into account in their planning and we push them to look at how they can use that as a way to avoid future new generation. But going forward, will we be looking at whether that's a marketable product that may be more valuable to us, I think that we will.

We also have some difficulties in vertically- integrated states because our utilities serve more -- serve our customers in more than one state. And the policies across

state lines don't align very well. I don't think it's any big mystery that North Dakota and Minnesota don't see the world through the same eyes. And North Dakota's 51st in its energy efficiency policies, so their customers in North Dakota are definitely benefitting from the energy efficiency policies that Minnesota has set for Excel in particular, which has by far its largest load in Minnesota, but leaks over into North Dakota, South Dakota, Iowa and Wisconsin.

On the other hand, they look at other pieces of the energy policy in Minnesota that they believe are costing them money, solar in particular and they don't want to pay for it. So, there definitely are challenges when you are attempting to balance the policies of the various states. In some respects, I think MISO handles that very well, because the utilities can, essentially, self-schedule and can offer their resources in as price takers in order to meet the states' goals.

And because MISO does a good job of

looking ahead and asking the utilities to give them a one-year look ahead on which generation is going to be in the system, which generation is going to be retired, they have a pretty good idea, footprint wide of whether there's sufficient resources to meet reliability standards. Right now MISO is quite long actually. Could that change? And as they were looking ahead to implementation of the Clean Power Plan, obviously there were some red flags going up.

But, in general, because of the very cost- effective wind and our ability to integrate it across a wide and large footprint, I think it's about 1,000 miles, maybe 800 miles, I think, allows for a lot of variation in whether excellent weather forecasting interestingly that I think has developed as a result of that MISO footprint, that can allow for then the anticipation of whether other resources like natural gas or nuclear are going to ramp up in those states when wind is not blowing.

So, that's the view. You know, I'm not

a market expert, fortunately I don't have to worry a great deal. We have people at the Commission who follow MISO carefully and participate in the OMS stakeholder group, but as we do meet with MISO on a quarterly basis, they come in and talk to us about questions that we may have, or topics they want to address to us, and it seems to be a relatively -- how shall I say -- strong relationship that is working well at this point.

And within MISO I believe about 90 percent of the load is served by vertically-integrated states. So, again, that is the model if you will, that largely dictates how the market operates within MISO. So, I hope that's helpful; a little different perspective. Welcome to answering your questions.

MR. VAN WELIE: Thank you very much. I have a whole series of questions, but I don't want to dominate this. I'd like to open it up to the floor, and let everybody else have an opportunity, and if that's okay with you Rich? I'll save my questions if there's time at the end.

CHAIRMAN COWART: All right. Well, we'll hear from John, and then Paul.

MR. ADAMS: Well, I wanted to ask, you know, I heard one statement made that the renewables were not an issue and that they didn't set the price, and I just want to comment in ERCOT, yeah, they do set price and it is negative. Joe, I'd like to thank you, I've never considered a residual market separate from the other resources. I'd always thought there were three solutions to this, in an energy-only market, which is really the only one I had experience with. One was extremely high scarcity prices. The second one was ancillary services.

Essentially pick up that cost, and the third is what we don't have, a capacity market. So you've introduced a fourth, but what I didn't hear is price formation for the first of those. Okay, so you've got residual market for fossil only, was what I understood that to be, but you said nothing about the pricing for the zero marginal cost units, is what I'm thinking of these

as. Do you have any comments on that?

MR. DOMINGUEZ: Yes. And I guess what I really think is going to occur is that that is not going to be a market price in the traditional sense, that it's set by the wholesale market. That we are going to bundle up these externalities, we are going to make decisions that we want these resources to exist, and essentially, that is what we have been doing at a federal and state level, with the mandates that already are in place.

And so my view is, and it was interesting hearing the Chair's comments, especially, and particularly one comment about North Dakota, but now I think that that is a little bit of the model as we trend back in the market world to something where the states actually do have some significant domain over zero carbon resources, renewables, hydro, and nuclear, and the balance of the market where price formation is going to be important is in the fossil side.

And I think the payments to the zero carbon resources are really going to be based on their externalities and a desire to have them, rather than their relative competitiveness with fossil fire generation.

MR. ADAMS: Anyone else wants to comment on that?

CHAIRMAN COWART: Paul?

MR. ROBERTI: Great panel. And I wanted to ask Bob a question about the construct of capacity markets, given what Rob said, and I thought he eloquently stated about the role of long-term contracts, that state regulators like myself, and others are typically approving in order to provide the best value to consumers. And I know in the capacity market in New England, we move from a commitment period that you could get revenues from, I think, five years to now seven years, and given what Rob said, and the way we've continued to refine capacity markets.

I'm just wondering if you had views on whether the construct should reflect the financial

instruments that are actually prevalent in the marketplace, and perhaps have longer lock-in periods for receiving capacity revenues, if the marketplace really needs 20-year agreements, and I don't think anything has changed recently on that, in order to incentivize clean energy resources, what's your view on, you know, we've gone from 5 to 7, why not 10, or maybe 20, as a product in that market to represent what's actually going on?

MR. ETHIER: Boy, you really give me a tough one, Commissioner. That's exactly the sort of discussion we've been having internally about, if the states continue to design where does our capacity market go from there; because if the states want to continue to do that, the MOPR is probably going to become untenable for some reason, right. There's going to be so much political pressure on it, that it's not certain, at least, that we could continue to do what we do and keep those sorts of contracts, and resources associated with the out-of-market.

So what do you do then? Certainly one

option is, all resources get longer-term contracts, that's a very different design than we have today, at least on the auction side. I think a lot of the performance characteristics that we have in place could still work, and actually are still the right way to incent, you know, sort of real-time performance, but you'll have a very different construct, if you said, okay, we are going to get all new resources into the market with 20-year deals.

You could do that, but then what do you pay the existing resources? That's sort of where it gets difficult. You could say that the existing resources get what the capacity market pays them, which is going to be some de minimis amount, because the new resources would no longer be setting a competitive price. And I supposed you could get away with doing that once, but never again would you get a merchant entrant because they would see that all their expectations of competitive market revenues were just undermined by this new regime.

So, you know, I think if the states want to keep going down this path, and as an economist, I would rather they didn't. I would rather see something like a carbon tax, which I think works better for a whole bunch of reasons, and accomplishes the same -- you know, get you to the same point but through a much broader array of cost- effective mechanisms. You know, if the states wanted to go down the long-term contracting path, one of the implications is that everything new is going to have to be through a long-term contract, including non-renewable resources, which the states haven't been as interested in supporting.

So I think it's a much broader discussion, and I think it will be a challenging discussion just because, you know, there are certain elements in New England. Rob sort of mentions this, which is retail competition which just makes it harder to figure out who is going to sign those long-term contracts, and if you want to keep retail competition, how do you have long-term

contracts? Who signs them? Is it the utilities and then they allocate the cost out to the retail players?

I don't know. It will require a lot of coordination amongst the states to make that work out. So, you know, I'm not saying it's not possible, but it's a pretty fundamental change to what we have today, and the states are clearly going to have to be in close cooperation with us to figure out what a future path would look like, because I think our current one would not work.

MR. VAN WELIE: Rich, may I just ask a follow-on question to the one Paul asked, because I think it's --

CHAIRMAN COWART: I think you should do the follow up whenever it occurs to you.

MR. VAN WELIE: Also, I want to make a linkage here to a discussion we were having yesterday, which is there's a lot of enthusiasm around setting up markets at the distribution level. And it strikes me that, in order to have functional markets at the distribution level, one

of the things one has to be able to do, is value the incremental provision of the reliability service. You have to be able to price it somehow.

So, I wonder in a world where everything is contracted or long-term how one does that? And I'd be curious, as to whether the panel has any views on that? At the wholesale level signing everything up with long-term contracts, how does one reveal the true cost of providing reliability, so that you can make distribution level markets work?

MR. ETHIER: I have to admit I haven't put a lot of thought into distribution-level markets, but it does get -- when you have lots of long-term contracts you don't get the same transparent pricing that we currently provide in our markets, that's for sure. Not that there are, you know, sort of aggregators, or aggregations or average prices that you can look at, but it's not as transparent and it's not as necessarily as liquid.

In terms of the cost distributing out to

the retail level, there would be a whole other level of cost allocation discussion that we would have to enter into if we had long-term contracts that were entered into at the wholesale level, and would have to pass those down to the retail folks. I think that would be have done by the states, I don't know how we do that, as MISO.

MR. DOMINGUEZ: I think the answer to your question is you don't -- I mean, if you have long-term bundled contracts for these resources, and what you are trying to distill out is some transparent price for some component of the value proposition like reliability. I don't know how you do that in a world where you have long- term, bundled contracts. I mean that's one of the reasons we tumble to markets in the first place is to try to distil out the different components as we unpack energy, ancillary services and capacity.

And so if the notion here is to repackage all of those things in addition to other externalities around environmental attributes, and then say, well, what's the component price you are

paying for reliability, I don't think you could do that from a market standpoint, and it's a market design standpoint. I think where you probably do that, is in judgments at the Commission level, in terms of how they justify the price level for that long-term contract for distributed resource.

And there, you know, and I think the route proceeding then gives us a little bit of the roadmap, one might say that building solar, for example, on the part of the distribution network may have the need for other investments in substations or hard investments. And there I guess, Gordon, you can make some sort of judgment that the component value of reliability at that part of the grid, is worth the eliminated need for the hard investments, but in terms of the market I don't see it.

MR. GRAMLICH: You know, there are two frameworks in the country, one is kind of vertically integrated traditional planning model, and the other is the full market model. If you are in the full market model I think you define

the services the system needs and create a market for each one. And that hasn't changed a lot, although as I said, there is more need more need for flexibility so, you know, kind of an hour, two-hour product and we where you have suppliers and buyers for that, I think there's a need for that, and I would roll that down to the distribution level.

I have not thought about it a lot, I know those in New York are thinking a lot about it, but it seems like you value, take the services that are needed by the system and create a market.

MR. VAN WELIE: How does it get revealed though? I mean, that sort of thing that occurs to me is that once it's -- once the bulk of the service is bundled in the contracts, there's only a very small portion of the value that's actually visible to the marketplace, so how do you actually get somebody to invest, in supplying that service just from a merchant point of view, or do you -- or are you forced into saying, I recognize a need and I'm going to sign another long-term contract

with this type of technology to satisfy that need?

MR. GRAMLICH: Right. So, if you are allowing for bilateral contracts as opposed to a system where everything is part of the pool, and there's only sort of short-term trading, then I think you have to assign out the obligation, so the system needs, you know, X-widgets of reliability service and, you know, each load-serving entity have their proportional share, or however you share it out of that widget obligation. And then they have to go into the market and buy their widgets and the suppliers of widgets sell, and they can sell, and the willing buyer and seller can sign a 10- 20-year contract if they so choose; or they can just go to daily spot market.

CHAIR HEYDINGER: And I'm sure Commissioner Zibelman has thought a lot about this, but I think as a Commissioner, I also do a little bit of work around the remaining state authority over telecommunications. And in some respects this is the same point as the telephone

companies are increasingly deregulated, there's a big question of, who serves the customers at the end of the line, where the costs are much more expensive? And it's essentially the reliability question as well.

How do you create the right, either obligations or incentives, to assure that those least cost-effective customers continue to get the reliability that we've come to depend upon?

MR. ROBERTI: Could I just follow up on that one to complete the circle on this? Given the panel yesterday, given the retail versus wholesale dynamic, and what, Gordon, you just said, I guess the final question to Bob would be, is an energy-only market like ERCOT really the preferred way of accomplishing all the goals rather than the bifurcated approach for the capacity market? And even a seven-year -- I guess seven years, was probably just a midpoint to balance that interest between what states are doing, and the market principles that you need.

MR. ETHIER: That's another debate that

we've had many times internally, of energy-only versus a capacity market. To me, the benefits of energy-only aren't quite as clear cut, or I don't necessarily know that they resolved the issue that you are talking about. You know, as Joe mentioned, he has some real concerns about energy market price formation in a world where you have all these different subsidies coming from different entities that have these sort of, maybe unintended consequences in the energy market.

So, all of a sudden you are throwing your lot in with an energy market that's got all these -- you know, that already has concerns around it (a); (b) then you have to have scarcity pricing nets that's radically high compared to what we, at least, in New England are used to; not that it's not rational given that you have an energy market, but you have to be prepared to live with that.

And third, and maybe most problematic is in New England, you know, we have reliability standards that are sort of maybe beyond our

control. That is, we have certain criteria that we are obliged to aim at, that we don't have as much flex about. You know, I'll be certainly happy to talk about whether those are sensible reliability standards or not, but that's -- probably shouldn't get into that today.

Where, it's my understanding that ERCOT and the state of Texas have a little more flexibility about what reliability level they are comfortable hitting, which seems to me, pretty important in an energy-only market because, you know, you are setting these scarcity prices that are only going to come into play, you know, 15 days, 20 days a year, and you are trying to drive a 30-year investment off of this one number that you are setting, or these few numbers that you are setting. And you don't know how the market is going to react, because that can be high enough, it's going to be often enough? Are they going to meet the reliability standard that you want to hit?

Versus in a capacity market, you know,

when we run the capacity market we have a pretty good idea where we are going to end up on that reliability curve, and we design our market to land about where we are going to land. You know, not that you can't operate it, obviously, and I applaud ERCOT for trying it, but part of me is also happy that they are trying it, not us.

MS. ZIBELMAN: Can I follow up with that?

CHAIRMAN COWART: Let me just make a statement here. There's lots of interesting conversation here, I'm trying to keep track of everybody's cards in the order they went up. And just to give a heads up, I have Audrey and Tim next, followed by Chris and Sonny, and I'll just work down the list.

MS. ZIBELMAN: First of all, I think it's -- I appreciate the panel, and the candor, and I think it was a -- To me the conversation that Rob Gramlich set out, which is this, really ends up, can be a debate that we had in the '90s around capacity planning, and whether retail competition can work we can think about these as

sort of options and say, we'll, a lot of these issues could be eliminated if we move to the California model, and just eliminate retail competition and put the utilities back in the planning mode, and allow the markets to be residual markets.

Or, we could think about the ERCOT model, and say, well, maybe we just rid of the capacity markets, but I think what I'm disturbed about is the fact that we have to have the conversation, I think in a way that absolutely addresses the hands we are dealt. I mean, it's nice that we have this debate internally. Wouldn't it be great to have a carbon tax? Well, we are not -- We don't have a carbon tax, but we do have states who have legitimate interests, and I think the friction we are seeing now, because of low gas prices, is that in the restructured states you have states who are not able to serve what I think everyone would agree, are legitimate state interests in a way without running into litigation risks between state and federal rights.

And I think that's -- that's what we really sort of need to talk about, is there a way that the markets can accommodate the state interest? Or, do we have to look at a new restructuring, because I don't think those state interests are going to go away at any time soon, and I know we talked about a couple of them. But, you know, let me put this, I would like to, sort of the panel, and what I would say is, are we wrong in saying these aren't real interests that the state should pursue.

I mean, one is resource mix. You know, clearly the states have an interest in things like carbon, reduced technologies and fuel diversity. The polar vortex was not that long ago, that a lot of us saw very, very high prices because of an over-reliance on one fuel, and we worry about reliability, and w worry about fuel diversity, and we think about the fact that we are at that point in time, low interest rates, low tax rates, ability to create renewable infrastructure, and we would like to take advantage of it.

Secondly, it's with consumer affordability. I mean, we worry about the ultimate price to the consumer, so if you have things that we know are cheaper, because we know long-term contracting reduces financing costs, and therefore reduces the cost to the consumer. Can we say that the market should be able to accommodate that in a fair way? The other is allocation of costs. I mean, the states do worry about low-income, and seeing how they participate in the market, and those issues aren't going to go away.

Other questions that are really becoming important to us, is public safety. I mean, one of the things that is becoming increasingly apparent, you know, low gas prices are wonderful. We like to maintain diversity, that's why we are having this discussion with the nuclear power plants. If they were in an integrated state the question that Bev would ask is: Are the capital investments prudent? And then she would make sure that the nuclear plants are being funded even if they are

market in MISO, because she will be making a determination she wants to retain nuclear.

I worry that if the markets aren't giving nuclear owners enough capital, are they going to be making decisions that are really going to put public safety at risk, and so how do we, as a state, supplement what the markets are doing because we might want to maintain those carbon-free resources. And then lastly, is economic support. I mean I think we can't get away from the fact that we have a lot of communities across the country are really depending on generators for a good piece of their tax revenue, so when these plants retire, and we are seeing this in New York, where could be very much affected communities, that becomes a big issue for the state.

So, to me, the issue has got to be, we can't say: Oh, it's really bad or the states to pursue the legitimate interests, I think we have to have these discussions, and that's what I'll go back to, is maybe, in a low gas market, we really,

we need to think too, do we need capacity markets? Should be saying maybe we should go back to some sort of local procurement, and allow the markets to be residual markets because low gas prices are just changing the nature of the game, and shouldn't the markets be flexible enough to deal with the reality of the changed dynamic?

As opposed to saying, well, because the dynamic has changed, we are going to have to mitigate, and we are going to prevent the states from going forward. I think that's, in my mind, where the discussion needs to be taken.

CHAIR HEYDINGER: Audrey, thanks very much. I just want to add, too, that you raised this point about many other interests that expand the scope of how our decisions have to be made. And the one about closing generators in communities is the big one, and so that in Minnesota, raises the question of -- we have a few large coal plants that we are planning for closing in the 2024 time horizon, which you might say gives the community plenty of time to plan. And

we would typically look at reducing -- replacing those resources in a way that would meet renewable energy goals, be cost competitive.

And in Minnesota we've often required the utility even though it's to serve their own load, to go out for competitive bids, so they may not be the builder and owner of the resources going to serve that. So then what happens? Well, utilities get nervous, and go to the legislature to say, you know, that's a non-starter. We need that new generation to be located in the same community, there are other political and economic reasons why it should be placed there, and they'll put us through a competitive resource acquisition.

And so I think it's no surprise to anyone that rational step-by-step planning also gets bypassed in many ways, both at the state level and the federal level, frankly. These aren't perfect worlds in which we operate where we can put all of our policies in place, and then try to make decisions that are balancing a variety of interests. A lot of times we are doing that with

one hand tied behind our back, at every level. I'm not suggesting that's unique to Minnesota, or even just to the state governments.

Yes. And that's sort of this final point I wanted to make. The markets are good commodity markets, the commodity pricing isn't the end all and be all of the policy, and that's what I'm thinking we need to get the markets to sort of think about how do they do their jobs in this complexity of issues that we have to deal with on a policy level.

MR. GRAMLICH: And I'll just add quickly. I think those are exactly the right questions for each state to consider. I think they are all legitimate state interests and they've all traditionally been in the domain in the states, and some states have chosen to, sort of, delegate or allow regional entities to perform some functions related to those, and I think there are a number of advantages to doing so.

But, again, with things like long-term contracts, I would say look, the ones looking out

for retail rate payers ultimate costs, or the state regulators in the states, and if they want to preserve long-term contracts, then I think that should be one of many issues that the RTOs and our ISOs should have their markets operate on top of. And there are countless public policies underlying the power system and the transmission that's been built, and the various subsidies that remain for all generations, versus have their form of subsidies and, you know, that hasn't changed. And, you know, in many respects the wholesale power markets just sit on top of all of that, and if the state wants to do some of those things, I think they should be able to.

MR. VAN WELIE: So, Rob, can I just ask as follow- up question here. I'm not sure of my facts here, but it seems to me that part of the challenge here, is can you design the market to -- and I'm really coming off Audrey's point, to give the states what they want in some way, without having to use a whole barrage of different long-term contracting arrangements to buy the next

increment of what you think is needed. And I look at Texas as an example, where they lowered the barrier to entry for wind, and by putting in the crazy investment, $6- $7-billion investment.

My understanding is that the wind then, 10,000 megawatts of wind were built without long-term contracts for the most part. So it seems to me there's an example of a very market-compatible solution, which is, you know that there's a barrier to entry which is the transmission investments, so you lower the barrier to entry, and then the combination of the natural pricing that's available in the market plus the production tax credits, does it's work, and you get the entry that you are looking for, as opposed to having to go and sign contracts to the wind.

So I just -- that's my perception of what happened in Texas, and I was wondering whether you could either confirm that or just expand on it.

MR. GRAMLICH: There are some long-term contacts. I actually don't know the full details

of percent there are, certainly a lot of merchant projects there, and so I don't -- I mean there are a lot of attributes of the Texas market and they could be very amenable to wind, and I would say all new generation in the open -- you know, the open market and the trading, helps a lot. You know, it gets back to this, it's an almost age-old question now of energy-only versus capacity markets, and personally I haven't spent a lot of time thinking about that lately, but it's still, you know, I think it's a very relevant question, and probably some of the changes in the market do, you know, cause entities like yours to think about it, the states to think about where do we want to go on that.

MR. VAN WELIE: Rich, back to you, queue.

CHAIRMAN COWART: All right. That means it's to Tim.

MR. MOUNT: So I just would like a comment about energy-only market, so I personally, am rather skeptical that they can remain viable

with a high penetration of renewables in storage, and as an indication, I just read a paper about the Australian market, where they are proposing to put the cap at $80,000 a megawatt hour, if either of the Commissioners want to go and tell the Governor that, I'd like to go to the meeting with them.

But anyway, I want to get back to Bob and the New England market. It seems to me inevitable that long-term contracts are going to be attractive to new, particularly, wind farms and, you know, I see that side. What I don't see is why I want to buy that contract. And so my question is, when I sign up for that contract, am I trying to sort of get out of things, like undermining the capacity market? Do I pay for the extra reliability? I'm purchasing a very variable source, you know, somewhere up in Maine, and wherever I am, in Harvard or somewhere, that my load profile is pretty well behaved. So how do I -- maybe don't turn up on the peak. I mean, how do I pay for these sorts of extra ramping

reliability time costs.

MR. ETHIER: Okay. And I can, I'm going to try to combine my answer to your question with a -- sort of also address the Commissioners a sort of helpful enumeration of all the state concerns, because I think they are connected. The entities signing these long-term contracts in New England are typically state-backed entities, and they are signing contracts that are sort of embedded in there, are netted out of the contracts are the revenues that the wind resources are getting in the wholesale market.

So, it's up to us designing the wholesale markets to make sure that the wind resources face the price signals at the right time. So to the extent that the wind resource has to pay to generate during some hours, because they make the system less reliable by continuing to generate, that needs to be reflected in the money that we pay or don't pay to the wind resource, and with reflected into their willingness to sign a long-term contract with a certain price with a

utility.

As far as the things like ramping and that goes, we don't actually have sort of a charge-back mechanism for reserves. Reserves are socialized, so I know there's a lot of discussion about whether wind resources do or don't impose additional reserve costs on the system, and we don't, you know, at this point we just charge out all those to load, so there's not a specific charge-back to any specific resource about any reserve or emergency costs that we may incur.

But sort of stepping back from it, I think it's -- I think we are teeing up sort of the fundamental decision that really is -- relied on the states and is, if the states want to sign long-term contracts because they feel that that's the best way to achieve their policy goals, it's going to require some rewriting of the wholesale markets.

You know, I think there are two paths we can go down and ISO, at least the one that I worked for, we are trying to say, if you want to

stay in the current market, here are the tools that actually will work well, that will allow us to continue on this current path. But if you want to go down a different path, and you want different form- control over the generation mix in your region. If RGGI is not enough, if SO_2 and NO_X's aren't enough, if RPS is not enough, then you'll probably need to come up with a wholly different approach that probably involves long-term contracts, and ripping up what we do today.

And those long-term contracts have consequences; (a) they have to be for everybody, which a lot of the states, at least in New England, I don't think really are interested in. They are not interested in signing contracts for lots of generation, they just want the generation they want. And it also gets you back into the boat that we tried to get out of 15 years ago, which is long-term contracts sometimes don't look so good when you are partway through the contracts, but you can't get out of them.

So, I'm not saying it's easy, and I completely get that the states have a lot of interests that they want to meet, but, you know, as an RTO, the best we can do is say, here are the choices that you have, you know, here are the two paths, we are on one, here is what works best with the current path, or you can do other things that are going to create a lot of friction in the current, or we can talk about going down some different path which has its own pitfalls and challenges to overcome.

So, you know, if there's anything I want to get across today, it's that sort of choice at that sort of level, is maybe the path we are headed towards, depending on how the states want to push their public policy objectives.

CHAIRMAN COWART: Sonny, I think you are next.

MR. POPOWSKY: Thanks. I wanted to get, talk to you, Joe, a little bit about that hybrid approach you talked about. As you remember, when we restricted in Pennsylvania, I guess the

assumption was that the generation would -- you know, you would get the single market clearing price on the energy side. You'd get something like the capital cost of combustion turbine, on the capacity side. And that worked real well for you guys in MCF and my assumption, frankly, the one thing that I always say, is that these nukes would run forever. They were money machines. It would cost a penny or two to run them. You charge a nickel or a dime, and you just run forever. Now suddenly, we are seeing Exelon saying we are going to have to shut down -- we may have to shut down our nukes in Illinois, New York, Massachusetts.

They need a different pricing model, and should that pricing -- would we be better off, we need a rate parity, if we want to keep these things running, let's just take the Minnesota approach, and put the capital -- you know, return to some kind of cost-based model, rather than one where you pay the market price when market prices are high, and make we pay enough to keep you running when market prices are low.

MR. DOMINGUEZ: Sonny, I guess the first thing is we definitely do need a different pricing model, it's self-evident from what's already occurring in these markets. We are, in our Midwest units, Sonny, we are seeing 15 percent of our off-peak hours trade negatively every year. And so we are paying back the system at that point, and the reality is, as we go back to 2002 or 2003, we weren't seeing that phenomena. And so we are seeing an impact of distortions, we certainly have the low-gas-price issue.

I'll broaden your horizon a little bit; it wasn't always the view that nuclear plants would be cash machines, right. I mean the original stranded cost payments were made because the supposition was that the nuclear plants would not be cash machines. In fact, would be losers in the market for a period of time, when gas prices went up, they were cash machines, and they did very well.

But as we've seen gas prices come down, nuclear economics become quite elastic with gas

prices, and then we also have this impact associated with the fact that a lot of resources in the market are getting payments that cause them to act in ways that traditional market participants would be active. Back in the days when we were originally thinking about markets in Pennsylvania, I don't think anybody was thinking that there would be out-of-market payments that would actually attract people to bid in that negative 40, negative $50 a megawatt hour just to keep running to seek some sort of payment.

So, we have this new world we are living in, and I suggest he hybrid much, because I share Chair Zibelman's concerns. You know, the conundrum we are in, is that if we are at FERC and we are talking about carbon, often times, the predominant view I would say of FERC is, we don't regulate carbon, that's not within our jurisdictional province under the FDA. If we then get into a situation where FERC is saying, we can't regulate carbon, and it is also implementing things that interfere with the states' ability to

regulate carbon, then I would suggest to you that these markets are going to be very short-lived.

They were ultimately at the very beginning, voluntary endeavors by the states, as you pointed out, and that willingness to continue with markets isn't going to go forward if the federal government who are blocking the states, were being unable to act on its own, forces us into a position where we have to choose markets or deal with carbon with many of us here in the room waving that carbon mitigation, is a far more important thing than preserving a competitive market at the end of the day for our country and for humanity.

So I do think we do need a different pricing model. What I'm suggesting to you is that units that have a particular environmental characteristics needed to be included in that pricing model. I think they will draw revenues from the residual model, from the residual market that will be fossil market. They'll get some energy in capacity payments, whatever those things

might be, but let's face it, let's not kid ourselves. The construct today is whether it's a federal payment PTC or the ITC, or state RPS payments, we already have a hybrid model, where the dominant income stream for many resources is outside of wholesale energy market revenues, that's just the truth of it today, and we all certainly understand that.

I think the difference is nuclear. I think the question you pose is a very good one. How far do you go? Are you just ensuring that nuclear plants remain in operation during difficult times? Or are you saying, hey, if gas prices take off again, I want a share of the profits, so that they don't become cash machines. I think those are all tradeoffs, and I think it's -- I think that this is very clearly something that the New York Commission is going to wrestling with over the next few months.

How to make that trade off in a way that doesn't produce asymmetrical results where it's a win for industry but consumers aren't getting the

benefit in times of high prices. I think those things need to be sorted out, but I am no longer confident that the wholesale market as designed, and given the increasing penetration of renewables is going to provide revenue adequacy for the machines that currently in America, produce over 60 percent of the nation's zero carbon electricity. And the only machines that we have that produce it, on demand when our customers need it, without water being in the river, the wind blowing, or the sun being out.

I think they are unique, I think they are our bridge to a future with a lot of renewables and a lot of storage. I think we need to preserve the machines, and we need a new construct to do that. And again, I applaud the New York Commission for stepping forward and doing that.

CHAIRMAN COWART: Paul?

MR. CENTOLELLA: I somewhat hesitate to jump in on this, because I am sort of veteran of the energy-only in the capacity market debates,

and the MOPR debates as a Commissioner, but I -- So let me give you a little context and then ask a question. I mean, I always felt, historically, when we were talking about energy-only, and capacity markets. The capacity market, it really ought to be a fall back.

I mean, you are allowed more scarcity pricing in the energy market, and you'll create the flexibility that that creates, and you'll maybe have a capacity requirements, but not have the capacity requirement be necessarily be the driver for all of the new generation that comes in. I also, as a Commissioner, was fond of saying if -- Well I certainly wouldn't want to enter into a long-term contract to wipe out the new entry.

If my neighbors down the road and some other state want to do that and want pay an uneconomic price, I'm more than happy to benefit from the low market prices, because I don't think that's a sustainable model for any state. You know, you are going to end up wiping yourself out of the competition for the new industry if that's

the choice that you make.

But I want to come back to, you know, a question of how we -- and I also want to say that I fully agree that we ought to be looking at carbon prices rather than subsidizing a bunch of things, and I want to come back, though, to the question of, how do we get closer efficient economic markets rather than -- I mean, yes, we call capacity a market, but it's really an administrative requirement that says, you know, that these have to have this much forward obligation whether or not their individual customers would have actually chosen that or not.

And so I want to come back to the question of -- because I sit here troubled, what can DOE do about all of this given that we all know that this is going on and stakeholders processes in it (inaudible). And I come back to a question that always struck me as an important question when we were having the energy-only versus capacity market today, and that is the question of, can we develop metrics so that we can

better tell whether or not, you know, we are in fact developing the capacity where it's needed.

So that, if in fact, you know, we have to develop an alternative to MOPR, which is kind of a -- this is sort of a sledgehammer, sort of approach to dealing with this but, you know, we actually have to look at whether or not, the combination of markets that we have is creating a liquid forward market, is creating, you know, a real long-term contracts voluntarily for people to enter into, you know, these kinds of arrangements.

Can we think about a question of metrics? Can we ask DOE to be thinking about a question of, what would be appropriate metrics to know whether the market structures that we have are actually working to produce a viable secure, long-term supply? And what would those look like in your view?

CHAIRMAN COWART: Rob?

MR. ETHIER: Well, certainly to me the most immediate one would be -- Well, I share your -- Well, I have my own concerns about reliability

standards, but as long as we have them, that's a metric, right? Are you meeting your reliability standards that are imposed on you by your -- or that you agree to live by for your reliability entities? So, for us it's MPCC and NERC, and it's the one they intended standard which we all know and have debated many times.

You know, are, over time, the markets meeting that without needing extraordinary help. I think in New England, it's only the last few years that have been useful, because before that we just had such a large overhang that it's sort of an irrelevant period of time. I think in the last three auctions it's been -- the signals have been, yeah, the markets are working to meet that sort of very basic metric. It would be great to have a few more years before we draw any conclusions for sure, but the signs, at least right now, are pointing in the right direction.

To me, that's probably the most important one as long as you are going to have reliability standards. You know, if we went to

energy-only, and we said, the value of a megawatt is X, and that's what we are going to pay, and if we can't get it at that, we won't have any electricity, or we won't have as much as people would want. We could go that route too, but that requires a lot of change beyond the RTO level.

MR. GRAMLICH: So, this brings me back to, you know, FERC looking at this in the early 2000s, and there are some FERC whitepapers at the time which basically said, look, reliability services are public goods, and the technical economic definition of that is non rival and non exclusive, and in the electricity markets you can't physically curtail free-riders and therefore, you know, it's of social benefit, but the private parties won't, on their own, procure the needed services.

Therefore, something is needed, and then the choice for the Commission was, okay, do we require capacity markets, or do we simply allow them and the -- I can't know if -- I don't remember if this is written down, but ultimately

the Commission did not require them, but said, in the theory, at least, as I recall it was, you could do the energy-only market to just price the heck out of the free- riders when the day comes, and you really need the power and they didn't show up with any.

And it's, I think, Tim said, you know, that can lead to a very high energy price, and I know Pat Wood was comfortable with that model in Texas, and that was his thinking coming into FERC because, well, let's just use that, but if regions don't want to get to that high spot energy price, you know, particularly as they are kind of doing this right after California, then okay, got it. You know, so let's allow a capacity market.

MR. VAN WELIE: I have to chuckle, because I do need to refresh your memory, because I very distinctly recall getting an order FERC in 2003 saying, you shall implement a capacity market, and the reason was we were entering into all of these out-of-market contracts to keep the resource base in place. So, we had a situation

which if fear returning to at some point, but the construct at the time was, because of constraints, there were certain resources that weren't making enough money, but we needed them for reliability, so we had to enter into reliability contracts, and in the end, the direction we got from the FERC was, you need to do something about that, you need to get that money into the market, as opposed to having inside contracts; and we were told to go and put in a capacity market.

MR. GRAMLICH: I assume you read it. I don't recall that, I mean it could be a lesser evil of the side reliability payments, I don't know. But, you know, in terms of standard market design and what we were requiring nationally, that's what I recall, and I think the same goes for not just long-term planning capacity, but short-term operating, which is all these services are things that no individual wants to go out and say, hey, I want to get some short-term operating reserves, or some frequency response.

These are system needs, right? And so,

therefore there is a need for a public policy, or a regulatory regime to either require the procurement of them or, you know, put it into a market.

MR. CENTOLELLA: So, just to back up a little bit to the debate from the yearly 2000s, I mean, the MISO position at that point, or at least the MISO management position at one point is you could have either a forward contract, or you could have a security interruption price, at which point you would say, I'm ready to get off the system, but you had to have one or the other. And that gets you to the same place, and put some limit on how high the price can go, and creates an incentive for rendering the contract. This is what we anticipated people would do.

MR. DOMINGUEZ: Could I just jump in? I think you've -- first of all, I don't think we have real markets when we talk about the capacity product. It's an administrative market, where the only thing that is a market about it is we have bids in an auction, but even the seven- year lock

in, in New England, that's not available to our existing resources in New England, it's all vintage priced, and it's one particular product, one year of capacity, three years out, and the difference between, frankly, Texas and every place else, is that Texas doesn't have an administrative model in place, that says, we are going to guarantee we are going to have enough generation in place to meet peak demand.

They are hoping that the prices alone will bring the power plants there, that's not a choice that a lot of the states we do business in; we do business in Texas are willing to make. But going back to the metrics, one of the metrics that would be interesting, what is the required carbon price to literally do what you are suggesting we do, and take the subsidies out of the market?

And I think what we'd find, is for many states that have goals around solar, for example, or goals around wind, that required carbon price would have to be a pretty muscular carbon price. I'm talking over $100 a ton of CO2. And that

carbon price would have a lot of effect on the market. I think we just have to be honest with ourselves that if, again, you take the DOE report that issued in the spring of '15, and you say, okay, DOE has estimated the cost of wind to be 70 to $90 of megawatt hour. I mean, unsubsidized basis. DOE has estimated the cost of new nuclear to be 140 or $150 a megawatt hour on an unsubsidized basis. And wind didn't -- or solar in a distributed form, in the hundreds of dollars, right?

Are we really saying that it's realistic that we are going to impose a carbon price that is going to bring these resources in the market? Or, again, should be just start to begin to realize we are in a hybrid market, and until these resources that we really like show dramatic, and I mean order of magnitude changes in their cost structure, I think it's unrealistic that we are going to get all of the results we want simply through the imposition of a carbon price, and achieve what we also want to achieve on the

consumer price side of the equation.

So as I just began, I think we are in this space we often to each other, boy, it would be nice if we took all the subsidies out, just had a carbon price. DOE and others need to do a pretty good job of explaining exactly what that really would mean in terms of consumer prices, and in terms of the needed carbon price, and I think once folks see those numbers, we are going to realize that we are not going to be in a pure market world.

MR. GRAMLICH: If I could just respond a little bit. I mean if you -- I suggested a model, that's out in the press yesterday of: no additional targeted incentives at all, but just if you put in a carbon price or a model for the Midwest region, a significant carbon reduction, they got something like 200 gigawatts of wind, just on that basis.

So I think we are going to a future of open competitive markets with the externality factored into the price, and that's sort of the

natural evolution, and I think the wholesale power market structures are generally robust to that future, and I don't think it's an either or capacity markets, carbon price would have over the wholesale power markets if you can sit on top of whatever environmental regime we have; generally, quite efficiently.

MS. ZIBELMAN: Can I just follow up on Joe's point, on the role of the DOE, because I think this is an important issue. I was just whispering to my neighbor here, "Isn't he glad that Southern company did what Southern company did." But the fact of the matter is, we were looking at in-city gas prices in New York City last week, and they were just about a buck.

Several years ago those prices were $15. I do think there's a role for the DOE to say, we have to get realistic about this, because the premium we would have to pay above those gas prices today, is really astronomical, and that's why I think we have to be more surgical about how we are starting to approach this issue because we

just never have had these kind of gas prices t deal with, and I think we are sort of fooling ourselves if we say this could be just in LMP.

There is truly an issue that we have to address as a country in terms of, if we once maintain resource diversity, but we recognize you want to take advantage of low and natural gas prices, what does the mix need to be -- look like, and how do you implement policies around that? Because I don't think -- no matter what we do around the capacity price, it's never going to really -- or the market, it's never going to really address this issue of around what's really happening in -- around the fundamentals of fuel.

MR. VAN WELIE: Actually, Audrey, I agree with that last point. So, let me just -- I think what you are doing in New York is going to be really interesting to watch, which is I think, and if you look at what the states are doing with regard to -- with they are heading with renewable energy standards and so forth, the question is: Do they want to do something similar for nuclear in

the end?

CHAIRMAN COWART: Roy?

MR. THILLY: Thank you. First of all I think the distinction that Rob drew between where there's retail competition or not is really fundamental to this issue. And Audrey is right, raising the right questions. But I do wanted to hold this dichotomy between simply markets, and short term-capacity markets, or long-term contracts, from the point of view of where I came from which is an obligation to serve state, or municipal and co-opted as an obligation to serve its load. What we are looking for, we are looking for is a diverse portfolio of capacity resources, short, intermediate and long-term.

Long-term is equivalent to rate base in the investor-owned world. It's very risk to be all long-term, it's very risky to be all short-term, and not to have energy or protection in that market. So, if the markets can provide various forms of capacity in terms of capacity, I think that's not dissimilar to what the states are

looking for in terms of balancing fuel diversity, and a lot of other concerns, to put that mix together.

And then markets need to serve that need, I think. But the other observation I wanted to make is on the nuclear side. We have one nuclear power plant with constant shutdown, and that was in the market, in the energy market, and the energy market only, couldn't survive. The amount of coal generation the following year went up in the state by about 25 percent. A little bit of that was the change in gas prices, almost all of it was nuclear being supplied with (inaudible) by coal. If you are trying to reach carbon goals, that is a really scary proposition. And so I think we had to come up with some sort of structure that doesn't rule nuclear out of the market. It's certainly without long-term contracts I don't see how you could possibly have new nuclear units.

CHAIRMAN COWART: All right. I'll call on myself. I've whittled down my comments to just

a couple. One observation I wanted to just echo is that we do need to keep in mind the conversation we had yesterday, as Gordon pointed out, alongside the conversation we are having today, because if we want accurate price signals to drive flexible and distributed resources at the distribution edge, and we need to have a wholesale market that actually is delivering some meaningful prices, to reveal that value, and so this is just to remind you to -- all of us -- you know, that we actually have to remember what we talked about yesterday too, and as we talk about the design and the wholesale market.

A second point that I'd like to make in response to Tim, is that scarcity pricing doesn't really have to be that scary. If in fact we have created a market that allows demand, response, distributed resources, storage and those other resource to play because they are getting those price signals. Then in fact, as we saw in some of the slides yesterday, a lot of that volatility is pulled out of the market by the existence of a

much more diverse set of distributed resources as well as supply side resources. I assume I'm stating something that people can generally accept.

The third, I guess I would agree that we are not going to see public policy in this country that injects high enough carbon prices to be the drier of all of these, theoretically efficient solutions. You know, I spend my time these days working in Europe and the Europeans have a hard time, even though they are intellectually committed to it, they have a hard time seeing carbon prices, you know, getting above the equivalent of 13 or $15 before they start getting worried about it.

Now, I'm going to go to a fundamental question I just want to put on the table. There's kind of an assumption in all of these conversations that the wholesale markets reveal short-term marginal costs, and that's what the market clears at. And therefore that's all the generators get, unless we come up with some other

thing that we give them. And so I just want to ask the question: Is that true?

If you had an energy-only market, with the opportunity for buyers and sellers to engage in various kinds of other instruments, are we in fact stuck in a world where, when the wind is blowing the price is zero or below, and we can't do anything about it, and therefore everybody, including wind generators, is losing money. Or, do market participants actually find ways around that?

You know, in the vertically-integrated states, as the Chair pointed out, the ERP process and rate-base takes care of it, but don't market instruments take care of it in other more fluid markets? And that's just a -- that's a totally -- how do you say it -- straightforward question, because it seems to be an underlying proposition in this whole conversation.

MR. GRAMLICH: So, I have thought on that, and I hope I cannot speak for my organization because we have absolutely no

position on these issues. But again, back in the FERC days, considering market design, there was a lot of sort of economic study of that question, and you can -- I think that most economists consensus, and Bob and correct me, was that you could, in theory, do an energy-only market, you have to have -- but you have to look very closely at what is that ultimate very high price on that peak, you know, summer day? And it's not the operating cost of the last unit dispatched, but it's something higher that reflects true scarcity, and it probably goes up to the value of lost load which, again, no regulators are comfortable determining that, because how the heck do you set that and it's not based on supply and demand bids, but that's, in theory, the way you do an energy-only market.

MR. ETHIER: That's good memory. And, you know, the discussion hasn't change a lot in the last decade or so. You know, that's sort of the solution to an end, it gets more complicated when you recognize that you actually can't turn

off the people in a very disaggregated way, you can't turn off the people who have really low values of energy and let the ones who have very high values of energy stay on, because we just don't have that capability yet. And until you have that, it really limits what you can do, unless you are willing to make these sort of broad-brush policy decisions, which is essentially what we do it one day in ten.

It's a decision about how much reliability is worth, it's a reliability number, but it's very easily translated into a dollar number, and it's actually something that we have actually done in our markets, and it's reflected in our market goals. And until you get away from the need to do that, and get down to this disaggregated, everybody reflects their own values. It limits what the market is going to naturally bring forward, it's sort of on our mind, because you can free ride, you can say, if we lose 100 megawatts, what are the odds, I'm going to be part of the rotation of outages, pretty low.

CHAIRMAN COWART: It seems like you just addressed part of what I was talking about which was this business of, you know, in the markets that we are talking about going to where demand side aggregators have a lot of different customers who are signed up to be turned off at different price points, and different resources, or either on or of depending on being blackouts it's a question of who is willing to be interrupted for a price. That's on one side of it. I agree that in the very, very extreme event you do have an involuntary interruption backup. But on the other side, I'm really asking the question, if I'm the generator in a market where let's just say, it's energy-only and some days -- some hours it will be negative, and some hours it might be pretty high. And I don't like that volatility. I don't want to have to live on a few uncertain hours.

And I'm a retail supplier on the other end of the market, and I don't want to have to have that much volatility on my product, so I want to engage in a contract with the supplier, or a

set of supplier, and my question is, you know, and in some places they call it contracts for differences, and people can cover both generators and retailers can cover volatility by entering into a contract for a difference.

What is it about the markets in New England, New York or MISO that lead us to believe that we have to live in this highly volatile world instead of contracts for differences world?

MR. ETHIER: I think the answer is, the majority of generators for the majority of their output do live in a contract for differences world. You know, most of them aren't -- for most of their resources aren't going hour to hour spot prices. You know, we, as ISO do get some view into that, and we are constantly -- we actually settled a bunch of those contracts for folks, so it's certainly possible and likely, I think the disconnect is, you don't see those very long term, at least in New England, largely because of the retail competition structure.

No retail -- I don't know about no, but

few retailers have more than a one-year horizon so they don't want to sign contracts for more than that. And that is what prevents the 10 and 15-year deals which, if you talk to both sides independently, they are interested, but the retailer is saying, I don't know if I'm going to have load in five years, much less 10, and the generators, they are like, there is nobody out there who wants to sign a contract with me for that long, because I would love to hedge my output too, or at least a portion of it.

MR. DOMINGUEZ: Yes. I would just add that I don't even seen that from the utilities in the States we do business where the utilities are seriously interested in hedging a significant amount of the load for 10 or 15-year periods, part of it is, I think one of the premises of your question is, that the contracts provide more money, more value opportunity for the generators than going to the spot market. And Bob said, all the generators are hedging 1, 2, 3 years forward, but nothing really long-term and the market is so

transparently clear, there's no reason in the world someone would.

They are going to always reference the market prices, and there's no reason someone would go real long at this point, on something that is substantially higher than the market, and there is a liquid gas market that's a 5- or 10-year market, some would say even a 20-year market, that correlates pretty closely to power prices, and I just don't think that -- I don't think the answer to this question lies in, go out and get long-term contracts. First, I don't think there's a counterparty for it, and second, even if there were I don't think it would produce a revenue stream that is significantly more adequate than the one we face in the short-term markets.

CHAIRMAN COWART: All right. Thank you. Carl?

MR. ZICHELLA: Thanks. Interesting conversation, I found myself taking tons of notes, and little snarky asides of my own about some of it to be honest with you. It just strikes me how

different things look in the Western United States, and what we are talking about here today. We are looking at trying to get more of an organized market approach across more of the west, to help facilitate some of the policy goals Audrey enumerated, and it seems like there is a construct here that we can create that isn't necessarily what has been created so far.

I think, certainly, there will be some kind of a hybrid approach because there are many state policy mandates across the West; in fact most of the western load is under a high RPS now. Not just a short one, a high one. From Colorado to California, to Oregon, you know, we have lots of concern about climate policies, coastal states are going to be heavily impacted by climate change. So we are seeing many state policies that are very aggressive across the board.

How we have a market context in all of that, is going to be very interesting. However, I think it's very possible because we are in such a highly vulcanized situation right now with 38

different balancing authorities, a bus with 38 drivers, essentially, running a situation -- a grid that's almost hostile to renewable energy resource integration, because of this vulcanization and artificial congestion on transmission.

You know, we are going to preserve state prerogatives, and we are going to have some sort of a market I believe, it's not going to happen. It's not going to be easily done, but how we put that together is going to be a bit of an adventure especially given what I've just heard today, we are not going to have -- I don't believe we are going to have a capacity market in the west. We don't need one. We are going to have plenty of resource adequacy without a capacity market, and because of the huge footprint in the West, it's clear from all the studies that have been done, renewable energy integration can be done very comfortably.

We do have good energy efficiency programs across most of the region. We do have a

growing increment (inaudible) that we are going to be relying upon. Those things make the lift easier, but also the geographic diversity that exists in the operational hours which we've studied in the west, that lets us match renewables with renewables, and wind being particularly useful in this regard, helping to even deal with solar ramps in many cases, give us an opportunity, having a diverse renewable portfolio to do that.

Thank goodness we are not saddled with tons of nuclear power, we are getting out from under the nuclear fleet that we have. They weren't intended to run forever. They reached the end of their design lives in many cases, extending their lives is going to require massive infusions of capital to keep the plants running, especially at once through cooling requirements coming into play.

We are not going to be building new nuclear power plants in the Western United States; that would be idiotic for us really, frankly, because they are so inflexible, it's just not in

the cards for us. Where we are headed is much more variable generation dominating the electricity market, and a little bit of flexible thermal resources to fill in those gaps. That seems to be where we are going. And having a market to help dispatch those resources more efficiently with what we are doing, is really one of the big benefits, and it's an operational benefit, as much as it is an economic benefit for us in the west.

So, when I look at the landscape that we are facing, and trying to learn as much as we can from what the RTOs have done in the eastern interconnection, take the good stuff that's been done, try to avoid the errors, so we are in kind of a good place, because we can learn from what hasn't really worked that well. And we don't have the same resource mix, 80 percent of the coal plants in the United States are in the Eastern interconnection.

And we are retiring in the western coal plants at a similar rate, they are going out of

the stack very quickly. And the markets give us a chance to run out those plants that are least efficient, that shouldn't be kept long-term, that should be kept on life support by capacity payments, and we really don't need to do that. So I think we may find a third way in the Western United States. I think the distribution grid challenges are actually pretty similar as we heard yesterday, but the bulk system is different.

And I think we are going to have a different approach to this. We are actually wrestling with what it ought to be right now. And it's a very real question for us, about what the construct will look like, how it will be governed, how we'll deal with differing state goals, because just like in the Eastern Union Connection we have coal states, and we have renewable states. It just so happens that most of the load isn't in the coal states.

So, the trend away from coal isn't going to be interrupted any time soon. I think I'll stop there. It's just been drinking from a

firehouse for the last hour-and-a- half here, and I've been saving it up, so I apologize for being all over the map here. But I'm not buying into the nuclear thing and trying to keep them operating much longer, it's not going to happen.

The older plants, they are going to have the higher O&M costs, when you start replacing reactive vessel heads all over the steam generators, and every single pressurized water reactor in the United States, and building new cooling towers, you know, there's no way we are keeping them afloat.

MR. DOMINGUEZ: Well, I think I have to answer that. Look, whether you choose to save nuclear plants or not, those are decisions that need to be made regionally. I'd simply point out a couple of things. A number of the places you were referencing also have some of the highest retail rates we see in the country. And Germany as an example, that has gone in the direction you are describing where they are shutting down the old nuclear plants and relying on renewables has

driven its average retail rate over USD0.40.

Now there is a lot of hydro in the West that dampen some of the price impacts, and there are some states that enjoy those benefits, but it hasn't exactly been a success story in Germany shutting down a third of its nuclear reactors, seeing the highest prices for electricity in Europe, and not making any progress on carbon reductions. And so there have been studies that indicate that the implied price of carbon reductions in Germany, net of the retirement of nuclear units is 1,200 bucks.

But if you are making a judgment that this more than just words, but you have numbers on a sheet of paper that says, look, the cost to keeping the nuclear plants open is less, and the cost of replacement is cheaper, then replace them. The analyses I've seen, I think some of the analyses that have done in other states, indicate that if you have a unit, that is a base load unit that could provide guaranteed zero carbon electricity for $0.35 or $0.04 a kilowatt hour,

then that's probably a pretty valuable resource, if what you are trying to do is replace that with some sort of combination of solar and storage that may come in substantially higher than that.

But those are judgments, I'm not trying to ram nuclear down anybody's throat. Everybody needs to kind of make their own economic decisions. I could tell you have a lot of energy about it, and I'm not going to push back on the energy. It's simply the case that I think, what we need to do is look at the relative carbon value of saving those units relative to alternatives. And if the alternatives are cheaper, you know, God bless.

MR. ZICHELLA: Sure. And if I could just say quickly, I mean, I think that we are going to start throwing the numbers around. Let's say that in the decommissioning costs, let's add it all in. Let's add in, you know, the cost of retrofitting these plants to keep them running safely, let's add in the cost of nuclear waste remediation. Do you want to talk about subsidies

and, you know, the investment or production tax credits, you know, compared to what nuclear has gotten, you know, I have to tell you that over the long haul here, these plants are not intended to operate for 60 or 70 years. They just weren't designed for that. And we have had massive failures with major increments that cause the shutdown of the plant because there weren't even replacement parts for these things, so I think this --

MR. DOMINGUEZ: Yes. I don't think we are going to get to the bottom of this --

MR. ZICHELLA: This conversation is not going to -- Right, we are not going to get to the end of this one today.

MR. GRAMLICH: Rich, just to comment on the other half Carl's comment, I couldn't agree more about the importance of the large open markets that the west is moving towards, and I appreciate Carl and NRDC's leadership in moving that way. It's not always, I guess, been the environmental communities' major focus to expand

markets for everything, but it's absolutely essential, particularly in the west, to get this regional trading that allows renewables to integrate on a reliable and low-cost way.

And I also agree that some of these complexities with the New England and retail access issues, are not -- I don't think those are really concerns in the CAISO, you know, restructuring going on. So, hopefully it will be -- at least that's one problem you won't have in those debates, but I'm sure there are many others.

CHAIRMAN COWART: And, by the way, the Europeans and the large footprints of the American markets, I mean, I see that every day, it's one of the problems in Germany is that the footprints they are trying to just balance within is too small. We've got Merwin with his card up, and I think I need to alert everybody to the following, we will end on time at 12:30 and we have one more business which Carl will take us through, which is to come, but if we can get it done in time. Okay, so first, Merwin.

MR. BROWN: Thank you. Admittedly this is probably an experimental question, but since we are really here to guide DOE and their main thing is technology, I think, safe to say, open up your minds and let your imaginations run wild, and don't let cost, at the moment, get in your way. Is there a technology that could make your lives easier? That would make some of these issues go away, if not all of them? So, you know, is it energy storage, is it an ability to be able to calculate or determine and measure the value of something more accurately than you can now?

Is it a forecasting tool that is much better than what we have now? I don't know, and I'm beginning to lead you now, but is there something that you would say, hey, if I could have this technology tool that would make our lives a lot easier?

MR. GRAMLICH: I certainly can think of a lot of great studies that DOE has supported, on sort of integration of renewables and the value of transition across multiple regions which needs to

be done again. The technology, I mean certainly the great operations practices are very important and using the data from the synchrophasers, and all the other kind of data that I don't follow closely, but the technology that's been deployed, I think helps grid operators. Gordon would know better than I and others here but, you know, you do have to operate the grid with, I think, more data, more information, more forecasting in a high or a low-carbon -- high-renewable low-carbon environment.

CHAIR HEYDINGER: I think from our perspective, are becoming increasingly focused on being able to -- where we locate resources, and historically states, in particular, have been very responsive to the proposals brought to them rather than creating and figuring out, electrically, where would new generation and what size would be most strategically and cost-effectively placed. And so I think, as DOE moves forward, getting more focused on the locational attributes could help with both cost and resiliency. So that's the

direction I'd like to see.

MR. ETHIER: And as far as renewables integration, certainly one of the big focuses we have now is improved forecasting tools, and to the extent that those improve that will help us do a better job of dispatching the grid. You know, we have tools now, they could work a lot better.

MR. VAN WELIE: A quick question. So, Rich, I have just a -- I have a response for Merwin. It occurs to me, and it triggered the same thing I said yesterday which is, what I've learned here, being on the EAC the last five years, at least this part of the DOE we are interfacing with is very technology oriented, it's very engineering oriented, and I understand that. But I think it -- I find it -- I find as if we are always having one-half of the conversation in this room, and I think the -- so it's great to put up the PowerPoint slides that sort of show how things are going to work harmoniously together, and we are going to be able to garner all of these efficiencies; but I always find myself wondering:

Well, okay, so how is it going to happen? How are we going to make this happen?

Because it has to be paid for, and the people who authorize these payments sit in two different places, and there's all this dramatic change going on. So I think, from my perspective, you know, will the DOE just sort of step back and paint in some of that picture without necessarily prescribing solutions, but just sort of point out that we are not going to just arrive at this future. It's going to require some harmonization, they are going to need alignment between state and federal policies, et cetera. I think that could be incredibly helpful, because I don't think people understand that big picture.

MR. BROWN: I didn't mean for my question to be critical of what we've been doing for the last hour-and-a- half by the way. It's, you are right, that shapes this, but also, I kind of want to hear the answer to the other. What would you rather -- What would you like to have? And then we can figure out whether you can do it

or not.

MR. VAN WELIE: So, Rich, shall I wrap this up?

CHAIRMAN COWART: Yes. Let's wrap this one up.

MR. VAN WELIE: I'd like to thank the panel, thank you so much for making it, for you to come out here.

(Applause)

CHAIRMAN COWART: So we've had two really, mind expanding panels, in these meetings, I appreciate everybody's -- I appreciate the panelists and the commentary and questions from the EAC. It's been terrific. We have one final report from Carl.

MR. ZICHELLA: Can I do it from here? Okay. I think I'll probably just do it from here so I can see the slides more easily. And this is a report on the Clean Power Plan Working Group. It's quite a -- as we are teeing that up -- quite a large group of folks have been attending the calls on this, and we've been struggling -- If you

can just move to the first slide, please? Oh, here we go. Great.

We've been struggling a little bit about how to approach this because of the uncertainty. Obviously there's tons of it, and we have had the implementation to ways that we've known from most recently the Supreme Courts stay. The state approaches are unclear how people are going to approach it. We've talked a little bit earlier about mass versus rate approaches, and whether states will go it alone, or collaborate.

We, as a result, we didn't feel ready to put a product together to recommend to DOE how to proceed. But I thought it was worth trying to understand what was being done and how well it was being coordinated.

The next slide, please? So, as we looked across what was trying to understand was being doing, one of the things that did lead -- that lead out to us, was that modeling assistance is likely to be very necessary, because there's varying capabilities between states. And among

them, the differences of various approaches, that would I just mentioned, and the need to have consistent methodologies to identify compliance and approaches, and to track the effectiveness of the states' actions; and also the role of markets with regard to compliance.

The next slide? So, we realize the DOE is already working on a lot of these things, and we had somewhat of an imperfect knowledge about what the organization is doing and looking at. So, one of the things we decided to do is to request a series of webinars with DOE staff, to go over a series of topics we identified, so that we could better understand where there may be gaps. And we came up with a list of topics that we want to propose to DOE, that our working group have a set of webinars about.

The next slide, please? In the interest of time I'm not going to -- I'm going to read through these, or skip through these fairly quickly. We realize we may have to combine some of these. The first is a gap in the analysis on

the models, who is doing what? Has DOE inventory the efforts that are going on around the country? Are there gaps in what's being done? How should we be focusing our efforts on modeling, in particular? Amongst the different models, how do we make sure people can get access to them? Many are -- or some of them anyway may be proprietary, some of them may not be open source. There is a real need to be able to come up with something that many of the states are going to be challenged to do some of this work can't get access to it.

Also the status of coordination between the various agencies, EPA, DOE, FERC, what kind of guidance is EPA providing about their needs for modeling? Just getting a better understanding of that level of coordination, recognizing that it's happening, but not really understanding the depth of it; how do we go about that? A really important component that came up from our colleague, Tom, from Kansas was, what's the strategy in outreach in the states? How do we make sure they know once there are resources

available, that they can get access to them? So, having some understanding about the outreach strategy would probably be good too, and if there isn't one and there's a recommendation for us.

The next slide, please? Climate risk analysis; is there an evaluation of the risk to plants due to climate change, generating plants, drought, sea-level rise, extreme heat events. Those are topics that we are interested in seeing if there's work being done on. What DOE or related work is being done on transmission analysis, and by whom? Are we able to get access from remote areas to load centers to facilitate compliance?

And there are a number of other activities around the country that have been related to DOE work with regard to resource zoning, and transmission that would be worthy of exploration in terms of trying to plug that information into what we are doing. Also, what is DOE doing on studying ways around markets, as part of the compliance plan in modeling? I think this

is a great interest around the country and especially as states look at working together on compliance plans; this is going to be an important topic.

The next slide, please? Okay. The distribution side that we spent so much time talking about in this meeting, we would like to know more about the work on factoring in the distribution side of energy efficiency and demand response. Is this a part of lab call, who is on point for it, I think we did hear a bit about that, but not necessarily in relation to the clean power plan.

Rate design is another topic. How that might be factored into clean power plan work. And is anyone modeling the best ways for states to get to longer-term goals, say, 2050 or beyond, we are at risk of creating a compliance strategy that really fosters a heavy investment in gas plants. Is that the best strategy for us going forward when we are looking at having to meet much more aggressive longer-term goals, by the middle of the

century?

Now that's a question I think that's particularly relevant because we can get ourselves on a trajectory that makes the second tranche of our work much more difficult.

The next slide? So, we took the step trying to rank these topics so we can have a conversation with DOE about how to order the webinars, and what sequence we try to take them in. And we try to do this by email, and I take responsibility for that, it was a bad decision, because we weren't able to come up with the conclusive consensus about how to rank those. We need to discuss that a little bit further, to see about consolidating some of these topics because I do think there is some overlap, and prioritizing the ones that I think we are going to want to try to do with DOE first.

I do think there is strong agreement about the importance of getting our arms around the modeling questions, so that's likely to be one of the earliest webinars we request.

The next slide? So we are going to be -- Our next steps will be to review the topics again, confer with DOE on the availability and schedule for webinars and calls. After that we'll look at reviewing and summarizing our lessons from the calls, and from this process come up with recommendations for DOE. I put September meeting with a question mark, because it's very unclear to me, there's not a big rush right now to do this, and there is an opportunity for us to suss this out, so it may or may not be something we would be willing to tee up by September, but that is something I think we can shoot for, I think.

We should be able to do some of this work, or most of this work prior to the September meeting. We may not be able to come up with our recommendations by then, but we should certainly have been -- completed our fact-finding, if you will. I believe that's it. Next slide? Yes. That's it.

CHAIRMAN COWART: Any questions for Carl? Thanks for an efficient report. And

clearly there's a lot of work going on there. Anything further?

MS. HOFFMAN: Just looking at this, off the top of my head and we'll go back to our group, but I think there are some things that we can easily provide information to the Committee on. You know, the existing market is going on in climate risk analysis. I think the modeling question we should, you know, first look at what the ISOs and RTOs are looking at with respect to the modeling work they are doing, because they are closest to some of the decisions that are being made, so that we don't have to get in a whole belly of generic modeling that's occurring, more than try to look at some of the modeling that's actually occurring at the ISOs.

With respect to some of the comments on energy efficiency, I think if we want to -- if the Committee wants to look at the value of energy efficiency, moving forward the power plan or the, you know, the climate efforts, we should be looking at energy efficiency, and yes, it does

contribute but it's not the sole reason that the department is working on energy efficiency. And so we've got to recognize that there's a broader set of, you know, needs and objective that the department is going after with the things that we are working on. So, I just want to put that comment out there. But I think there are things that we can move forward out of your list, and then we'll figure it out from there.

MR. ZICHELLA: Thanks. You know, these things came up in our conversations, mainly in this context, between power plan, but your point on energy efficiency is well taken.

CHAIRMAN COWART: All right. Any further discussion? I'd like to close simply by thanking, once again, Gordon and Paul for putting together the panels for this session. A lively discussion, and thought-provoking suggestions came forward. And with that I think this meeting has come to a close.

MS. HOFFMAN: I'd just like to thank everybody for hanging out there -- hanging in here

'til the end.

CHAIRMAN COWART: We are adjourned. Thanks very much.

(Whereupon at 12:27 p.m. PROCEEDINGS were adjourned.)

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CERTIFICATE OF NOTARY PUBLIC

COMMONWEALTH OF VIRGINIA

I, Carleton J. Anderson, III, notary public in and for the Commonwealth of Virginia, 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 Commonwealth of Virginia

My Commission Expires: November 30, 2016

Notary Public Number 351998