BEFORE THE

FEDERAL ENERGY REGULATORY COMMISSION

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IN THE MATTER OF: :

OFA TECHNICAL CONFERENCE :

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Hearing Room 2C

888 First Street, N.E.

Washington, D.C. 20426

Wednesday, May 26, 2010

The above-entitled matter came on for technical conference, pursuant to notice, at 9:00 a.m.

BEFORE:

TITANIA V. KRAMSKAYA

Office of Energy, Policy, Innovation

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Office of Energy, Policy, Innovation

CARL PECHMAN

ENERGY POLICY INNOVATION

ROMULO F. BARRINO

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PARTICIPANTS:

AMERY PORE
Energy Market Regulation
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COMMISSIONER JOHN R. NORRIS
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PANELISTS:

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BEACON POWER CORPORATION
PRAVEEN KATHPAL
Market and Regulatory Affairs
AES Energy Storage
JONATHAN LOWELL
Principal Market Design Analyst
ISO New England
RALPH D. MASIELLO
Sr. Vice President Innovation
KEMA, Inc.
ANDREW OTT
Senior Vice President Markets

PJM Interconnection, L.L.C.

PARTICIPANTS:

ROBB PIKE
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New York ISO
TODD RAMEY, Executive Director
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Midwest ISO
DeWAYNE TODD
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DON TRETHEWAY

Senior Market Design and

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RAHUL WALAWALKAR, Vice President

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Customized Energy Solutions, Ltd.

P-R-O-C-E-E-D-I-N-G-S

(9:00 A.M.)

MS. KRAMSKAYA: Good morning and welcome all. Thank you for coming. We are here to discuss issues related to our frequency regulation in the organized wholesale market, Docket ED10-11.

My name is Tatyana Kramskaya and I am with the Office of Energy Policy and Innovation. I would also like to introduce some of my colleagues here at the table. If you would like to, turn on your microphone and state your name and office.

MR. QUINN: I am Arnie Quinn from the Office of Energy, Policy, and Innovation.

MR. PECHMAN: I am Carl Pechman, Office of Energy, Policy, and Innovation.

MR. BARRINO: I am Romulo Barrino, Office of Electric Reliability.

MR. PORE: Amery Pore, Office of Energy Market Regulation.

MR. WINTERBAUER: Eric Winterbauer with the Office of the General Counsel.

MR. HELLISH-DAWSON: Bob Hellrich-Dawson from the Policy Office also.

MS. KRAMSKAYA: The goal of this conference is to explore whether pricing for frequency regulation

services in the organized wholesale market compensates providers in a way that will provide an incentive to invest in technologies that can provide high-quality of service. By "quality" in this context, we mean the speed and the accuracy with which a resource responds to and helps manage the area controlled error.

The impetus for this conference is the development of new technologies including large-scale batteries, flywheels, electric grid systems, or consumptive industrial processes that are commercially promising and technically capable of providing regulation service.

According to the number of recent studies by the Department of Energy, the Electric Power Research Institute, and KEMA as well as others, these new technologies are able to provide a greater contribution to frequency accuracy and stability than conventional resources such as conventional turbines.

Some argue that these two characteristics can reduce the overall expense of the regulation market. The Commission recently accepted proposals by the New York Independent System Operator and the Midwest ISO to integrate such technologies into regulation service markets. The Commission specifically pointed to the very fast response times

of storage resources as a benefit of the organized wholesale markets.

The Commission also recognized that such technologies can help integrate wind resources and that their integration into the regulation service market should help these ISO and TROs meet or exceed Herc-controlled performance criteria.

In addition ISO New England has recently sought to extend a pilot project for testing the ability of different storage technologies to participate in the regulation market.

Similarly, PJM Interconnection, a California ISO, allows storage devices to enter into their frequency regulation markets.

At this conference, we would like first to discuss with the representatives of these ISO and TROS as well as the industry participants their experiences with these technologies. We would also like to explore whether greater entry of technologies that respond to regulation dispatch signal faster and follow it more accurately will provide enhanced reliability and economic benefits.

Finally, we would like to discuss whether the existing pricing mechanisms for frequency regulation service reflect the quality of the service

provided and whether reforms are needed.

Before we start, I would like to address some administrative matters. There are, first, copies of the agenda, which I hope all of you have, outside of this room.

We are planning to have two sessions, and all the panels here at the table will be participating in both sessions. Even though this is a formal room, we do hope that this will be a rather informal discussion, a lively debate, and we will hear more about the operational details of these markets.

I would also like to ask the panelists to comment on the specific question in the agenda, but we do not expect every question. There will be an opportunity for all the panelists as well as members of the public here as well and also others to submit comments in the ED10-11 docket after the meeting within 21 days of this conference.

Also, as much as I can, I will try to keep things in order, but to move the conversation, we may need to break the discussion before everyone has had a chance to talk, just to ensure that we do cover all of the questions that we would like to ask.

Also, I would like to introduce my colleague, Caroline Dailey, who is sitting there on

the left side of me, who will be taking questions from the public. If you would like to ask a question, please write her a note, and she will submit it to us.

Now, without further ado, I would like to introduce our distinguished panel here.

(There was a pause in the proceedings.)

MS. KRAMSKAYA: My apologies.

Bill Capp, CEO of Beacon Power Corporation; Praveen Kathpal, Market and Regulatory Affairs, AES Energy Storage, Jonathan Lowell, principal market design analyst with ISO New England; Ralph Masiello, senior vice president with KEMA; Andrew Ott, senior vice president markets, PJM Interconnection; Rob Pike, director of Market Design, New York ISO; Todd Ramey, executive director of Market Administrative, Midwest ISO; DeWayne Todd, energy services manager with Alcoa Power Generating; Don Tretheway, senior market design and policy specialist with California ISO; Rahul Walawalkar.

I apologize. How do you pronounce your last name?

MR. WALAWALKAR: Rahul Walawalkar (pronouncing "rah-KOOL wall-a-walker").

MS. KRAMSKAYA: Rahul Walawalkar (pronouncing "wall-a-walker"), vice president with

Emerging Technologies and Markets Customized Energy Solutions.

With that said, if the panelists would like, we can probably start right away with Question 1. As I mentioned, the first session will really focus on the questions related to the value of faster responding resources and the value that they bring to the market.

If any of you would like to start, and I know some of you had submitted comments or presentations, which we will be posting on the Commission Web site and later in eLibrary, but if you would like to start, we would greatly appreciate it.

MR. CAPP: Raise your hand?

MS. KRAMSKAYA: Yes, please raise your tent card, if you would like to start.

Mr. Capp?

MR. CAPP: Thank you. I don't know if everyone has a copy of our comments. If you don't, I can pass one around. I am just going to be referring to a couple of those as we go along here.

Does everyone on the staff have a copy?

(No verbal response.)

MR. CAPP: Good. We've got three. I am looking at page two of our presentation. The first

one is just more of a diagrammatic sort of a visual of the difference between a fast-responding resource. This is Slide No. 1, "Q1." It just shows you the difference between a fast-moving and a slow-moving resources.

In this case, on the left side you have a green line as to what the desired output would be, and the red line is what you get if you have a slower-moving resource. It is just kind of the physics of a slower-moving signal -- I mean, a fast-moving signal, a slow-moving resources.

The second slide down is some data that we have as part of our acceptance process when we certify a flywheel. The diagram on the right shows you some data that came out of our testing at the California ISO that was conducted at the PG&E R&D Labs. They constructed their own test just to determine what the speed of response would be.

Essentially, we respond and other resources, fast-responding resources, can respond before the next signal comes in, which would typically be every 4 seconds in most ISO, 6 seconds in the case of New York.

We completely respond to the previous signal before the next one comes in, so a 4- to 6-second kind

of a ramp rate. That would be compared to the minimum acceptable ramp rate, which would be a full response in 5 minutes in most markets, and actually 10 minutes in the California market.

There is a 100 to 1 or a 200 to 1 ratio between the fast-moving response rate and the minimum acceptable response rate. That has been shown to have a significant difference.

I will refer then to the next slide, which is Slide 5 on page 3. There are two lines on this one. There is a green line, which is essentially the signal that we were dispatched from the New England ISO which shows it goes up, goes down, goes up. This is over an hour's time, by the way.

Superimposed on that is a red line, which would be the minimum acceptable response rate that would be paid the same in most markets as a fast-moving resource.

You can kind of see just visually that the green line is doing a lot more work. It is offsetting area control error much more effectively. The area under that curve is much larger than what you have under the area of the curve of the red line.

They are just some diagrams, just some visuals, just to give you an idea of what the numbers

are in terms of a response rate and what they look like.

MS. KRAMSKAYA: Thank you.

Mr. Todd?

MR. TODD: Yes, DeWayne Todd with Alcoa. I guess I just wanted to comment on the first piece of this question. We provide an alternative process through demand response.

I mean, we are operating today in the Midwest ISO. We currently provide 70 megawatts of operating capacity which can be available for regulation throughout that entire range. We have been successfully doing that for about a year and a half.

It presented some overview slides that showed that over that year and a half we have been available for about 99.14 percent of the time. Our availability in terms of the accuracy, we have hit the targets as they are currently established inside of right at 99 percent as well. That is looking at 10-minute intervals for a year and a half worth of data.

Currently, we operate at the maximum response rate, ramp rate, from a regulation perspective that is compensated inside the Midwest ISO. For our range, 70 megawatts of operation, we run

about a 4.9 megawatt per minute ramp rate.

The reality is, what we have seen internally is that we can go as much as three times faster than that. Again, this is purely off of a demand resource, so there is not a thermal momentum and all of the overshoot and slop associated with a traditional thermal generator.

I just want to lay that as an example that there are technologies out there that are successfully working today. However, there is not a compensation mechanism that says for a faster response rate -- there is no incentive for us to go any faster or operate and make those services available.

MS. KRAMSKAYA: Thank you.

Mr. Ott?

MR. OTT: Yes. Again, this isn't being broadcast, right, so we don't have to say our names; right?

MS. KRAMSKAYA: (Moving head from side to side.)

MR. OTT: What we have seen to date is definitely the storage-based devices can respond faster to the signals and more accurately to the signals than what we have seen with generation. The only limitation they seem to have is how long they can

sustain moving in one direction.

Again, because there are different components of the area control error, one of the components really is looking more towards fast response not for sustained periods, and that is perfect our storage device. We have seen excellent response. I mean, way above what we are seeing for generation; it is not even close.

MR. PECHMAN: Can I just ask maybe just a followup question to make sure that we are all on the same page. Is there anybody that disagrees on the panel with the idea that these new technologies can respond both faster and more accurately than the old technologies? Is there any evidence to the contrary that anybody wants to bring to our attention? Thank you.

MS. KRAMSKAYA: Mr. Masiello?

MR. MASIELLO: You might want a clarification that the compressed air energy systems, which look to be the new large-scale storage, are going to behave more like combustion turbines, so fast but not different.

MR. PECHMAN: Okay.

MR. MASIELLO: Pumped hydro systems under discussion that can be controlled in a pumping mode

also will tend to behave more like a hydroelectric system, again, fast but not in the category of batteries and flywheels.

MR. PECHMAN: Okay. Well, thank you very much, Mr. Masiello, for that clarification.

MS. KRAMSKAYA: Mr. Potishnak, do you have a comment?

MR. POTISHNAK: Basically, what we have experienced at ISO New England with Beacon's flywheels is that they do respond very accurately and at least as fast as our fastest-moving, say, pumped hydro resources.

The main issue for us is sustainability and how to deal with that. We are still trying to work that through. Their basic ability to month after month follow the signals reliably and plenty of sufficient accuracy is definitely there.

MS. KRAMSKAYA: Mr. Walawakar?

MR. WALAWAKAR: Yes. Rahul Walawakar with Customized Energy Solutions. I just wanted to continue on that thought process. With all the emerging technologies, there are a number of technologies.

We have already seen the data with Beacon that these units are able to respond faster. At the

same time, there are a number of additional units which people are right now working on introducing in the market which can also provide faster response.

But one of the key parties that people are looking for is some indication in terms of is there a value for faster response. If yes, then they can introduce devices which can respond faster. But at the same time, for some of the technologies there is a pay off.

Again, the issues about 15-minute availability, I think that is also more of an economy issue. It is not an issue in terms of just technical characteristics.

Possibly you can configure most of the energy storage devices in different ways so that you can get longer energy duration. If there are studies which suggest that instead of 15 minutes there is a longer duration required, I think most of the emerging technologies will be able to respond to that. But it is just a question of if that will be economic to do that, given the capital cost.

But, in terms of the emerging technologies which we are seeing, particularly when you also consider demand response capabilities, then in general I think we can say that, yes, most of these

technologies will be able to respond faster than the existing generation.

But at the same time, maybe one issue to look at is, Are there existing generation technologies which can also respond faster? Maybe they are right now just complying with the existing rules and regulations. But overall I think all the data we have seen so far suggests that there is a benefit with emerging technologies.

MS. KRAMSKAYA: Thank you.

This is very helpful, and I think this really helps us to transition to the second question as to whether the newer technologies can potentially lower the total costs of various TROS and ITOs. We have heard from Mr. Ott, but would any other representatives of the TROS and ISOs like to comment?

Mr. Ramey?

MR. RAMEY: At the Midwest ISO, we are currently running pretty lean on procured capacity provide regulation. My perspective on this question of the potential to continue to lower the cost of providing regulation service by introduction of more and more faster sponsor resources is I think there is limited potential once you reach a certain level of capacity that you are procuring.

It is driven by -- imbalance really is addressed through primarily two mechanisms: the load following the redispatch and resetting of energy or unit base points to and balance the load, and then the regulation signal in between.

The dynamics of that regulation imbalance really kind of represents a range from zero, so at Midwest we are recalculating and redeploying generation on a 5-minute basis. Over a 5-minute period, the dynamics of our imbalance, given our system, is in 2 standard deviations, will be plus or minus 500 megawatts.

If we are only carrying currently in the Midwest 400 megawatts, in those time periods we are outside of that 400-megawatt range, we don't have enough regulation to bring us back in balance prior to the next 5-minute generation dispatch calculation.

If I have a lot of resources that can move from zero to 400 very quickly, that is great to a point. But I still need a certain amount of capacity to reach and cover broader periods of time.

Can I get there faster with faster-moving resources? That's true. But I still need to be able to step out further. If I can get their faster and replace my existing traditional resources that are

providing regulation with fast response resources, if I'm still at 400 megawatts, the potential for lowering costs is based on an incremental cost of providing regulation between the traditional resources and the new faster resources.

MS. KRAMSKAYA: Mr. Lowell?

MR. LOWELL: (No microphone.)

MS. KRAMSKAYA: In that context, would that have any effect on the traditional resources? Would they be freed up to participate in other markets more actively?

MR. OTT: Excuse me. You need to turn your mike on.

MR. LOWELL: With the amount of demand response and electric vehicles, and so forth, that could be there 10 years from now, and if my assumption is correct that it would be a lower cost, then, yes, I think it is feasible.

It could push some of the thermal generation that today provides regulation to New England out of the market. That won't be their best use. I don't know that it would push it all out. There are multiple dimensions to managing your area control error.

MS. KRAMSKAYA: Thank you.

Mr. Walawalkar?

MR. WALAWAKAR: I think in principle, there is definitely potential for reduction of cost because of some of these emerging technologies. Again, within the emerging technologies, particularly technologies which have been currently demonstrated in terms of energy storage technologies like Beacon's flywheel or nano batteries or similar other technologies, because typically the marginal costs for these units are relatively small.

They are typically based on just the electrical losses for the system, which are typically somewhere between 15 to 25 percent, at least based on the current available data.

Whereas, traditionally the regulation market clearing price also has a link to the energy prices for a fossil fuel-based generator the potential loss of opportunity from not providing energies incorporated in the regulation market clearing price.

There is a likelihood that with some of these emerging technologies where you do not have the direct fuel costs associated or these units are not participating in the energy market, they will end up having lower marginal costs. Particularly under current rules, the opportunity cost component is not

considered for these units.

Definitely I think in terms of the bid they will come in towards the left end of the supply stack for the regulation resources. At the same time, sort of the chicken-and-egg issue is that most of these technologies expect that they are providing better service, so as a result they should get paid more.

If the regulation process actually does end up going very low, then I think the incentives for introducing these new technologies would also diminish.

There is a sort of chicken and egg, but overall I think principally there should be a potential for reduction in regulation prices with the introduction of these resources.

MS. KRAMSKAYA: Mr. Capp?

MR. CAPP: Thank you. Again, I will refer to our handout. This would be page 3 of Slide 6. This is an extract from a study that was actually paid for by the California ISO and conducted by the Pacific Northwest National Laboratories. The question they asked was really the same question: What is the value of fast-responding resources in terms of regulation?

This characterized, first of all, what they viewed as the perfect resource, which is one that

responds very quickly, one that responds very accurately without hunting overshoot or undershoot, and one that operates indefinitely.

They said if they gave that a hundred percent on their arbitrary scale of ideal resources and they said, "What about a fast-responding resource," this says "flywheels" but it would really apply to several of the resources you are seeing gathered here today, fast-responding batteries, and so forth.

They got something like an 82 percent. You can see the other resources that are available. It basically said in terms of solving the problem of regulation in the California ISO, there is vast disparity between the effectiveness of the various resources that are or could be deployed on the grid. They came away, the perspective was "Well, maybe there should be a differential in payment." There is one view.

This really has to do only with the amount of regulation. I would agree with the notion that if you have more resources in the market obviously that has a secondary effect of more resources tend to bring down clearing prices.

This just speaks to the estimated

effectiveness. I mean, they also made a comment that I think it was if 30 percent of the resources deployed were fast responding, you would have something like potentially a 40 percent reduction in the amount of regulation required.

MS. KRAMSKAYA: Thank you, Mr. Capp.

Mr. Pike?

MR. PIKE: Thank you. I guess from the New York view of where we see regulation usage, when we look back at the regulation deployed, we find it is very unpredictable of what our needs were in any given 5-, 10-, or 15-minute interval in terms of did we have a regulation signal that was very intermittent.

The needs were very intermittent, and we really had a net zero energy need over that period of time, but we certainly had fluctuations that we needed to manage.

We also see certainly periods of time where those can be very sustained needs, either injections or withdrawals onto the system that can last easily 10 to 15 minutes when you start talking about wind integration and potentials for low-forecasting error.

I think it is important to recognize that both of those control signals are needed and need to be managed when we go ahead and figure out what

resources to use to best manage that.

To the study that Bill Capp was just pointing out with Pacific Northwest Labs, I think it is important to recognize that that looked at using regulation very differently than any ISO currently uses regulation service.

Essentially, that study looked at ignoring all of the small duration, small inconsistencies in balancing of generation to load and only went after some of the more extreme high-ramping events and catalogued what type of resources could meet that type of service deployment.

The statistics are there, but they are there for a very different type of regulation deployment than is seen in any of the ISO markets today or any of the non-ISO reliability coordinator areas.

MS. KRAMSKAYA: Mr. Tretheway?

MR. TRETHEWAY: Just to echo what Bob was saying, first, we do see that the demand for regulation is increasing as we integrate additional amounts of renewables. Having additional market participants will be beneficial.

We have seen through some studies that there is some relative value to fast. I think the key ability is we are procuring a certain amount of

regulation that is currently meeting our needs.

Over time, does the attributes associated with the regulation product we are buying, does that need to change to meet the future integration and future regulation requirements going forward?

We do see a relative value to fast. There is a relative cost to short duration. I think you need to look at them all in context in terms of what are the regulation characteristics that you need to procure through the market to meet your operational needs and to maintain the grid reliably.

MS. KRAMSKAYA: Thank you.

Mr. Capp, would you like to respond?

MR. CAPP: I just wanted to go to a couple of other slides, too, and receive the feedback. I'm trying to get a dialogue.

MS. KRAMSKAYA: Thank you.

MR. CAPP: I am now referring to page 4, Slide 7. This is a one-hour graphic. The same one I showed before with a little bit more information, though. That is, again, the fast-moving resources exactly following the signal and the slow-moving resource you can kind of see visually there the dark green is the portion of the light green that was covered by the slow-moving resource. But then the

pink areas are actually conditions where the slow-moving resource is actually on the wrong side of correction because it was dispatched, say, down reg and then the signal says "No, actually what I want is up reg." Because of its slow ramp rate, it is still on the wrong side of the signal.

The pink areas here are the places where the regulation resources actually are going in the wrong direction from what the dispatch desire is. Since from a reliability perspective it is all about CPS2 and what happens in the 10-minute interval, we think that is an important ingredient in terms of meeting those reliability requirements.

If you look at the extract there on the right-hand side, the flywheel or fast-moving resource has a certain amount of correction versus the other one.

There is a substantial difference between the two. It is just a mathematical extract. That particular draft, I mean, I think this would generally be the case, but it is a visual way of seeing the effect of a fast-moving resource.

Then, the last slide is at the bottom of that same page where we have extracted information from various ISOs for 2009. The key number on here is

the amount of regulation procured as a percent of the average low. That typically has been 1 percent over the years in most ISOs, but you will see there are some differences there.

ISO New England we view as having the best tariff in this area because they, first of all, dispatch fast first. They take advantage of the speed of response by dispatching those resources first. Of course, there is a pay-for-performance component as well.

*****Substantial savings for rate payers in terms of the amount of regulation requirement. Midwest ISO also dispatching past resources preferentially, there is no payment. Of course, the Midwest ISO has a similar kind of a performance.

PJM and the New York ISO are pretty close to the traditional 1 percent number. The California ISO, I think, shows you fairly quickly the real relationship between speed of response and regulation requirements. The California ISO to our knowledge is the only one that has a 10-minute resource availability.

In other words, in every other ISO you can only bid into the market the amount that you can move in five minutes. Whereas, in the California ISO, Don,

I think I can say that 10-minute resources are allowed.

You can see the difference there in terms of the amount of regulation requirement is 1.43 percent in 2009. We think that the main reason for that difference is the speed of response.

MS. KRAMSKAYA: Mr. Lowell and Mr. Potishnak, would you like to comment on the statement that Mr. Capp said as to the fact of the ability of these resources to participate and the effect on the total amount of frequency regulation that needs to be procured?

MR. POTISHNAK: I think that Bill Capp showed about 82 percent effectiveness compared to the ideal is quite accurate when you are in the friendly scenarios. What we are wrestling at ISO New England with is what happens with the other 18 percent of the time.

The one scenario that concerns us, and we're all still thinking this through, but supposing all of our regulation resources were of these high-speed but short storage, low storage, characteristics and we were, say, under generating for a few minutes where these storage devices were spun down.

They have been acting as sources for quite a

while. Then, we incur a large loss of generation with a disturbance control standard event. We lose, say, Seabrook at 1,200 megawatts or something like that. These resources would help out, would be sustaining where they are for a while.

During that recovery period if they run out of energy, they may amplify the size of that contingency. Now instead of having to recover for Seabrook, we have to recover for the loss of those short-term resources being depleted during that period.

One of the solutions that we are investigating is what Midwest ISO and New York is planning on doing to basically effect their economic dispatch such that these devices tend to be optimally charged.

There can be some "hell to pay," so to speak, if you don't have them properly charged on your disturbance control standard event. The ISO New England may incur the proverbial million-dollar fine for compliance.

MS. KRAMSKAYA: Would anyone else like to comment?

Mr. Kathpal?

MR. KATHPAL: Yes. I think a useful example

that we like to use to illustrate how you get to fewer megawatts total regulation you use, I think the slide that Bill was showing with the pink triangles, what those pink triangles really represent is when a conventional resource would be acting opposite in the direction that would benefit ACE.

The implication of that is that some other resource of equal megawatts needs to counteract it at each of those times, and some additional resource in conventional resources that are not fast needs to act to go in the direction that would benefit ACE. That is useful in illustrating why you would end up using fewer megawatts of regulation, if your resources were fast.

Then, also, too, your question earlier about the effect on the remaining megawatts in the fleet if fast resources took on the duty, the reserve duty, I think a project that AES has done in South America is kind of a microcosm of our greater market and grid systems where a specific storage unit was deployed to take on the reserve duty of a specific generator, freeing up the remaining megawatts of that generator to produce energy.

The same impact applies on a larger marketwide ISO- or RTO-wide system where those

conventional megawatts are now available to produce energy where they previously hadn't been.

In terms of total cost, I think that is part of the picture as well because you have units that are on line, they are spinning, but they are not producing to their capacity even though they have the ability to below what the market clearing price should be for energy.

MR. PECHMAN: (No microphone) Does that also imply that the generators are operating --

MR. KATHPAL: Yes. I would say that there were two efficiency benefits that result: One is ending up at a more optimal heat rate level, and the other is the reduction in cost for fuel and L&M from ramping up and down to provide regulation.

MS. KRAMSKAYA: Mr. Masiello, did you have a comment?

MR. MASIELLO: Yes. I would like to come back to Mr. Ramey's comments. This discussion has a certain abstract unreality to it. You can't separate regulation from the load following or the real-time dispatch.

For instance, in the discussion around the behavior in ISO New England, if ACE has indicated the units need to move up on regulation, that normally

means the real-time dispatch needs to move units up immediately as well to follow that.

You would have to look at the data. It could be the conventional units appear to be moving counter to an ACE that has gone down, but they are responding to a combination of regulation and dispatch. It is not a laboratory with a clean experiment.

Second, we have to think forward. Not only to storage devices could be half or more of the regulation resources, but when renewable resources are a large percentage of the energy resource, ramping of renewables is pretty widely accepted today to be the largest operational problem ahead of us.

Storage devices that are used to defend against ramping whether via the regulation scheme or real-time dispatch or a new service, at least the work I have been part of, need a one-hour or two-hour duration to be the only resource used for ramping.

That implies that if we have a true zero energy resource with a 15-minute duration, then those other units, conventional units, or something have got to be made available to follow an unforecasted ramp.

The cost picture is more complicated than simply saying you can displace a unit that is holding

back 10 megawatts to provide regulation with the storage. You have to look at the whole picture.

MS. KRAMSKAYA: Thank you.

MR. Walawalkar and then Mr. Capp.

MR. WALAWALKAR: Again, I don't have a specific answer, but just wanted to share some of the various technology providers who are struggling with the issue. The 15-minute regulation for them was its longer duration.

I think sometimes the perception is that by sort of maybe integrating the load following requirement with the regulation signal, maybe that is actually maybe the issue in terms of needing the resource, maybe needing regulation resources which are longer than 15 minutes.

Possibly that could be maybe handled more efficiently by having the resources which can respond within 10 minutes and maybe having the right price signal for those resources that can take care of it.

The faster resources can still provide a response to the fast part of the regulation signal within the 15 minutes. Then, if there is right signal out of the requirements for other ancillary services outside accordingly based on the ramping needs, which I think other ISOs are seeing with the wind

integration issues, then maybe that could be a more efficient solution than sort of mandating that all regulation resources may need a longer duration.

Just sort of on a different point, I just wanted to share a little bit caveat. I agree with almost everything what DeWayne said. But just in terms of drawing balance to the Chile situation with the U.S. situation, I just wanted to discuss this market-based scenario. Rob and Andy please correct me if I'm wrong -- right now in these markets we are co-optimizing for energy and ancillary services.

It is not that we are forcing certain generators to remain on certain idle capacity for just providing ancillary services, that decision on the dispatch level is done based on the economics by the ISOs.

At least based on right now, the prices for those ancillary services I think it would indicate that there are enough resources available in that area and some of the emerging technologies may not be cost competitive just for freeing up that energy capacity from the generators, particularly because I think that with the co-optimization that is providing a more transparent pricing for regulation and other ancillary services.

MR. OTT: Yes. I mean, the bottom-line answer to the question is it is a no-brainer. These resources have to lower the cost. I mean, you bring in new technology that can provide competitive price regulation it has to lower the cost.

I mean, you look at the sources of lowering cost. Of course, one's potential source could be people get more confident, operators get more confident, that we can control better because we have more accurate response, and we lower the overall regulation requirement. That is fairly small.

Second, is this issue of the product substitution. The energy price is actually higher because we have regulation requirements. In other words, you are pulling generation out and saying "Go to regulate," so energy prices are higher.

If you can lower energy prices, that is a big deal because now you are talking about lowering the marginal price of energy. You have units that I will call them "reluctant regulators."

They don't really want to regulate. They don't like to regulate. It increases their L&M cost, but they submit an offer to do it anyway because traditionally the needed to and now it is just viewed as a revenue stream. They don't jump at the chance,

let's put it that way.

The point is if you can get them displaced by another type of resource that is better at it and wants to do it, they have less L&M, so they have less outages. Their costs go down.

I think the product substitution is probably the big deal because you are essentially not -- you are using resources that would rather generate and produce energy to do that.

I agree with you we take at least a run at doing it optimally today, meaning, make a decision. If you have a new set of supply come in, it can't help but lower cost. I mean, I don't know how you could say it couldn't.

MS. KRAMSKAYA: In both markets? In both energy and regulation?

MR. OTT: Yes, both energy and in regulation. I mean, it's not a hedge here. Unless you say it comes in and it is way above market and it can't compete, but otherwise how could it not?

MS. KRAMSKAYA: Mr. Capp, did you have a comment?

MR. CAPP: I just wanted to followup on Mike's comment. We learned a lot from Mike about the regulation markets. We certainly view him as an

expert in the area.

I think when he said there may be hell to pay in terms of these resources, I think that was strictly a view toward this particular combination. I think all of the ISOs are going to dispatch resources and procure services in a way that will prevent those things from happening.

It could be that when you rebalance all the resources, maybe you use a little bit less regulation. Maybe you bring in a little bit more spending reserve to handle the contingency events.

I don't really think that there is anything about fast-responding resources that can compromise reliability. I think it actually enhances it but in the grand scheme of things it may change a little bit of the balance of the procurement.

MS. KRAMSKAYA: Thank you. This was actually our third question. Before we move on, I wanted to see if Mr. Ramey had any comments. Did you raise your tent card?

MR. RAMEY: I would echo Andy's comments that fast response, new technology coming in, in the short-term can only have downward pressure on cost of operating the system.

In a market design that includes

co-optimization of the available offers to provide competing services, energy regulation or spin, that can be co-optimized and managed on a very short time frame across the fleet maybe on a 5-minute basis, you are capturing a lot of the value of getting the right megawatts in the right places, providing the right resources. You can capture a lot of that value through available market designs that are out there today.

The value for fast-response resources as competing against traditional regulation providing resources comes really from a couple of places. One is the wear-and-tear factor and cost that traditional resources do incur for providing regulation as Andy said.

The second is that a traditional resource that is capable of providing multiple products, energy in particular, faces a real opportunity cost of providing regulation but market clearing price.

Market design can accommodate cost, put that in the market clearing price, so the traditional resources that clears and provides that service is fairly compensated for it. A new fast-response resource effectively has a zero opportunity cost there, so that is a cost advantage as well.

There is potential for in the short-term real cost competitiveness of these real resources, frees up traditional capacity, provide competing services.

As Andy said, it tends to marginally lower the overall value, price, and cost of providing all of the services to make sure that energy is continuously delivered reliably.

MS. KRAMSKAYA: Thank you.

If there are no further questions or comments, I would like to move on to the third question with respect to the effect that these technologies may have on the overall reliability of the systems. Would anyone like to start?

Mr. Ott?

MR. OTT: If I could set the stage, I think a couple of us have danced around the issue of the fast response versus sustainable. I think we just all should take a deep dive and talk about the two components.

When we are trying to do system control, control frequency, essentially there are two components we need to worry about. At least the way we term it is that we will call it the "tie error component," which is essentially tends to be stay in

one direction longer. It is the basis for the fact that we are all interconnected. There is a tie error component, and there is a frequency component, which tends to move a lot and is faster.

Essentially, when we look at this, I couldn't have, for instance, all of my regulation signals being sent out, the type that is very fast moving.

I need to have some respecting sort of the longer-term trend, if you will. I've got to have both components. Both components are in the ACE, the "area control error" measurement. Sometimes they are opposite. Sometimes, the frequency is high, but the tie error component would tell you to go in the other direction. You can't ignore that.

Now, I will make a statement, though. Having devices that are fast and accurate and will follow the signal they are sent to the letter, if you will, would be helpful in both of those. In other words, it wouldn't be unhelpful.

It is just what we can't do is assume we can put everybody on an ACE-based signal or a frequency-based system and say "Run the system because you would essentially then get into a situation where it would be like oversteering a ship, you would be

overcontrolled.

MS. KRAMSKAYA: Mr. Potishnak, and if you could, follow up on Arnie's question.

MR. POTISHNAK: There are two ancillary products out there. Signals are sent out based on your controller, and it is thought of as a minute-plus kind of product. Just don't fall in the trap thinking everybody needs to get a fast signal.

MR. QUINN: Can I ask a followup, just so that everyone is on the same page. Does that mean that you send different signals to different resources? One signal based on the frequency, and other signal based on --

MR. POTISHNAK: That is what we did when we had the battery storage device, the AES battery. Essentially, it wasn't doing well following what I will call the standard regulation signal, which essentially looks at the tie error component and these other things. When we sent up one that was more just frequency-based, it did extremely well because, again, it was just sustainability versus fast.

Now, of course if you took a bunch of batteries together, they could be sustainable, too. They just wouldn't have as much quantity, so you could certainly have them follow a slower signal.

But I think what we are looking at actually is saying we have to quantify how much of the slower stuff, the tie error based stuff we need, then everything else can be the frequency-only based signal.

We would send different signals, but both signals would want people to be right on the signal. In other words, it would be very beneficial to our operator to have people -- because today generators really can't regulate to save their lives.

Today, generators really can't regulate to save their lives. They don't follow the signal accurately; the big generators. I mean, they just don't, and they never have.

The point is you can't just throw everybody pure ACE, either. Yes, we do, in fact, send the storage devices different signals, and we've found that to be great. I mean, it was mutually beneficial.

MS. KRAMSKAYA: Mr. Potishnak, if you can also followup, if you have any comments, on Arnie's question.

MR. POTISHNAK: I want to add on to what Andy was saying. One of the problems I have had with the question is the terminology using frequency regulation has been out there.

I think we need to be very clear that there are two ancillary service products. One is regulation, which in practice the overwhelming majority of the balancing authorities out there are controlling their area control error. There is an area control error computed centrally. Signals are sent out from the area control based on your controller to the devices to provide regulation.

It is thought of as a minute-plus kind of product, conventional thermal generators often take 3 minutes to turn around from going down at 3 megawatts a minute, yet we make it worth it. CPS2 criterion has a 10-minute window. The field trial that is going on in Eastern Interconnection has a 30-minute window. Regulation is thought of as a shorter-term product.

Frequency response is not based on error controller; it is based on a local measurement of frequency. The devices respond providing that service subminute, hopefully a lot of it in less than 4 seconds. It can't have signals coming from the control center of the balancing authority. They are very different products for very different solutions.

A device like Beacon offers with the flywheel can provide both services. It is just that

there are developed markets for regulation, and there is not much developed yet for the frequency-response product. I wanted to clarify that.

MS. KRAMSKAYA: Mr. Masiello?

MR. MASIELLO: Yes. If I could just keep that thread going a second. In a high-renewables scenario, the amount of frequency response in the system could decrease significantly as conventional units are displaced from the dispatch. There could be a future where there will be a frequency response product or some basis of ensuring it's there. These devices could also provide that.

If you go even closer to zero, inertia, the rotating inertia, in the system will also be at risk. There haven't been very many studies of that yet. But it is conceivable that these storage devices could provide a synthetic inertia as a product that either the market operator procured or renewable operators were required to provide somehow.

MS. KRAMSKAYA: Okay. Mr. Barrino?

MR. BARRINO: I believe you referred to improving system reliability by improving frequency response. Now, is there any other benefit to that offer by these facilities to improve reliability?

MR. OTT: Is there any other benefit to

having more accurate response to regulation other than improving reliability?

MR. BARRINO: Not only for frequency response, but for any other.

MR. OTT: Well, certainly, I mean, if the system operators were confident that essentially the regulating resource would lay on top of the signal they are sending, that would be a big benefit to reliability, assuming over time people would adapt how much regulation they needed in their calculations, et cetera.

I mean, obviously that would presumably lower costs. The two benefits of course improve reliability and lower cost. I don't see another one, if that was your question. I think both of those would be awesome.

MR. BARRINO: Do you see enough information out there to quantify the benefit over what is existing today?

MR. OTT: I'm sure you could devise a study to do it. We have some experience. I don't know that we have enough to have a lot of confidence that we could accurately quantify it. Certainly, we could take a run at it.

I mean, the components of it are pretty

clear. It is just a matter of what do you assume. We have 1 megawatt or a megawatt-plus of it as opposed to 10 or 20. I think as this penetrates over the next year, I think the study could be done, yeah.

MR. BARRINO: Do you see among the existing and the new resources of frequency response enough differences that could justify separating them in groups for purposes of performance evaluation and compensation?

MR. OTT: Well, there is enough difference to want to send the two types of signals, which I will call a "standard regulation signal" and a "frequency-only regulation signal." Certainly, you could do that.

I think you could measure performance, though, of following to the signal you are sent the same way. In other words, whether you are sent a standard signal or whether you are sent a frequency-only signal, you measure, okay, how well did you follow that signal.

I think you can standardize that measurement across both types. Again, let me be sure we are communicating. The fast resource could qualify to be either one. The only difference would be on the standard one they would have to be more sustainable,

meaning, for us we are thinking of for the frequency-only one we would go a 15-minute duration, and for the standard we would go an hour, for instance.

We're thinking we would probably need less of the standard than we would need of the frequency type. Again, it is not a constant. It is that the split between which way we would split those signals would depend on system conditions.

You wouldn't have to make it two separate products, and I think you could standardize how you measure based on what you are sent. If that is your question, I think you could do it that way.

MR. BARRINO: Thank you.

MS. KRAMSKAYA: Thank you.

Mr. Capp?

MR. CAPP: I don't have anything to add.

MS. KRAMSKAYA: Mr. Todd?

MR. RAMEY: I guess I want to piggyback on this idea. The systems we have today are designed around thermal generators. Performance standard CPS, those elements are written to say, "Well, this is reliable for what we have traditionally had, which is large thermal generators."

I think Mr. Ott hits on this point that we

have brought up and experienced that says, "Even though we are able to respond faster inside a lot of the control areas, the system, ACE controls, are not designed to happen something that happens much faster. It is really an undesirable element because the system is designed to handle a large grouping of "This is generally how thermal generators respond."

To me that is what calls up this notion that inherently the system is designed for a generator that has a large inaccuracy. It is slow moving. It is not necessarily going to be there when you want it. There is availability. Industry average for a thermal generator is 6 percent. Six percent of the time it is not even going to show up as available.

From liability standpoint, if you can be assured that something is going to respond. It is going to be there where you want it, when you want it. Then, the reliability inherently may redefine what is a reliable set of conditions by which the system is operating, the ability to accommodate how those impact into the system.

Today a lot of those mechanism aren't there to accommodate additional or quicker faster types of response into the very control systems themselves.

MS. KRAMSKAYA: Thank you.

Mr. Pike?

MR. PIKE: Just kind of one comment to build on. We have had a lot of discussion about thermal units providing regulation service and some of the inherent inaccuracies they have.

In New York, most of our regulation service historically has been provided by large hydro units with very high response rate and very accurate response rates.

Just kind of a balance to the discussion that there are traditional resources that are very accurate and very fast at moving towards regulation signals and can play big parts in the markets today for those services.

MS. KRAMSKAYA: Mr. Capp, I apologize.

MR. CAPP: Oh, don't worry. We just had page five and six has three slides that talk about not exactly an improvement reliability today, but really a need for more of these resources to maintain reliability in the future. That is related to variable resources, wind and solar.

There have been a variety of studies. We cite some of them here. They all show an increasing need for additional regulation associated with the deployment of wind and solar, especially when you get

beyond 20 percent into the 30 percent range. The amount of additional requirements is still somewhat in the stage of flux, but it can be a significant increase.

I know there are some concerns around the table that there won't be enough of those regulation resources even available at some point in the future to properly integrate wind and solar without compromising reliability.

MR. PIKE: If I could just touch one more on the renewable aspect. Actually, ENRAL had a number of studies, but they had a recent report that I was reading. They actually buried something in a footnote that I thought was really important in that it tried to draw a distinction of what is an intermittent resource. It was generalizing an intermittent concept, and said "That might not be the appropriate definition for wind."

Wind is variable in nature. It is ramping in nature, but it really doesn't suffer from short duration, high volatility in its output. It is going to ramp in, and it is going to ramp out. You have got to be able to manage those ramps. It is a very different profile that is produced by wind than is produced by solar.

As we talk about integrating intermittance under the system, we recognize that at least those two produce different regulation needs.

MR. RAMEY: We would agree with that. The variability of wind as we are looking at higher penetration levels, I agree with what Robb said. It is really not changes in wind output that is happening in the regulation time frame. It is more of a load following duration time frame question.

In the Midwest where we are facing the potential for significant increases in penetration and renewables, five years ago we had 300 megawatts or so of renewables, and today we are over 8,000 megawatt capacity.

Some studies and scenarios are suggesting that number in the Midwest ISO territory going up to as high as 40,000 megawatts of intermittent. Even at those levels we are not seeing or expecting that penetration of wind to be a strong driver of the regulation requirement.

We, however, do have very significant concerns about the ramping requirement that high levels of wind penetration poses and the load-following time frame.

This question of the value of ramp, whether

today we are talking about the value of ramp in providing regulation service or in general, these systems are very dependent on flexibility to accommodate changing system conditions.

Flexibility really comes down to ramping capability, how quickly a resource can move and its range of movement, how far it can move from its minimum operating point to its maximum operating point.

We see this ramp issue, in general, being a big issue that we need to think about, strongly and long and hard about what the implications are for ramp requirements going forward the low-filing therefore and the regulation time frame.

MS. KRAMSKAYA: Thank you.

MR. LOWELL: I would echo a lot of Todd's comments. In some analysis that we are in the middle of now looking at various wind integration scenarios, we have found that if in New England the wind tends to be developed offshore, we see very different characteristics than if it is on shore. We see different utilization of the storage requirements, the predictability of the events.

One of the questions that we are looking at is: Do we need a different category of reserves to

deal with wind rabs? Are they contingencies, or are they forecastable events several hours of; and if so, what is the best way to do it? We would prefer not to create a brand new category just for administrative purposes, but it may be that that is what necessary.

I think, as Mike said earlier, the difference between the services that the controller may stop or the grid frequency control regulation operating reserves, you have to keep that in mind as you look at all these things. It is definitely not a one-size-fits all.

MS. KRAMSKAYA: Mr. Potishnak?

MR. POTISHNAK: I would like to make a followup comment on our thoughts of conventional thermo generation and response problems. If you go back to the early nineties when pulse-based control was prevalent, and not too many power plants had plant computers and may be using turbine technology, AGC performance was pretty ragged. But over time we have seen the plants get into coordinated control, having plant computers there. With the conversion set point control, we do get sufficiently good performance out of our regulation fleet.

We have a lot of combined cycle plant generators that maybe can turn around in one minute

instead of three minutes compared to an old barge coal plant. One of the things: How closely to they have to follow signals? How do you value this new potential product? How important is it when you look at the control performance standards?

Right now, we are getting 95 percent CPS2 compliance using set-point control. While it is true qualitatively that these new devices can get there fast or more accurately, I don't deny that, how do you value that, given the starting point where we are? Of course, when we get more valuable resources, what will it mean then? How do we put that all in perspective? I am at the front end of wrestling with all that.

MS. KRAMSKAYA: Before we move on, I wanted to recognize Commissioner Moeller, who joined us after we started. Commissioner, would you like to make any comments or questions?

MR. MOELLER: Thank you, Tatyana. I appreciate the effort of everyone coming here. Staff is putting together an excellent briefing book, and for holding the conference. It is obviously a very important issue moving forward. Just the last few minutes of discussion on integration of variable resources, this is going to be a key part.

I was very happy to visit the fine folks at

Beacon in December to see the headquarters and the facility. It is an issue that is important to me. I can't be here much more than 20 minutes, but I wanted to show my support.

Thank you for the time.

MS. KRAMSKAYA: Thank you, Commissioner. With that, I think we can move on to the last question for this panel. I think we had already started on that path of discussing the quantitative benefits of faster-responding technologies.

I know that several of you had mentioned both economic and reliability benefits. Mr. Ott had mentioned some of the information the be extracted from the pilot programs that are currently run. Are there any other initiatives that the stakeholders and the ISOs and RTOs are currently undertaking that would allow to better quantify those effects?

Mr. Ramey?

MR. RAMEY: In Midwest ISO, January 2009, we transitioned our footprint from a regime where we had 26 separate balancing areas individually procuring and deploying and balancing those individual balancing areas.

January 2009, we transitioned from that multiple balancing area regime to a Midwest ISO

balancing area where we began procuring and deploying ancillary services. One of the things that was key for us to track and process was the value that was actually delivered from that transition.

The way looked at it was that -- this gets back to the prior discussion, what is the value of improved reliability -- our viewpoint is that we fortunately enjoy a very reliable system today.

We weren't looking towards going from a CPS1 of 125 percent and driving it down to 100 percent and quantifying, or maybe even driving it up to 150 percent in trying to quantify the value of the reliability improvement.

We set the target of performance under Midwest ISO operation to be consistent with the high level of reliable performance, controlled performance that we had prior to MISO's implementation as a balancing authority.

Anyhow, what that turns in is a reduction in the requirement for capacity to provide regulation. That is easily quantifiable in terms of value. Prior to MISO's implementation of regulation service, the footprint was carrying about 1,200 megawatts or so average in reserve to provide regulation.

That went down to 400 megawatts on

January 5th of 2009. We had an 800 megawatt capacity savings for regulation, which was freed up to provide other services, and had the other benefits that Andy kind of reviewed. Just the overall impacts to prices were generally lower.

It is fairly to say that at 1,200 megawatts we could look at the rate that was being charged customers for providing regulation versus 400 megawatts under MISO's market operations.

We also have the market clearinghouse value for those 400, so it was really a straightforward calculation to estimate those benefits. Our estimation is that that is our footprint in the $60 million to $80 million a year range, just for the reduction and the requirement to provide regulation service.

MS. KRAMSKAYA: Thank you. This is helpful. Would any other panelists like to comment on this? Mr. Kathpal and then Mr. Lowell.

MR. KATHPAL: Well, to directly answer your question, yes, we believe the benefits can be estimated. I think if you have a detailed enough production/cost model and you are able to introduce the types of resources we are talking into it, then you can properly understand exactly what Andy was

talking about earlier, not only the reduction in need for regulation and therefore the cost of regulation, but also the corresponding lowering of the marginal price of energy because that capacity that was held back -- even though, as Rahul pointed out, it is co-optimized in the flow of opportunity cost, it is still capacity that is below the margin that is being released.

I think it would be a relatively simple exercise of establishing scenarios, obviously you would need a pretty detailed and sophisticated model to do that, but our belief is such a thing exists.

MS. KRAMSKAYA: Thank you.

Mr. Lowell?

MR. LOWELL: My view is that there are a lot of things going on, and it is difficult to tease them out. In New England, the cost of regulation in 2008 was on the order of $50 million.

Beacon came on line, I think, at the end of November of 2008. They operated all through 2009. Our cost of regulation in 2009 was about $23 million, more than a 50 percent reduction. However, that was mostly due to changes in the price of gas.

We need an awful lot of experience and an awful lot megawatts of resources of different types to

be able to kind of tease that out. Also, there have been comments, and I think I made the same comment, that in the long-run we can see that there could be reduced requirement from having fast-responding resources. I think that that is probably true.

Over the last 8 to 10 years, our requirements in New England have dropped pretty much steadily. I think that the average for 2009 was something a little bit more than 80 megawatts on a various seasonally type of day, and so forth. Most of that reduction has come from shifting to a 5-minute economic dispatch.

As I thought about, "Gee, how could we do a study that would provide some data to support conclusions here," I couldn't get away from the feeling that we did several years of data with a number of different resources before you could really do anything other than make speculative guesses, on quantifying it.

I think we may be able to determine trends, but I think it would be awful hard to get a credible quantified number without more experience, which is part of the reason we did the pilot program that we have now, so we can get that experience.

MR. KATHPUL: I was going to ask a followup.

So the reason you would need more experience is because you want to a kind of historic study, or is it because you feel you need more experience with the assets providing the service to model them?

MR. LOWELL: It's because there are so many moving parts. How do you separate out the biggest chunk, and correct me if I'm wrong, of regulation that we get today comes from gas-fired combined cycle units. Part of their cost is their energy market opportunity costs.

If new resources that are not in the energy market but are willing to provide regulation, they don't have those opportunity costs, they are able to bid lower, and it lowers the cost of regulation, then there are two things going on.

How have gas prices changed? You have to have enough data to statistically tease that out, and there is also a different type of resource with a different cost structure.

My view is in the long-run it is the different cost characteristics that are the real benefit that will get resources that need to burn fuel out of the business of providing regulation and back into the business of just providing energy.

I don't think that a year or two will be

enough, other than to identify the trends, to be able to say it's got a 3 percent impact or a 10 percent. We just won't have enough data.

MS. KRAMSKAYA: Thank you.

Mr. Ott?

MR. OTT: I think, again, we know the categories of potential cost reductions. They are, again, a more efficient procurement of regulation, so you are going to lower overall procurement cost regulation by lowering the price or lowering the quantify you need.

The second is, again, this product substitution cost, which is a much bigger benefit with energy, and even synchronized reserve of some of the other reserve products could even benefit to an extent.

I think the best you can do, and the reason I think some of us are hedging, is we could probably get a range and that would give you an upper or lower bound.

In other words if you say, "Well, if you eliminate all of these product substitution costs against the energy, here is what would happen. If you only made half of them, here is what would happen, 20 percent, or whatever." You get sort of a range of

potential outcomes. We could certainly provide that. It's not hard to do. Bound the problem and say "Benefits could be from here to here." We can't say it is this number, and it will be this number.

I think what you are hearing is, I mean, we can sort of give you the range, the sense of it, but none of us can attest that is an accurate assessment of what the benefits are. That is the bottom line.

MS. KRAMSKAYA: Thank you.

Mr. Walawalkar?

MR. WALAWALKAR: Just to continue on what Andy said or what Praveen said -- again, I do understand the challenges in terms of looking at different factors which impact the prices and after the fact just looking at the impact. One particular factor, assuming that everything else has been constant, that is difficult.

But I think I basically, again, not looking at just historical, but in terms of predicting, I think there are enough statistical and mathematical models available where you can say, okay, "Under this scenario with these gas prices, this would have been the cost for providing regulation, given a certain load profile."

Again, we can look at that information and

then compute that calculation and then say that now if there are different resources of a level, which I have lowered marginal cost, can respond faster.

Assuming that the performance criteria is not adding too much uncertainty, I think quantifying the benefit is relatively straightforward, at least from an academic point of view.

Now, then, sort of putting your money on that particular number would be difficult, but then you can create sort of, as Andy said, a boundary scenario saying that under a $3 gas price we expect that as a business case the regulation price would have been this.

We can say that even that scenario maybe adding resources would have saved so much money. In a $10 gas scenario, that savings could have been much bigger. I think that is definitely possible.

MS. KRAMSKAYA: Thank you. Would anyone else like to comment?

Mr. Pike?

MR. PIKE: I just want to comment. In the amount of time it will take us to run these studies, we are also going to have some practical experience very soon. We have got two storage facilities that will be on line in New York by the end of the year, a

battery-backed and Beacon's flywheel-backed system. As the other markets are putting in capabilities for storage to come on line, we are going to have very practical data very soon on controlled signals and controlled methodologies and response to those.

MR. BARRINO: Can you quantify frequency response in terms of primary frequency response and secondary frequency response?

MR. PIKE: I'm sure we can quantify it. But I think what is important and is actually something we want to make sure we draw a distinction of is frequency regulation is very different than frequency response, at least as I am considering them in my nomenclature, in the sense that I see frequency response being a very autonomous site-specific, controlled reaction to an event on the system, an EMIC event on the system, where fiscal year regulation is more dealing with the steady state fiscal year control of the system.

I think they are very different products. They are very different services that Resources can provide. As the comments are made, we have frequency regulation markets. The frequency response doesn't have a market behind it.

MS. KRAMSKAYA: Thank you.

MR. BARRINO: Would you consider that frequency response immediately after the contingencies more valuable than the later one, or it doesn't make any difference?

MR. PIKE: I think they are different. I mean, I wouldn't try to qualify one as more important than the other. I think they are both services and reactions that we need to be able to maintain on the system to run a reliable grid.

MR. BARRINO: Thank you.

MS. KRAMSKAYA: Mr. Masiello?

MR. MASIELLO: Yes. I mean, those terms have formal definitions under NERC, going back decades. Primary frequency response is the governor. All rotating machines have a governor. The droop setting is established for NERC for each control area. It is actually very important, from a reliability point of view, that the droop settings on those machines are coordinated.

If they varied widely from machine to machine, the system stability would be at risk. the primary frequency response, especially in a situation like Ercot, where it is an electrical island.

MR. OTT: If I could jump in just quickly. It is not compensated. In other words, it is good

utility practice. It is like do the right thing, but there is no compensation for that capability. In the regulation market there is lots of compensation, but that kind of response isn't.

MS. KRAMSKAYA: I would like to add that we had two written comments or rather questions on whether it should be compensated, and we will try to maybe get to those in the second session. It is not that we are ignoring it, but we will get to it in the second section.

If there are no further comments, maybe we can break a little earlier, but then start a little earlier as well because I think we have a lot more questions in the second session.

Now it is 10:25 almost. If we can get back in this room at 10:40, I would greatly appreciate it. If anyone hasn't been to this building before, there is a caf, which is on this (pointing) side of the building. We will be back here at 10:40.

Thank you again.

(A recess was taken from 10:25 a.m. to 10:40 a.m.)

SESSION II

MS. KRAMSKAYA: While we are still expecting a couple of the panelists to return back to the table.

I wanted to maybe start reading the first question of the second session. We would like to dedicate this session mainly to the issues related to compensation and market design. The question that I hope will lay the foundation for this discussion is very broad.

The existing frequency regulation market designs in the ISO or RTO markets provide compensation-efficient price signals for investment in new technologies that respond to a regulation dispatch signal faster and follow it more accurately than the traditional resources. Why or why not?

We have heard some of you address this question already in the first session. But now if you would like to provide any additional details or insights from your operational experience, we would greatly appreciate it as it would help us build the record in this proceeding and then eventually decide whether any further Commission action is necessary in this respect.

Would anyone like to start?

Mr. Todd and then Mr. Capp.

MR. TODD: I guess our feedback is that right now ALCOA has five U.S. smelters, only one of them is providing regulation type of response. It isolated in the Midwest ISO, and it is primarily of

the way it is being FCB and the opportunities to participate in the market there.

First of all, the market design has to be there that allows alternate sources, in our case, load-acting as a resource to participate in the market.

Our experience in the Midwest ISO is basically we don't have any incentive to overperform or perform faster or more reliably than what the market has set up, which currently there is a 4 percent dead band or a six-megawatt minimum for performance characteristics.

If we can hit our target across a 3-minute to 5-minute interval within plus or minus 6 megawatts, then we are okay. There is no additional incentive to respond at a faster ramp rate than what is defined by 5 minutes of total regulated capacity.

We have a range of operation. We don't have any incentives inside of that to respond tighter or more frequently at a faster rate inside of that market. To us this is the question that says, "If there's a value to it, it needs to be explored."

MS. KRAMSKAYA: Thank you.

Mr. Capp?

MR. CAPP: Thank you. I will refer to

Slide 13 on page 7 of our handout. It shows you the effect of fast-responding resource versus a 5-minute ramping resource. It is just another way of addressing that issue that there is certainly value there. Our view is that only ISO New England's compensation incents that moving quickly.

As Alcoa said, there will be potential to do that. In many cases, there is a cost to provide that. In many cases, batteries will incur a shorter life, if they are exercised more aggressively. Throughput is on first order, an indication of the life of the system. If you want to get the value of fast response, I think it is essential to pay for it.

MS. KRAMSKAYA: Thank you.

MR. PECHMAN: Could I maybe just ask, if you were looking at a blank slate right now and you were saying "Okay, we've got these resources. We've got various different kind of resources, and we understand that there are some limitations in terms of durability of the resources. We also understand there is value in terms of speed and accuracy. We are now creating a market and you don't have any constraints.

What ideas would you have in terms of how would you think about pricing these resources? Would it be different than what you've got now? Do you

think what you have now, as we say in the question, efficient?

I would like to hear from the different ISOs about how you would do things differently. What is about the characteristics of these resources? Or, do you think what we have now is good and should stay this way for the next 10 years?

Andy?

MR. OTT: I will start by admitting that I don't think we are in a good enough spot right now. I think if you look at how we compensate in PJM today, we've essentially established what we call "regulation marketing clearing price," which recognizes the product substitution or the substitution of energy and reserves.

When a unit has to forego providing energy to go on regulation, that is part of the clearing price. It is necessary to have that obviously, because you will have resources for some period of time that have this decision to make, whether they provide energy or reserve.

Through the optimization establishing that as a clearing price and making fair compensation is important. I mean, it is important incentive to make the machine indifferent to which product it provides,

and it is doing the best thing for reliability, so that is important to keep. I wouldn't change that specifically.

What is missing is we don't do any measure of performance of delivery other than we have a testing requirement that is done periodically to qualify whether a unit provides regulation. But in the actual hour of delivery, there is no measurement of performance.

In fact, I think that needs to change. I think we need to change that and actually measure performance against a standard. We have to set a standard. I think, hopefully, the standard is the signal we send them that they actually respond to it.

I think it may be appropriate at that point to compensate based on how well you respond. Now, I think there is a question of, Is the compensation in the form of a penalty that says "You didn't perform well enough, so I'm taking the money I gave you away," which I think it would be a bad thing.

Then, remember we had a product substitution decision, so they had to decide whether they gave energy or reserve. They decided to reserve because they are indifferent, or we decided for them.

Now then we tell them, "Oops, wrong answer.

You didn't do well, so now we're taking your money back." I mean, that is not going to do anything. I think it is an additional payment for performance that you performed well that is probably the most fertile ground for the correct incentive.

We probably are underpaying right now for good performance. If your question was: Would we do something different with a blank slate? I think the answer is yes. I think you would have some performance-based payments during the hour in some way.

MS. KRAMSKAYA: Mr. Ramey?

MR. RAMEY: Just in terms of design choices, I think co-optimization of capacity for energy and ancillaries is the right direction for us to head in. Midwest ISO uses co-optimization. At the unit level or asset-owner level, there is no real choice about which products their capacity is being requested to provide.

They are cleared in such a manner and priced in such a manner that they are ultimately indifferent to whether they are providing using their capacity to provide energy regulation or spin.

I think that is demonstrated and proven effective at getting to a lot of the benefits that are

already available just in terms of maximizing efficiency of which units are providing which products in which locations.

In terms of a blank slate, what is it that MISO is working on? Again, we are working on this notion of: Is ramp capability -- is flexibility an ancillary service that needs to be defined?

It is not really kind of defined as an ancillary service today, but any system operator will tell you "I need flexibility to manage the system well."

Again, flexibility looks like dispatch range and ramping capability. Is there a product that we can define that actually provides direct compensation for providing the system flexibility? We are looking at that.

Today's dispatch engines typically enforce ramp constraints at the unit level, so there will be constraints in the algorithm that says this individual unit can only move at 4 megawatts a minute. It is not going to get a dispatch instruction that exceeds that ramp limitation.

What the algorithms don't necessarily include is a specific procurement requirement for ramping capability. You may solve your dispatch at

the unit level, enforcing all ramp constraints, and you end up with a configuration of your fleet that provides 100 megawatts per minute ramping capability, but you may very well need 120.

That is another area where there could be some improvements in the algorithms to directly determine a requirement for ramp, have that as an input either from the operator saying, "This is what I need" and the algorithms providing it, or probably a preferable approach would be to have some sort of market mechanism that says, "The value of this much ramp is 'X,'" and it is cleared and compensated directly.

MR. QUINN: Can I ask a followup and ask whether you just care primarily about just the ramp rate per minute, or whether you care about ramp rate plus ability to sustain that ramp rate over a period of time?

MR. RAMEY: Yes, the sustainability question can also be addressed in a couple of different ways. In our market design, we have included in the algorithm the notion that we are going to manage the energy charge state, a variable or of short-term energy storage devices in such a manner that maximizes their capability continuously to provide the service.

We are giving them on a five-minute dispatch basis, a dispatch target that is intended to drive them to the midpoint of their charge state. That has the upside from a system operator's perspective of not exhausting either full charge or zero charge on those devices.

The cost of that type of design is that it prevents the resource from clearing its maximum theoretical capability to provide regulation service in a 5-minute period. We have addressed that question. We don't exhaust the storage capability's resources because we manage that charge state.

MR. QUINN: Rob?

MR. PIKE: I honestly don't think it would be far from where we are today in New York. We have a regulation market that allows generation demand side and energy storage resources to participate.

It is a control signal that has two different types of attributes to it, but I don't know how you would separate those attributes in a short-duration/long-duration component without ending up having to buy twice as much regulation as you are already buying.

I don't know going into an interval what type of regulation service is going to need to be

deployed in that instance. If you are going to separate it, you need to be able to deal with both, I guess, and so you are going to actually see a reduction in what's available.

The resources all compete within the market, which is simultaneously co-optimized every 5 minutes producing clearing prices that balance regulation and energy.

They are paid based on their performance of delivering that signal. We do a 30-second validation that the units are controlling to the regulation signal and essentially prorate their payment based on the quality of service that they are delivering.

We bought a contract for so many megawatts worth of service, and if we are not getting that quality of service, we are reducing the payment to the resource.

We are managing energy storage facilities to maximize their ability to participate in the market, both from an energy capacity perspective, but also from a regulation signal perspective.

Whenever the signal of regulation needs is beneficial to the state of storage, they are getting that signal first. Yes, we are benefitting from a fast control signal, but they are benefitting by

getting back to the maximum operating point, the optimal place to be in that state of charge to be able to use that resource.

It is all contained in a transparent clearing price. All of the value of the service is in a publicly available, publicly seen transparent market clearing price.

There is no behind-the-scenes payments that can distort that clearing price, that can see a different set of payments being made that isn't transparent to the market in allowing the market to react, but is exposed and available.

I think the prices that we have posed and the response that we've gotten is an indication that the market is working. We have storage technologies that are interested.

We have had a growth in the traditional resources that want to participate in New York's market. We have had demand responses that want to participate in the market. The price signals have been there. They are available, and the market is responding to delivering those services.

MR. LOWELL: If I can touch on several of the points that came up and how they relate to New England, I think we have some principles that we

would like to try to follow as we look at how we change our regulation market design.

I don't think it will change radically from where it is, but there are a few things that we would like to change, and then there are other things that if we truly had a clean slate, maybe we would change.

But, as a practical matter, if the regulation market is $25 million and it would cost $3 million to go in and change all of the energy management software to implement some new feature, then that might not be the best use when we could put those development resources to changes in the energy market that could change hundreds of millions of dollars.

That is part of the issue we are struggling with, the balance point between theoretical improvements you could make and are they the ones that we should focus on? Should they be the priority, or should it be something else?

The principles, the first one is I think maybe the most important one, eliminate the barriers. Two years ago, the New England tariff restricted regulation to only generators. Alternative technologies were not even allowed to participate.

Well, that was a very easy barrier to

eliminate formally, but that doesn't mean that we have the infrastructure in place, and we are working on that now, to allow non-generators to participate.

The second principle is pay for performance. This relates to the commentary about should you have penalties. We believe if we get it right that paying somebody to perform is all the incentive they need. There is no reason to penalize.

If a participant has to deal with the risk of incurring a penalty, it will just go into their bid, and it will drive up the clearing prices. Why do that?

Now, that is not to say we don't have penalties for certain things in our other markets. But the approach in regulation we believe should be if somebody can accurately follow the signal, then they should get paid for exactly what they do.

If they tell us their perform characters are "X" but they don't do "X," well, then they are not going to get paid the full amount. That should be enough of an incentive to give us accurate information, and characteristics that they can actually perform to.

Right now, we have opportunity costs paid on a resource-specific basis. I don't want to say it is

not a level playing field. It was a level playing field when you had only generators. When you don't, then it becomes sort of a pay-as-bid market instead of uniform clearing price.

That is an issue that we are looking at and working on, but it may fall in the category of given the nature of existing systems, implementing that change might be very difficult and expensive. We are exploring different ways to do that.

I think to get the long-run investment signals right, you have to allow everybody to receive the same price. If we accomplish that over the long-run, the right resources will come into the market, and the ones whose best use is to provide some other service will pull out of the regulation market.

Yes, I think those are the points that I want to make. Thank you.

MS. KRAMSKAYA: Mr. Tretheway?

MR. TRETHEWAY: I just wanted add that we are going through a similar process where we are starting with the first step, which is eliminating the barriers that have previously prevented storage resources or demand from participating in our regulation market.

The next is really to look in terms of what

are our actual standards and requirements for regulation; did we set those in terms of a mind-set that it was always going to be provided by generation; and trying to look at how we are actually operationally using those products to meet the needs that our operations team has.

Then, also understanding that based upon how we then set those requirements, there may be additional sort of changes in terms of what signal you send to a limited-energy storage device. Because, for instance, in a regulation-up environment, we need a resource to sustain for the entire hour.

However, we can find ways to send the different signals such that a limited-energy storage device, in essence, stays able to provide up within an entire hour.

I think you can look to eliminate the barriers, look at understanding how you are actually using that regulation product, and then working to see if there are additional changes you need to have an even deeper pool of resources able to provide the regulation products you procure.

MS. KRAMSKAYA: Mr. Ramey?

MR. RAMEY: Another area of improvement in the Midwest I think generally is I think in the area

of deployment of regulation. I spoke earlier about the clearing process, which is just reserving capacity of the AGC systems actually deploy the regulation capacity in response to imbalances in frequency deviations.

AGC systems tend to bias that deployment instruction to those resources that appear or have available ramp capabilities. The faster you move, the more work you are actually asked to do.

In the Midwest, there is no formal recognition in our compensation or market design that recognizes that those that move faster are actually asked to do more work, so that is another area for possible improvement.

MS. KRAMSKAYA: Could you elaborate on that or maybe provide an example?

MR. RAMEY: Yes. Again, it gets back to my flexibility theme. System operators need flexible resources to manage the system. In a regulation deployment sense, actually a unit has the capability to provide multiple products.

Load following, it can change its energy set-point; it can be cleared and deployed to provide regulation service. But the unit only has a single ramp rate to cover those various uses, typically.

Our system will actually look at each unit that clears regulation, and it looks at its change-point request for energy. If the unit has all of its ramp capability being consumed in an interval because we have asked it to make a big set-point change to follow load, that unit will go at the back of the line in interval for regulation deployment. It doesn't have any ramp.

The regulation deployment algorithm within our AGC system identifies those units that have the most ramp capability, those that are most likely to provide a positive regulation response, if you ask them to. Those are the ones that are asked to move first.

That looks like units that have few competing resources for its limited ramp, and those resources that have higher ramp capability than others, those units will go to the front of the stack for deployment.

They will over time be asked to provide more regulation service in deployment than a slower resource or a low-cost resource that may be moving to provide a change in the energy dispatch point.

MS. KRAMSKAYA: Mr. Ott?

MR. OTT: Right, if I could follow on that.

I think that is the real crux of it. The way we assign regulation is we essentially say, "Be available to move a certain amount."

Now, what we are seeing is the emergence of resources that now have capability to move in megawatts per second as opposed to other megawatts per minute, and that is the point.

Now those resources are really going to move. We have no compensation structure for how much movement we ask for. That is why I made the comment that we are more than likely undercompensating.

Even today a hydro unit versus a traditional steam unit, if we don't differentiate, they are both on regulation. How much they move? We really don't differentiate. I think that is probably one of the gaps.

I think another gap PJM happens to have, which we are working on, is a 5-minute price for regulation versus an hourly, which also had some embedded incentives. I think others don't have that problem. There are some compensation gaps is what we are seeing.

MS. KRAMSKAYA: Thank you.

Would anyone else like to comment on this issue?

Mr. Potishnak?

MR. POTISHNAK: One thing that has been very successful in ISO New England is we've had our mileage payment. We actually pay those generators that do more movement a greater amount of money.

We have calibrated our market so that the typical generator would get 50 percent of its revenue for the capacity reservation payment just being there and 50 percent for mileage.

Those resources that move faster -- and we have that replicated in our pilot program and they have been the beneficiary of that with the flywheels -- they may get two and a half times more revenue for a particular busy hour out of the service or mileage component.

I think that has been pretty well road tested and available for anyone to come and borrow should they want to do that from us.

I am hearing talk about accuracy, and I would like to comment a little bit about that. How accurate is accurate enough? If you take what the requirement for a balancing authority is, and the more constraining criteria that has been out there is a CPS2 criteria over the last decade or so, once a balancing authority gets to 90-plus percent of meeting

that criteria, in the month they are compliant there are no penalties. That is sort of a close enough level.

What we have tried to do on a performance basis is to bring that 90 percent performance level down to the generator level where if the generator is claiming 10 megawatts a minute, and we have samples that show, I have 10 samples, and 9 of them they did at least 9 megawatts a minute, then you are okay. But if you fall below that level, you are not okay.

We cajole them either to reduce their offer or increase their rate or get out of the market. But to pay progressively more money for greater and greater accuracy seems to be kind over -- the accuracy is well achievable with the technology. I think we're kind of in an "If it ain't broke, don't fix it" for the accuracy part of the equation.

Sustainability is very important. Sustainability is impacted on how you do your economic dispatch. The plans for New York ISO and MISO are to try and keep these limited-energy devices optimally stored at 5-minute resolution.

In our world, that is a challenge. We approved new economic dispatch executions by the operator at 5- to 15-minute resolution. How do we

work that, optimizing those resources in that time frame? We don't have a 5-minute selection process. Our regulation market is typically once an hour. At the top of the hour, we find the resources that seem best for the hour and run with them.

How much more optimal can it be? Well, it seems that our costs in the market are quite a bit lower than the other ones from I've been hearing. How optimum do we really need? What is the point of conditioning returns with the technology you have to think through?

MS. KRAMSKAYA: Thank you.

Mr. Capp?

MR. CAPP: Thank you.

I just wanted to agree completely with what Mike said. We think that the New England model provides an excellent way of providing compensation for comparable -- I mean, to provide essentially a comparable treatment for fast-responding resources.

It does, in fact, pay in accordance with the amount of work that was done. I think it is really among the ISO we've seen, we think it is the best approach to providing comparable treatment for fast response and would recommend it to others.

One of the things we have observed, just

parenthetically, is that when we first started working with the ISOs, there wasn't a lot of cooperation among them. One of the things that I've observed in the last five years is there has been a lot of interest really in best practices.

We are very pleased to see -- we know all the folks in the ISOs, and they have really taken a much aggressive approach in learning from each other and adopting the best practices. This is certainly one that we would recommend as a best practice for the other ISOs.

MS. KRAMSKAYA: Thank you.

Speaking on best practices, Mr. Ott commented on the preferences for performance measurements. Would Mr. Ramey or Mr. Pike like to comment on how performance measurements are done in their market designs?

MR. PIKE: Within the New York market, conventional generating assets and demand-side assets have what we would term a "performance index" for validating that they are responding to the control signals that are being sent.

AGC is determining the regulation needs. It is partitioning that out based on the award that was received. They are eventually moving in response to

the contract that they have got, a portion of the contract that they have in constraints of ramp rates and recognition of that.

Then, we are looking at basically every 30 seconds to validate that the units are moving to those control signals. It is not a has to be precisely at the point that they were to find that, but are they moving in the same direction that the control signals are going? Are they within a bounded range of that control signal?

That is a continuous snapshot of every 30 seconds revalidating that that control signal is being reflected into the plant's output and responded back to the grid.

We do not have a performance index on energy storage facilities at this point in time. We went live with the program with the recognition that after we gained experience with controlling those types of facilities we would determine what an appropriate equivalent performance index would be.

The scenario was simply that the 30-second window was likely to be inappropriate for a storage facility because it is moving so much within that window that it would be challenging to try to say that they did or they didn't come into that same direction

that you were trying to achieve control for, just because the movement is so significant over those 30 seconds.

We chose to not implement one at the start, recognizing that after we gained operation experience, we would have a better opportunity to match up the control signals with a response and develop a performance index.

MS. KRAMSKAYA: Thank you.

Mr. Ramey?

MR. RAMEY: In MISO, we struggled with this question of performance monitoring and applying incentives or negative incentives as they are penalties.

What we came to understand very quickly is that it is a fine balance. If you don't have any performance measurement or any expectation of performance by generators, then you run the risk of making capacity reservation payments to provide services that you don't have to provide, and you still get to enjoy the benefits of the reservation payment.

The downside or the other extreme of that is a system operator's concern that if your performance measurement criteria is too stringent and the penalties or incentives are too punitive, then what

you see is individual generators pulling back their flexibility.

It is not worth it to them to offer you 5 megawatts a minute, if at one interval they give you 4 and you give them a penalty, then they are only going to give you 3 megawatts a minute.

We have evolved over time in the Midwest where we currently do have performance measures and a combination of incentives, primarily penalties. If a resource is getting a dispatch instruction, and their dispatch instruction on a 4-second basis is the sum of their requested deployment for energy regulation or even deployment on the spin that they carry, if they fall outside of a certain range for a 5-minute period, it sets a flag.

If they get four consecutive flags in a row, then they progressively enter into settlement implications where they may forego their capacity regulation payment, for instance, for that hour. If it continues, they can forfeit their payments for a full day.

They also get the opportunity to participate in the allocation of regulation procurement costs, if they fall outside of performance boundaries as well. In terms of impact, in any 5-minute interval we see

about 2 percent of the generators that are on line, that for that interval are exceeding that threshold.

But in terms of the percentage of an individual unit falling outside for four consecutive intervals, it is a much lower percentage than that. It is not very punitive in Midwest ISO, but there are rules there that say "At least we've got this expectation of performance, this is how it is measured, and these are the implications of falling outside those bounds.

MS. KRAMSKAYA: Would anyone else like to comment on this issue?

Mr. Walawalkar?

MR. WALAWALKAR: Since we have talked a lot about the sort of price signals and market mechanisms, I just wanted to bring attention to a couple of additional points.

I think we just see when I'm talking with potential technology providers or project developers who are evaluating the situation across markets, I think apart from the market design issues and maybe pay for performance towards additional incentive, other factors which people are considering is just looking at the market dynamics and which market is right now providing enough price level which justifies

an investment.

There we see that there is a lot of attraction, particularly in New York, particularly since they seem to do implementation have sustained are more efficient. There is the interest in PJM. But I think one concern particularly for some of the emerging technologies in PJM is that there is this sort of after the market cost payment, which regulation only provide is not able to achieve.

There is a difference in terms of the cost which a load is paying for regulation versus the payment which regulation-only provider can receive. There is that discrepancy. There are ways to get away with that by possibly doing BPAs. But, again, the issue with long-term BPAs for regulation is not that common, so that is a factor.

Another issue, which again if you look at the issues for demand response, then one of the issues is a faster response required, and would there be any compensation? Would there be any compensation?

Apart from that I think in terms of demand response, we could see possibly a lot more resources participating in the market, but one of the issues is apart from the price signals also in terms of the requirement for communication or even interconnection

or some other things.

I think in the case of PJM and the New York ISO they have now in the same market, over the last couple of years, which have removed some of those barriers. But still we see that at least in New York there is some concern that the ISO communications requirements right now, how to go to the transmission owner.

There are certain demand response providers who can provide -- they are happy with the price points especially since they have certain costs in terms of the capability or equipment, and they are only looking at their marginal costs. Pricing is not efficient.

Apart from just the market design, the interconnection or communication issues, those are also critical for new resources to come into the market.

MS. KRAMSKAYA: Thank you.

Mr. Lowell and then Mr. Kathpal.

MR. LOWELL: Just one comment following up on the demand response theme, one of the issues that we are giving thought to as we transition from a pilot program to permanent regulation market rules is making sure that the performance monitor requirements don't

become essentially a barrier to entry for the demand response type resources.

One participant who is actually providing regulation now and another one who is not yet quite on line are both essentially aggregators of very small resources.

The type of metering that might be appropriate at a generating plant, would make it totally impractical for a homeowner to allow their electric storage heat system to provide regulation.

It is an issue that we need to look carefully at. I hope that we can learn from what the demand response industry is doing. I know that there are efforts to develop appropriate standards there, and I hope that those will be applicable. But, if we are not careful, we may create a barrier that would prevent a potentially large resource from entering this market.

MS. KRAMSKAYA: Thank you.

Mr. Kathpal?

MR. KATHPAL: I think it is important to point that for any type of resource, a generator or a demand resource, that is based on an industrial process or for energy storage, there may exist a gap between how fast you are able to respond and how fast

you need to respond to meet the performance requirement of the service that you have committed to.

Assuming for a second that responding as fast as you are able to incurs some incremental cost to you in terms of fuel use or reduced productivity, degradation on an energy storage resource, additional L&M, any of these things, if you are not getting paid more to move faster than you have to, then you are not going to provide the full benefit to the system that you are capable of.

I think this is especially highlighted in the energy storage area where a lot of these resources are controlled by software. They can be programmed to do whatever the owner and operator desires it to do.

The response to a signal from an ISO that tells you to move, you might be able to move in megawatts per second, but you might only move in megawatts per minute, if that is the standard that you and the rest of the resources in the fleet are held to.

MS. KRAMSKAYA: Thank you. I think this will allow us to transition to the second question, which is related to the benefit that the resource can bring to the system. Here we would like to hear reactions from the ISOs and RTOs as to how accurately

they can measure the impact on the systems frequency and its area control error that results from the individual facilities provision of regulation service, if anyone would like to comment on that

Mr. Ott?

MR. OTT: I can start. At least what we can measure on a 2 second scan presently is how accurately the device, whether it be a generator or any device, follows the signal that we send to them. We can measure how well they are following what we are doing on a 2-second scan and what we are sending.

By assumption, if it follows the signal more accurately, it is doing the optimal. In other words, if it is following exactly what we said, then it is providing the most optimal result for frequency control.

By extent, that is an assumption, but not necessarily a bad one. I think using that logic, yes, I think we have the ability at least on a 2-second scan basis to measure that.

Now, below that, going sub 2-seconds at this point, it would be extremely costly for us to move below that kind of accuracy measure and, again, accuracy based on signal response as opposed to anything else.

MR. QUINN: Just a followup. If we kind of change the premise of the question to be, again, blank slate, we are trying to come up with a way to compensate for regulation service, if we wanted to start out by saying: "Can we measure what you are giving to the system?

What you are giving to the system is either controlling ACE or changing the frequency. Could we measure what an individual unit is doing to either change the balancing areas as ACE or change frequency?

Mr. Potishnak?

MR. POTISHNAK: Yes. I would say very much so yes to ACE and probably not the frequency. We deal with just area control error. That is what our signals are based on, what we send out for our set-points.

We have been very successful in monitoring our fleet of generation with one methodology, I discussed it earlier, providing 90 percent of their rate or capacity. That is close enough that we are held to that standard.

We trickle down that standard. We have something different within the pilot program, which that methodology we have a tolerance that you must be within the target within a given grace period.

It is different, but it achieves the same result. I think right now we can do that. We actually did have an instance where one generator a few months ago for some reason did not respond to its set-point signals, and we incurred a CPS2 violation.

I was literally able to go into the data and back out and said, "Had that generator not followed its signals like it should have, we would not have had that violation."

That happened to be a single instance. We don't commonly do that because we are getting the results we need. Our generators are meeting our standards.

Maybe once or twice a year I have to get involved in talking to a generator to get them to do what they are supposed to be doing over the last 10 years or so. We are there. We have the ability to monitor that we are getting what we are asking for already.

MR. RAMEY: Yes. My answer would be pretty similar to that. Can we do it? Sure. We have the data the unit level. We know their set-point. We know where they are actually performing at. We can see the detail.

The question comes back to: Is it worth it?

Is it worth it to track at that level and to have mechanisms, either settlement or market mechanisms, that somehow differentiate individual unit-level performance, given that the goal of a system operator is the aggregate response of the fleet to a request to move?

You get back into a question of individual units doing what you're told, or there may be penalties, or there could be incentive payments. That is certainly a good idea.

But at the end of the day, a system operator needs the fleet to behave in such a way that they can man acceptable system control performance, so you can get back into this balance of "Am I applying too much focus on individual performance rather than over time a unit's contribution to the overall fleet's performance?"

MS. KRAMSKAYA: I guess in the context of compensation, would it help the ISO and RTO to able to measure that to more accurately compensate the unit for its performance?

MR. RAMEY: Well, that's the question that I asked you and you just asked me back.

(General laughter.)

MR. RAMEY: That is the question. Is it

really worth doing that? Possibly. I like the idea of the pay-for-performance issue, so I will at least get some of my folks thinking about that and what kind of incentives that provides and whether that is a better design overall.

MS. KRAMSKAYA: Mr. Walawalkar?

MR. WALAWALKAR: Just maybe going back to some of the earlier comments on some of the system dynamics and how larger factors are integrated. The one solution I have regarding sort of pay for performance, again, we are right now talking about, like, maybe the goal forward moving towards pay for performance is to provide maybe a higher incentive for new resources to come into the market.

But then if that ends up reducing the need for regulation, then that is again going to have a downward impact on the pricing.

I think, again, there is lots of interdependence on these factors and how the system requirements, I think, are maybe trying to set a pricing point or trying to come up with mechanisms to come up to a pricing point, and it may not yield the desired result, at least in the markets where -- again, markets are going to respond to the prices. As more supply comes in, you would end up seeing lower

prices.

I think the overall goal should be that we need to have maybe set some uniform standards and then be clear on those technology standards, either it could be through pay for performance or it could be maybe the penalties or some performance monitoring in order to get compensated. I think either could work. But, again, it could be almost impossible to guarantee any level of payment with the market dynamics.

MS. KRAMSKAYA: Thank you.

Also, I think some of you had mentioned that in your market designs there is compensation for both the capacity that the resource makes available on a call for regulation service as well as for the actual changes in the level of power that the resource supplies. Should resources be compensated for both? Why or why not?

Mr. Capp?

MR. CAPP: Thank you. I would just refer to Slide 14 on page 7 and also slide 15 on page 8. Absolutely would be my answer to that question, and it is from several points of view. I understand Todd's point about if you get the system to respond well enough, is that good enough?

I understand that from a reliability

perspective. But I think when you take into account the need for comparable treatment among various resources, then the answer is yes. I think you should have a methodology for compensating for both of those things.

We feel very positive about the system that has been established by ISO New England in terms of the mileage payment. We think that is an established, proven approach to accomplish both payment for capacity and for performance.

I think the other reason that it is appropriate to do that is that it will encourage the most resources to show up, which can only have a beneficial effect, whether you need them because of the deployment of more renewable energy or you just want to take advantage of the fact that you have more market participants and the effect that has on the price of services.

MS. KRAMSKAYA: Thank you.

Would anyone else like to comment? Mr. Todd?

MR. TODD: I would also like to highlight that breaking this apart into two pieces really captures how, again some examples like a load acting as a resource, how it actually is performing.

I mean, there is a cost to our business of the fact that we are making a piece available for regulation, but then there is also a direct production impact, depending on how much regulation we are doing.

If we are regulated down for a long period of time, we are going to have a production impact. That is separate and apart from the fact that if we move up and down over a period of time, that has a separate impact to what our cost of operations are. It allows us to separate those out.

Certainly within the Midwest ISO that is the market mechanism that works very well for us. Rather than trying to package into one price an offering in anticipation of how much we are going to regulate on the lower side or the upper side, we are able to price those in two separate parts, the simultaneous co-optimization mechanism captures both of those. We think that works very well in terms of capturing the essence of how the offering itself works.

MS. KRAMSKAYA: Thank you.

Mr. Pike?

MR. PIKE: I guess I would just like to take the question maybe to a higher level. What we want to be able to have is resources bid their cost of providing services to ensure that if they get

scheduled, the receive the compensation for providing that same service.

We don't want to create incentives where our resource is motivated to not bid their actual costs because there is some other mechanism for them to get compensated because then you are not going to achieve the lowest cost selection of resources in the complete pool of assets.

If all of the resources are incentivized to provide their variable cost for a service and the market can account for that and establish a settlement mechanism to make sure that is reimbursed, you are going to get the most efficient set of resources into the marketplace.

Yes, I'm competing for that clearing price and delivering the services that you need onto the grid. We don't want to have any counterincentives that try to distort their behavior.

MR. QUINN: Can I ask a followup and maybe use the analogy to spinning reserves?

(No verbal response.)

MR. QUINN: If I take what you are arguing, I would extend it by saying it makes sense to pay spinning reserves when they actually provide energy, because they have been able to tell you, first, how

much they need to be compensated to be available to provide spin reserve reserves for an option, a capacity payment. But then they have also been able to tell you how much they will need how much they will need to be paid if you want them to provide energy.

Your belief that with regulation service that resource can only tell you that first piece, how much they need to be compensated to be available to provide regulation service, but they can't tell you how much they need to be compensated to move within the dispatch period?

MR. PIKE: I would expect a resource in the regulation market to have a good expectation of what their costs are going to be to provide the service and to move over the course of the interval.

I don't have any grand insight into what the next interval costs are going to be. The ISO could throw a dart and pick a number that we should use for the next interval, but that is transferring all of that risk to the ISO to make those types of decisions of what the actual usage is going to be for the next hour.

A better place for that risk is in the marketplace. Can the market make an expectation of what my movement costs are going to be for the next

hour and offer the most efficient set of resources, or offer what my expected costs will be for providing that?

Then, the market can select the most efficient resources with that risk explicitly taken into account and reflected in the market an reflected in the clearing prices, again, rather than the ISOs trying to make some assumptions of what those additional costs might be over the course of a 5-minute interval in this case.

I think those costs can be estimated over a period of time. I don't know that anybody can estimate those costs for the next five minutes, but I think of a sample size those costs can be estimated.

They can be incorporated into the offer price for providing the service, and that leaves the risk of making that estimate in the market's hands rather than in the ISO's hands.

MR. OTT: Maybe I can help a little bit there. If you think about, at least in PJM, the clearing price for regulation is driven by two components.

It is an offer that the regulating unit makes that is, presumably, based on the wear and tear that they are going to experience on the unit for

moving around.

The much larger share of the clearing price is the opportunity cost to forego providing energy. There are essentially two components that make up the clearing price. Again, the dominant one is energy.

If what you are saying is you could take the calculation and just go on the regulation clearing price for the hour, make it based on just the opportunity cost component, and then somehow put the cost to move around and the wear and tear on the unit in some other part of the price, which would help you to determine what to pay them when they actually perform as far as movement, maybe there is fertile ground there.

But I think, as Rahul said, to actually say for a specific instance in time what that number is, is probably difficult, in fact, impossible. It is based on maintenance cycles and other things like that for traditional units. For storage devices, we probably have the experts here, so they could tell you that.

But I think the concept of breaking that down, though, to say the standby, the capacity payment, is based on what you are giving up and then the mileage payment is based on maybe the marginal

cost of movement, it may be worth exploring. There may be a way to get there; I don't know.

MS. KRAMSKAYA: Mr. Masiello?

MR. MASIELLO: New England and PJM settled the real-time dispatch, I believe, using an hourly average number.

MR. OTT: Hourly on B's.

MR. MASIELLO: Hourly on B's?

MR. OTT: The opportunity cost payments.

MR. MASIELLO: This intertwines with whether the ISO is controlling the storage level of the device also. A storage device with a longer duration and also higher losses in the discharge cycle is going to be more sensitive to the arbitrage from one real-time dispatch period to the next.

Now, you would like to think that when it is asked to regulate up, the real-time dispatch is going up and prices should go up and vice versa. In theory, it should make enough money on the arbitrage to cover the losses, but that's not necessarily the case.

The operator of such a device would probably be watching that real-time price and making decisions about how to maintain the charge level, looking at the energy economics which are going to be more significant than the regulation payments in the hour.

A very high-efficiency device, which I think is characteristic of the Beacon device, wouldn't think about that problem to the same extent, and certainly not when the hourly average is used.

I don't know what the right answer to that is, but I think it is a factor to be considered. Certainly, it is paying for the power used. It helps mitigate that issue because then you are getting paid to move, which might compensate for a cost in the energy price that is borne.

MR. POTISHNAK: Can I make a followup comment?

MS. KRAMSKAYA: Please do so.

MR. POTISHNAK: Just to give some real numbers to why the mileage payment is of value, we did a study about 15 years ago when combined cycle plants were just starting to perform regulation in New England where we took this generator that was supposed to be about 250 megawatts output and fed it a slow-moving signal that is 2 sign waves in hour, a 30-minute periodicity. We measured compared to the same 250 megawatts of flat hour. Their increase in fuel consumption was 1.6 percent.

The subsequent hour we gave it a periodicity that may have been like 5 or 6 minutes. I don't

remember exact numbers, but a faster signal. Their increased fuel consumption was 2.6 percent.

That mileage payment that we give them increases as we move them around more, which helps them manage the 1.6 percent. In the slow hour when we pay them less, the 2.6 percent; in the busy hour, we pay them more.

It also explains maybe some of the trouble in unbundling regulation from energy market. We had that period where the gas prices went up by a factor of two or three for a while, and the regulation, the the 1 percent of production, caused those gas units to increase their regulation offer prices. Those are just two considerations I wanted to throw out there.

MS. KRAMSKAYA: Mr. Capp?

MR. CAPP: Thank you.

Yes, I would certainly agree with Mike's perspective. There are a variety of costs that do get incurred associated with being dispatched. I think we have heard various examples around the table today.

I am a little confused with the notion of we should drive everything on the basis of cost. I think it should be on the basis of value. What is the effect on reliability? What is the effect on improving area control error based on the performance?

I think that is the real place where the combination of payment for capacity and payment for movement or mileage gets closest to that. If a resource is particularly inexpensive and yet provides a greater value, then I think the logic from a comparability perspective would be to provide an appropriate payment based on the value that it delivers. We believe that mileage is the best way to accomplish that.

MS. KRAMSKAYA: Thank you.

I think we have discussed some of the questions that we wanted to ask under Session II. We have discussed some of the models which would describe the mileage-based model in Question 4 and then the alternative market designs, the so-called accuracy-based compensation model, which my understanding is the model that is currently used in the New York ISO and the Midwest ISO.

But one other alternative that had been mentioned in some of the publications is to have two classes of service. The current AGC-based regulation service class and a new fast response regulation service class.

Have any of you given any thoughts to this type of alternative and what would be the advantages

and the drawbacks of this type of approach?

MR. Walawalkar?

MR. WALAWALKAR: There are some advantages for maybe having a separate class of partial response. I think particularly based on looking at the market side I think there are some real risks with sort of splitting the regulation market.

Maybe it might work in this where maybe the market size is currently around 800 to 1,200. But in most of the other cases with either ISO New England or New York ISO and California, I think with the amount of regulation which is currently required, if you end up splitting that again between faster response and regular response, and then if you also sort of go with the PNL Study that faster response adds a value that you don't need as much regulation as you originally requiring, that ends up creating issues.

You end up getting issues with market power or just price collapse. Again, there is more value provided by faster resources.

But if you just have multiple faster responses, resources competing against each other and all of them have marginal costs which are much lower, then most likely that price, market clearing price, is not going to be sufficient to drive investment in that

category.

There may be some who may get value. But, again, in doing that scenario there could be issues with market power and the price, market clearing price.

MS. KRAMSKAYA: Mr. Tretheway?

MR. TRETHEWAY: We have had some discussions on whether we would create a new product around a fast response. In essence, carving out that one attribute associated with regulation, we have seen some studies that there is some relative value to traditional regulation. Could you actually split two products? There is a relative value to the two that you could co-optimize the two of those product.

I think the issue we come back to is the market is so small that it doesn't warrant, for instance, a new specific product at this time. You are only going to carve off -- maybe you only need 30 megawatts of fast. If you get a little more than that, there is some other issue you have.

Then, it comes back to is the size of the market sufficiently large? Are there a sufficient number of market participants able to participate in that new segment of the product.

MS. KRAMSKAYA: Thank you.

Mr. Ott?

MR. OTT: Well, I think 20 years ago we had a Regulation A and a Regulation B, which was fast/slow. Back then, I mean, it was hydro versus other. We thought about, as we're thinking about this, we thought about having it as separate.

There are a couple of challenges that it creates that almost make it not worth it. Part of it is, again, the concept of the fast kind. The folks who can do fast can also do the slow, if they can sustain.

Again, they can make that decision based on, "Well, I can sustain if I lower my megawatt amount and distribute." That is a very complicated decision for them to make, to offer into both of those. It would seem to create a barrier and be somewhat inefficient to force that, because then we clear those markets and they may or may not have made a good decision a bad decision. I'm not sure the incentive you are trying to produce would be helped by that kind of process.

I think we very quickly realized that if we, the RTO, can differentiate the signals we need to send. We settled on this concept that we can send a frequency-only regulation, so you know a standard regulation, so you will manage performance against of

them and still have one market.

There is so much commonality. It seems that is a much more optimal approach than trying the route of two separate products, two separate markets. We did think about it, and certainly we are continuing to think about it.

But the differentiation of what signal you sends seems to be much more important because there is so much commonality between the opportunity cost component.

What Ralph was talking about before was you have to pay a certain amount to charge, a battery device, and then you obviously use up some of that energy. Well, that looks a lot like opportunity cost to forego energy, if you will.

Although, it is the same calculation, so that could be a component of a bid, for instance, that kind of thing. It sort of marries together and allows you to make that more competitive market across the system by having it all together. It is more the performance measure, I think, can differentiate.

MR. QUINN: Can I ask a followup, then?

(No verbal response.)

MR. QUINN: If they are getting two different signals. You give fast-responding resource

a quick signal and a slow-responding a more traditional signal based on ACE. One ends up doing a lot more work than the other, moves up and down a lot more. The fast resource moves more than the slower resource, the only compensation that they are getting is based on how accurately they are following the signal.

The slow guy is spot on their slow signal, the fast guy is spot on their fast signal. Presumably, they are both going to get exactly the same payment.

MR. OTT: I wasn't presuming that.

MR. QUINN: Okay.

MR. OTT: What I was presuming an accuracy-based -- again, the concept of the mileage payment thing I think important of how much you do. In other words, you can't also say, "Just how much you move is it," and you don't have anything in the equation that says what you are asked to do.

The performance, the accuracy thing, is a measure of what you are asked to do. If you are exactly doing what I asked you to do, you get an accuracy score of 1, and therefore you will get the premium payment for all of the mileage you moved.

If you are doing half of what I asked you to do, you will get half of the premium payment for all

the mileage you move. You are still getting the payment for the mileage you moved.

I mean, when I'm thinking accuracy, at least I'm thinking accuracy versus what you were asked to do a as a component of something along the lines of mileage. I think you need both accuracy and movement.

MR. QUINN: Okay. That is a great help. I guess the kind of follow-on would be then, if you're going to give the resources different signals, does it then follow that you have to do something like a mileage payment to acknowledge the fact that, one, resources are getting one signal and a different resource is getting a different signal?

MR. OTT: I think if you follow that logic, yes. I think you need to somehow differentiate. Again, the phenomena that Todd had described earlier and I had commented on, that the units that can move in megawatts per second, you are going to ask them to do it. I mean, that is a fact.

If that is a more valuable service, which I think it is for reliability, I think if we had a lot of those around, I think we would all sitting here saying, "Wow, this is wonderful."

The fact the we don't have them yet, we are all sort of saying, "Well, we think it might be

wonderful." I think setting up a mechanism that measures -- make sure you don't set up an incentive just to move.

(General laughter.)

MR. OTT: You can't just have mileage. It has to be mileage based on what you've asked. I think that seems to be the best way if you are going to keep the markets as one.

MS. KRAMSKAYA: Mr. Pike?

MR. PIKE: Just maybe a comment, though, on that, that we need to think about in the concept. If you've got a fast resource that is getting the fast signal first, and you're paying them a mileage payment, you have also created a conflict there. You have created a compensation mechanism and isolated a set of units that can get it.

If you were one of the other assets, the fast responder came, and therefore you missed out on this additional compensation, my first request would be, "Move me, too because I want some of that additional compensation that is associated with moving."

If you take that and you play that out, you end up with everybody gets a pro rata share because everybody wants a slice of that compensation for

moving.

I think you need to walk that down further on how units would react to that. If there is more compensation and I want more of that compensation, I want to move and get that compensation. You could find yourself doing pro rata.

MR. OTT: If I could do a quick conversation here. If you do make that decision based on the flexibility, they have offered, then you solved the problem that was indicated before. I have no incentive to provide you all the flexibility I can.

I think it is not a tie. It is you are actually making a rule that says if you give me everything you've got, then you will win. I mean, I can't imagine we would have that many ties.

MR. PIKE: No. Yeah, it's certainly got to be an offer-based service. But I don't think if you've offered another set of compensation out there, that you can preclude people from access to that compensation. It is a barrier. We have now created a barrier to a traditional asset.

MR. OTT: The point is if somebody can ramp 5 megawatts a second, and I say "I'm picking him to be the fast guy" versus somebody who said "I can ramp 3 megawatts a second," having competition between the

fast guys, then I have a justification that I picked you to be the fast guy and you are getting the more mileage payment. I pick you to be on the slow-burn just because that is what you offered, I don't see that as being discriminatory.

MR. PIKE: Now you've just created a rule as to what is fast and what is slow.

MR. OTT: Right, but I don't think it creates a perverse incentive, though. I don't think it is discriminatory because you are basing decision based on their capability.

MS. KRAMSKAYA: Mr. Ramey, did you want to comment?

MR. RAMEY: My concern would be if you've got a guy who can move 5 megawatts a second and a guy who can move 3 megawatts a second, and you are always picking the 5 megawatts a second guy when really the only think you need is 2 megawatts a second.

Then, you're asking one resource to do a lot more work than another when both of them could solve the problem equally. One may incur actually more cost by being asked to do more work, but potentially are receiving the same revenue from the clearing of their capacity.

MS. KRAMSKAYA: Mr. Lowell?

MR. RAMEY: I think that is the issue in the Midwest. We are always relying on the people who have ramp, and we tell them to move because they can. Someone else may be asked to do less work, but they are getting comparable revenue.

MR. LOWELL: The way I see all the pieces fitting together is, number one, we want people to tell us accurate information. If they tell us they can do something, we ask them to do it and they can't, they won't get paid for that, whether you consider that a penalty or just pay for performance.

In other ways, if somebody doesn't want to move at their maximum rate, they shouldn't offer that. We won't dispatch them beyond what they offer. This is really true for not just regulation. We want that in the energy market, too.

We want people to tell us the truth, and we want them to do what we tell them to do. Because if they don't do what we tell them to do, then very soon everything goes totally kaput. I don't know if it goes kaput faster in the regulation market or energy market, butt is fundamental.

You want people to offer accurately, and you want them to do what they can do. If they don't do that, then they should suffer somehow, whether it is

pay for performance or penalty or whatever.

I think the incentives all work together. If you pay them for what they do and you tell them, "Here are the rules, here is how it works, if you bid a faster response rate, you will get more," I think the pieces just fit together.

MS. KRAMSKAYA: Maybe to summarize what we are hearing, there are different economic values or goals that I guess all of these market designs are trying to achieve.

Would you agree that these goals would be one to compensate regulation providers for the incremental costs they incur, I think I heard some of you say that, as well as to compensate the suppliers for the value they provide to the transmission system? I think Mr. Capp had mentioned that.

Third, to compensate the ISO/RTO and ultimately consumers for the cost ISO or RTO incurs if a regulation supplier imposes cost on the system, for instance, by withdrawing energy from the grid to charge a storage device for a form of regulation down service. Would all of you agree on those three principles?

Mr. Pike?

MR. PIKE: I think you have to be careful.

with the value of service to the grid. I think we expect resources to bid their marginal costs, to clear the market and to make a profit.

To arbitrarily say that there is an added value that you are not securing for and explicitly running a market for, I'm not sure that is the intentions of our market. Our intentions are to bid cost and make money by not being the marginal provider of that service.

MR. QUINN: Just a followup. For those folks who think that a mileage charge makes sense, what should we pay per mile? What should that be based on? Are we back to Mr. Capp's question about value?

To some extent, what we are trying to understand in Question 2 is can we measure the value or the contribution to managing frequency, and can we attach some sort of value to incremental contributions to managing frequency or ACE?

Is it simply cost-based, or are we ultimately going to have to do something administrative that tries to get it about right? Tries to get it about right, then, what we are trying to get right is in the thing that we will debate.

MS. KRAMSKAYA: Mr. Capp?

MR. CAPP: We tried to extract sort of a simple version of the ISO New England formula on page 8, at the bottom there, Slide 16. It is a split, then, between a capacity payment and then a mileage payment.

If you bid in a certain amount of capacity, you get paid for that, and then there is an adjustment. It is basically intended to be the average unit gets 50/50, right, 50 percent capacity and 50 percent in mileage.

The average unit that performs on average gets half their compensation from the capacity bid and half from the mileage they perform, the value they perform providing regulation service.

If you provide twice a much, then that payment is more. If you provide half as much, that payment is less. That is the basic approach that we think makes sense.

MS. KRAMSKAYA: Mr. Potishnak?

MR. POTISHNAK: I wanted to back a little bit before we jump gears into the details of how do you value the mileage. It basically works out to be you get paid at 10 percent and clearing price, but it is a different metric.

What I really want to go back to was the

notion of could we or should we make a new product for what the fast-moving but maybe energy-limited resources can do. Could we? The answer is with a lot of work, we could, yes. Should we? Well, then I would come back and say, Why? Why should we do it?

If I have to rationalize what we do based on meeting industry standards, the ISO New England market and all our regulation markets take money away from the consumers to pay for this service that we are providing; okay.

How much do we need? What does the standard say we need to do? If you look at how regulation is talked about and NERC has put out some balancing fundamentals, they talk about regulation being a minute-plus.

The fact that they can do it faster, should we ask them to do it faster? The answer may be we don't want to ask them to do it faster. Because if I have a slow-moving resource, following some slower changes, I will pay them a relatively low mileage.

But if I am quickly saying, "I want you up, up and down, up and down," like what Bill showed here, they can really track that signal. That is very good if you need that quality service.

But the good people of New England would be

shelling out one buck at a time extra for all those quick -- his mileage payment will go up, but that comes from somewhere.

I think as the ISOs we have a responsibility to not take more than we need in regulation, and try and meet the industry standards, which should reflect reliability and not take more than we need. We don't have all the answers, John and I and others that I assume are trying to think it through.

Where I'm leaning right now, the important thing is providing the resources access to be on a comparable footing to the generator. We want them to have an equal opportunity to provide the service we define that we need, and not be biased based on technology. It is not an easy thing to achieve.

That is here my mind is at in this, but the wheel is still turning. If there is some other value in encouraging new technologies for a certain number of years, that is a different story. Someone has to tell us that that is more important. I'm handing in my soapbox.

MS. KRAMSKAYA: Thank you.

Mr. Masiello?

MR. MASIELLO: If we imagine in the future one of the ISOs in the market has the mileage tariff,

the mileage product or payment mechanism in place, and a mix now of much faster storage-based providers and others, they will get bids.

All of the bids will have a capacity, a regulation capacity and a mileage component. The formula in the Beacon slide has 1/10th of the miles as a multiplier, which I assume right now is an administrative function.

However, in the future, each market operator would have to decide "How many megawatt miles are we going to need, we think, in the next hour, and how much bandwidth are we going to need," and then co-optimize among those two bid factors to decide what awards to make going into the hour for regulation.

Theoretically possible, but far more complicated than today's regulation market. That will have an administrative factor to be applied to the megawatt miles, which done in all the different markets on large scale might or might not lead to an ongoing tariff process; right? These (indicating) gentlemen know far more about it than I do.

MS. KRAMSKAYA: Mr. Ramey and Mr. Ott, would you like to comment?

MR. OTT: Go ahead and jump right in.

MR. RAMEY: No, I wasn't going to respond.

(General laughter.)

MR. OTT: I was going to respond directly to that. I think the decision, at least where we are headed, you're making based on what components of area control are out there at the time, is going to drive how much fast versus slow. I didn't envision that being based on minimizing cost available. It was really more of a control system need thing.

It is really performance against, again, the two components of ACE, which are the tire and the -- obviously, the frequency-only, that stuff is all fast. I think it was more that than it was this concept of minimizing mileage payments or something like that.

Although, I think if you went to a cost-based approach and said if you go ahead and schedule all of the regulation, and you do that based on, again, a co-optimization, so the marginal price is based on the highest unit's opportunity cost, I guess you could then go in and say, "Look at all the units that were scheduled. What is the highest cost to move?" You could then pay everybody that, I guess? Is that what you meant? But I don't know how you get --

MR. MASIELLO: I don't know, Andy. I asked because I don't know, but I can imagine that if you

have a lot fast providers and the algorithms in the AGC are allocating the regulation movements based on the megawatt per-minute-rates available from these things, right, back to the points around one provider saying "You didn't move me. Why didn't you move me? I didn't have access to that?" That leads you to a price-based.

If it is administrative-based, then how do you pick the number to set? I'm just asking the questions. I'm not advocating good or bad or what it ought to be, just where is this going to lead to?

MR. RAMEY: I struggled a little bit with the concept of the mileage payment in the context of a co-optimized solution that creates a market clearing price that is fully loaded, if you will, and includes an opportunity cost for regulation providers of not making energy.

That is a capacity payment for a specific amount of megawatts. The deal is that that is based on a contingent deployment of energy on that capacity. They are already getting a payment based on their submitted preference based on their economics of providing that service. They get that deal if they clear.

If they are asked to deploy, assuming

comparable treatment, if they are asked to deploy, I don't see a need for a mileage payment. I can start to think maybe we need to think about that in the context, again, of this AGC deployment that really does maybe ask certain resources to do more work than others.

Maybe the right solution is pro rata deployment. My systems operations guys wouldn't like that idea, but hat would be a solution to this disparate treatment, just based on AGC deployment.

If you had comparable treatment throughout the whole process, I don't see any need for the mileage payment. Also, it would include if you asked someone to deploy and they actually incur cost if they burn fuel to deploy, then the market design should include compensation for that out-of-pocket cost. If you had all those pieces together, fundamentally I don't see why you would need the mileage payment.

MR. QUINN: Can I ask a followup, and provide maybe a possible reason in addition to the way you are deploying those resources? It goes back to Mr. Todd's statement that right now he is range constrained, but he is not ramp rate constrained, and so he is only going to give you the ramp rate that you ask him for. But if you were to pay him, and this

really goes back to a comment you made earlier, for a ramp rate or how fast he could go or if you are going to deploy him based on the ramp rate he provides so he would go more miles, he would tell you, "I can go faster. You can have everything you want." He and everyone else who can do that would enter your market and provide that to you.

MR. RAMEY: Two thoughts on that. To the extent that he is offering a higher ramp rate, he has an opportunity to clear more megawatts, to reserve more megawatts to clear for the service.

The second question is, again: Is there a value of asking a unit to move at 10 megawatts a minute when the system can meet its control goals by moving 4 megawatts a minute? Where is the additional value there in moving faster if the system doesn't need it?

MS. KRAMSKAYA: Mr. Todd, would you like to respond?

MR. TODD: Yes, just a quick comment. Right now, we ramp rate to the full extent of our range, so there is no additional opportunity if I go to the 20 megawatt per minute. I agree I would get moved more, but I clear my full capacity. All the time I clear my full capacity.

MR. RAMEY: You can go top to bottom at 5 megawatts just as easy as you can go top to bottom at 10. So you offer five?

MR. TODD: Right.

MR. RAMEY: That is a question of constraint of how much capacity you have to move.

MR. TODD: Correct. The capacity is there. We can move a lot faster. We believe there is inherently a value to that. We don't have the answer of what the value, but believe that it should be something that is explored and taken a look at to give an opportunity to capture that.

MS. KRAMSKAYA: Thank you.

Mr. Walawalkar and then Mr. Ott.

MR. WALAWALKAR: Just one point regarding, Todd, your comment about possibly sort of factoring in any cost for moving and including that in the payment. I think as long as that decision is made and included as part of the market clearing price, I think that would be fine.

But if it ends up being sort of an after-the-market to extract payment, then I think that could end up creating a barrier for maybe more efficient technologies which do not incur that cost.

MR. OTT: I just wanted to comment, follow

up on Todd. The point is if you are paying for something you perceive you don't need, because the criteria doesn't require it, I mean, one thought to have is to say, "Well, if I start paying for that kind of performance, then I can measure, I have better control performance, then perhaps you can lower your regulation requirements and save everybody."

The point is sort of a chicken and egg. You've got to throw the performance signal out there to see that benefit. Because as an industry, I don't think we are ever going to lower our regulation requirements unless we actually see the performance increase. It is sort of a chicken and egg.

MR. RAMEY: I completely agree that that is real opportunity value, but then you question, When do you get to diminishing returns? When is low, low enough that even if I have a demonstrated increase in control performance for CPS1, you may have insufficient regulation reserved to be successful about CPS2. You can't go any lower. At that point, you really don't have any incremental value from increased responsiveness.

MR. OTT: We may not be there today.

MR. RAMEY: We may not be there, but some of us might feel like we're close.

(General laughter.)

MS. KRAMSKAYA: Mr. Walawalkar?

MR. WALAWALKAR: I just wanted to add because, again, when I'm talking with potential project owners that are looking at investing into this emerging technologies and looking at sort of their potential compensation in the future, apart from the market design issues, the other factor which they are considering is: Is there going to be a change in the regulation requirement, and a different or a higher variable scenario?

I think, again, right now the way the regulation requirement is set is purely based on a certain percentage of the load requirement. There is I think one issue: Is there a likelihood that potentially in a few years there will be more regulation procured because now there is additional availability in the supply which needs to be addressed?

I know that FERC has already commissioned the study, I believe, last year to address that question. I don't know if that decision is best made by ISOs versus NERC.

But that is another way of possibly getting more emerging technologies because if you end up

having maybe the regulation requirement which is set at 1 percent of load plus maybe 2 percent of amount of available resources or something, then it could end up driving the demand up, and that could have again the same impact in terms of raising the prices, and thus enough incentives for new technologies to come in.

Again, the main issue is there a technical need for that. I got some comments, which said that maybe there is more needed toward the ramp, ramp control. But that is uncertainty, which is weighing on the mind.

MS. KRAMSKAYA: Thank you.

Mr. Ott, did you have a comment?

MR. OTT: No.

MS. KRAMSKAYA: Mr. Capp?

MR. CAPP: Thank you. I mean, I think we have all said in different ways that there is value for fast response. I think the data that has been shown, the studies that have been conducted all point to that.

I think if the only compensation is based on a bid, then that is not going to be realized either because you have a resource that can move quicker that chooses not to because it has economic disadvantage to do so, or perhaps there would be resources that won't

even participate in the market.

You won't be able to get a project financed or something because the economics won't be as attractive. We are facing a situation now where regulation prices have gone down dramatically, last year primarily because of the natural gas prices and the general decline in the consumption of electricity. I think to just say "It is complicated, it is hard to change is not good enough" is not good enough.

I mean, we really need to think about bringing new resources in and compensating them fairly for what they can provide. I think that the data to suggest that a mileage-based system can reduce those costs is pretty clear, and I think the studies have been unambiguous about that as well.

MS. KRAMSKAYA: Thank you.

While we are still on the question of creating new products, I wanted to bring back the questions that we received during the first session. We received these questions from Mr. David Taylor, who is with the North American Electric Reliability Corporation and Mr. Howard Gillian. Let me just read these questions, and see if any of the ISOs and RTOs or the market participants would like to comment on them.

The first question says a very important issue, the differentiation between frequency response and regulation dispatch that was brought up by Mr. Lowell, what are the ISOs and RTOs doing with respect to compensation for frequency response? Frequency response has a direct impact on bulk electric system reliability.

A related question is: How do we use the new fast response capability and provide market compensation for the faster capability under the regulation service?

A sub-question, most markets have co-optimization of clearing methods. Does the co-optimization clearing reduce the problems of having smaller individual markets?

Would any of you like to respond to these questions?

Mr. Ott?

MR. OTT: I can tell you for the frequency response, we have guidelines on interconnection, but there is no compensation. I mean, it is essentially consistent with good utility practices that capitalize term and tariff, and that's where it stops.

I don't know of any effort to make compensation based on that. You could argue that the

current compensation in our generation capacity market or a our resource capacity market could be considered as a place folks can put that, the cost of that, but there is no direct effort that I know of to deal with that.

Anyone else?

MS. KRAMSKAYA: Mr. Potishnak?

MR. POTISHNAK: FERC has directed NRC to address how much frequency response is needed on interconnection level and to determine how much is needed on a per-balancing authority basis and eventually get to the point to have the metric to measure how much that balancing authority is providing. If you are come up short, have the appropriate penalties in place.

There was an order issued, I believe, March 18th, which has since been adjusted to some extent, but I am on the Frequency Response Initiative Team, as is Howard, who is seated over there (indicating).

A lot of work is being done, and it is coming, and we will be hearing loud and clear about the need for providing frequency response. We are going to have to respond with some creative ways to meet our requirements that are coming.

MR. PECHMAN: What is the schedule for that?

MS. KRAMSKAYA: There is a tech conference scheduled for next month.

MR. POTISHNAK: Originally, it was 90 days from March 18th to turn this all around, but the NERC had some appeals which were turned around. Unfortunately, I'm not really up to speed. But a lot will be done in this year on determining that. It may change the playing field in that area quite a bit.

MS. KRAMSKAYA: If there are no further comments, I would like to move on to Question 7. I think previously when I tried to lay out the foundational principles for how compensation should work or what are the economic signals that should be sent to the industry in order to ensure sufficient investment in these faster, more accurate technologies, one of the principles that we haven't really discussed is whether a storage-based facility that is selected to provide regulation and which responds to an ISO or RTO regulation down control signal by charging the storage facility and thus placing a net load upon the network should be paid by the ISO or RTO for incrementally regulating down? Or, should the facility pay the ISO or RTO for the energy the facility absorbs from the network? Would any of

you like to comment on this?

Mr. Pike?

MR. PIKE: The way the New York ISO design functions for storage devices of this nature is we treat energy produced and absorbed as more of a conversion process. There is a process of absorbing to charge the facility in producing and discharging the facility. There is not an explicit payment for the energy purchased or delivered on the system.

What we do charge is over the net hour an absolute hourly value of energy produced or consumed. Really what we are aiming to capture within that are the conversion losses. To the extent that a resource has losses can charging and discharging, those accumulate over the course of an hour. That is what the resource is ultimately being asked to pay for as part of providing these services.

What we believe that does or feel that does for the market is incentivize the most efficient technologies. If you have a resource that's got a 50 percent conversion losses and a resource that's got 10 percent conversion losses, there is a very different outcome in the settlement the resource with the higher efficiency has the greater revenue compensation.

MS. KRAMSKAYA: Mr. Walawalkar?

MR. WALAWALKAR: I agree with Robb that I think that is best way where you are accounting for the total energy losses and then in most of the cases, most of the energy storage resources at least will end up paying for the losses, and that will provide incentive for having more efficient resources integrated because your payment is same for the moment, but then it would depend on how much losses you have.

Just a related question, right now I think in most of the ISOs this is settled that a fast resource which will be participating in the regulation market, it will end up paying for the energy at the wholesale rate.

We do see that in some ISOs there is still ambiguity on that. Just sort of from an economy point of view, I think if that ends up being the case, then I think that could kill incentive for most of the storage devices to participate in frequency regulation.

I think maybe the right approaches work. The New York ISO and PJM has already come through it on the same area, that they would end up charging the resources that participate in the frequency regulation for net energy at the wholesale rate, but there is

some ambiguity across the markets on that.

MS. KRAMSKAYA: Mr. Ott or Mr. Lowell, would either of you like to comment?

MR. LOWELL: Yes. just to describe, briefly, how our pilot program is set up. On the wholesale level, people pay for or get paid for the energy that they consumer. The energy is settled at the wholesale LMP, especially because some of the participants were talking to were aggregating retail-level resources.

It just wasn't going to make sense for them to install the appropriate interconnection to be metered and settled at the wholesale level. We provide for within our rules for these participants to buy their power retail on a net metering basis. That is potentially a barrier to entry.

The two resource that we have on line now are both served by the same distribution company. We get them up the learning curve once, and that was a good thing, but it did take a while.

It took a lot of meetings, a lot of coordination to work all of that out. It varies quite a bit from state to state how receptive both the utility and the regulators are towards the net metering concept. From our perspective, we think net

metering is good, that they should pay for or be paid for the energy independent of the actual regulation, but it is not necessarily easy to do for somebody who is aggregating small resources, at least not yet.

MS. KRAMSKAYA: Mr. Ott, did you have a comment?

MR. OTT: I didn't have anything.

MS. KRAMSKAYA: Mr. Kathpul?

MR. KATHPUL: Thanks. I think, again, I agree with Robb's description of how things are working in New York.

I think to expand on it, if you kind of abstract what the absolute level of output of a resource is or what it's sign is, then for direct comparability to a generator, a generator whose output is always positive, but it moves around in the process of providing regulation, if they are asked to reg down, to provide that service, then the net effect is a decrease in their injections, and therefore the amount of energy that they deliver on the grid and get paid for.

Netting and wholesale provide a directly comparable treatment for a storage resource. I think one implication that it is important to clarify that when a storage resource is withdrawing, it is not to

charge the storage, it is to provide the service of regulation. I think that is an important distinction in terminology that everyone should be aware of.

MS. KRAMSKAYA: Mr. Tretheway, would you like to comment?

MR. TRETHEWAY: No, I would agree with that comment.

MR. RAMEY: Let's be careful. In our design, the unit that is not at mid-charge will receive a set-point instruction to get them to the midpoint. You can't have a deployed injection or a withdrawal for the resource just to maintain his level without having a specific deployment instruction.

MR. TRETHEWAY: I agree. I think the key here is you are separating the two signals: one, to ensure that that resource is at its midpoint so that it can give you the full range up and the full range down when you need it.

The second is for that one instance in terms of what the actual regulation you want them to provide in that 4-second interval.

MR. RAMEY: In the day, it is net energy. It is net energy for the resource, for the hour. Actually, I am not positive on this. I believe our settlement is similar to what Robb described. It is

just based on our the hourly net energy for the resource, which includes both of those there, the instruction to maintain the charge level as well as deployment energy.

MS. KRAMSKAYA: Mr. Potishnak?

MR. POTISHNAK: ISO New England with our pilot program, we have struggling with how to deal what I will call "opportunity cost equivalents." Generators are made whole for hoe they are displaced in the energy market.

We are hoping to come up with one common rule to apply to all technology types. Some of what we have looked at, it is hard to discern any particular opportunity costs.

They just may be deferring the work that is done via electricity to a more advantageous time while we are getting a revenue stream for helping provide regulation. In the instance of Bill's device his flywheel will incur certain inefficiencies.

It is not a hundred percent efficient and charging and discharging at the end of the hour. It may not be exactly zero megawatts. He is not an active participant in the energy market.

If he wasn't providing regulation to us, he would have turned his flywheel off and consumed zero

megawatts, but maybe he consumed a tenth of a megawatt.

Even though he is not an active direct energy market participant, should we make him whole for that his energy that is there. I'm sure Bill would say "Thank you very much."

We haven't figured all that out, but we are trying to find commonality among the different technology types, but the cards are not all falling in a nice row where we have an easy answer to that.

I would like to hear if anyone has any of those thoughts along those lines, how to deal with the different technology types and dealing with make whole payments/opportunity cost payments.

MS. KRAMSKAYA: I would certainly welcome comments because this is our Question 8. How should opportunity costs be calculated?

Mr. Capp?

MR. CAPP: Well, I think the other ISOs that we have worked with have incorporated the opportunity costs into the clearing price, which we think is the simplest and most reliable way of accomplishing that.

We have a slide in here on page 10 that sort of gives you an example of how you can distort the marketplace if you have individual settlements. But I

think that is an issue that I think there is strong agreement on how to resolve that.

MS. KRAMSKAYA: Would anyone else like to comment on this issue? I know we have discussed opportunity costs really in both sessions? But if there are any other aspects that you would like to bring up or changes that you are currently discussing with your stakeholders, please speak up.

Mr. Ott?

MR. OTT: Well, I was just going to comment on the concept of it there is a cost incurred by the storage device, again, that looks like an opportunity included in your bid. You will clear it with everybody else, and you receive a clearing price.

I mean, I think that is the most efficient, it's competition, and it's clearing price-based. It seems to be most sound way to go. I don't see why you would deviate from something that that has that kind of strong economic basis.

If you clear the market, in our case, we cleared the market, this was mentioned before, an hour ahead and we're estimating opportunity costs, which has displayed some significant problems.

We are headed towards moving away from that and going to 5-minute opportunity costs like I think

others are doing. I will just mention that I did hear that in the discussion and I certainly agree having some of those costs hidden and not the clearing prices is not the best way to go. Other than that, that is all I had to elaborate on.

MR. QUINN: Can I ask a pointed version of that? I think it follows on what Mr. Ott said. Does anybody disagree with the notion or the assertion that the right clearing price should include the opportunity costs paid to the marginal unit providing regulation service? You shouldn't take bids, find the market clearing price, and then pay everyone their opportunity cost.

MS. KRAMSKAYA: Mr. Lowell?

MR. LOWELL: I think in general I agree with that, and that's the direction we're heading. But just by way of background, and I'm not sure how far back in history we have to go to get to this point, but why do we do it the way that we do it now? We pay resource, individual resource, unit-specific opportunity cost.

This happened before my time, but I am relating anecdotes that may not be a hundred percent accurate. My understanding is that the thinking at the time was if you ask a resource to estimate what

their opportunity cost will be for the hour ahead, and that is the way our market operates, they will have some uncertainly.

All they have in their information and a vague sense of maybe what is happening in the market. It is a risk. They have to price that risk into their bid.

Who has the most information? Well, it the system operator. Who could do a better job of estimating what those opportunity costs are, the person with the most information.

There is still some risk. But if you can reduce the risk, it kind of sucks that cost out of the market. I believe that was part of the rationale for doing it that way.

Now, it has consequences. It affects prices, it affects short-run, long-run investment signals, an things like that. By providing this background, I am not trying to argue that "Well, therefore it's good and we should keep doing it."

But I think there were some legitimate reasons for doing it a certain way, and it will be difficult for resources to estimate what their opportunity costs will be, and they will have to price that into their bid. Having said that, that is still

probably the efficient way to go. Let the market price the risk. I think that is part of why we have what we have today.

MS. KRAMSKAYA: Mr. Ott?

MR. OTT: Today, when people put a bid in PJM at least the bid they are putting in, they have an energy offer and they have a regulation offer, which is based on their cost to move.

There is a cap that they can only put a certain amount, but then the actual opportunity cost that ends up in the clearing price is actually calculated as part of the simultaneous optimization. They are not estimating their opportunity cost to us. We are actually calculating it.

MR. LOWELL: I think that may be the difference between how it works in New England and PJM.

MR. RAMEY: Is that a unit-level calculation, or is it a marginal unit calculation?

MR. OTT: Well, it is unit-level, but obviously the marginal unit is the one that sets the price, then. Each opportunity cost if unit-level.

MR. RAMEY: Everyone receives that same opportunity cost?

MR. OTT: Everyone receives the same

clearing price. Remember, the clearing price based on opportunity cost plus the offer to regulate.

MS. KRAMSKAYA: Mr. Potishnak?

MR. POTISHNAK: I have a question for Andrew. ISO New England had an AGC market that did not include the opportunity cost in the regulation clearing price and paid opportunity cost on a per-generator basis.

We went to the standard market design. I can't remember the year. It was in 2000 or 2002, or whatever. We basically copied your regulation market for the most part.

I recall that the regulation clearing price was determined a day ahead. For hour ending 13 today, yesterday you ran a study and said Generators A, E, I, O, and U would be providing the regulation.

From that, you calculated a regulation clearing price for the next day for that hour that served as a floor price that included the offer price times the capacity plus the opportunity costs and then all divided by the capacity again.

You had a clearing price that was based on A, E, I, O, U for yesterday for this. But when it came in real time, if you selected Generators X, Y, and Z for regulation, that only served as a floor

price, and the generator in real time with get the greater of the regulation clearing price times its capacity or its individual offer price plus its opportunity cost.

Do you still have that arrangement now, or has it changed since way back then?

MR. OTT: I don't ever recollect it being that far forward. There was an hourly one, and this was the phenomena we were discussing where 30 minutes before the hour starts, we do said calculation, which is essentially forecasting what the hourly energy price will be next hour, which calculates their opportunity cost. Then, the clearing price for that hour is set by the marginal regulating resource.

You calculate the regulation clearing price for each hour 30 minutes before the hour starts, not day ahead. It was never a day ahead on my watch, and I've been watching since we started regulation.

(General laughter.)

MR. OTT: There is a day ahead; they have to offer day ahead, but the actual calculation of the regulation assignments and clearing prices was always hour ahead.

There may be some miscommunication, but I think certainly the phenomena of doing a forward

regulation assignment and a forward calculation of a clearing price, we see a flaw there because it takes some of the money -- in the regulation market, prices tend to be depressed versus if you calculate them every five minutes.

We are hoping to you can do a regulation assignment hourly, but you are actually clearing prices every five minutes, and then you don't have this forecasting phenomena because it is a problem we have had uplifts and things like that, which you would expect.

Day ahead? I don't know how you could possibly do day ahead. I apologize. I just don't remember it. What we are hoping to do is calculate the price every five minutes. The compensation would be based on the average of those five minutes over the hour. We are not headed to 5-minute billing yet. Someday, I'm sure.

MR. RAMEY: I think maybe you are referring to on an hourly basis you would determine reg eligibility for the unit. Each unit you would select which resources were going to be eligible to provide for that hour or you will clear on 5-minute basis.

MR. OTT: Right.

MR. RAMEY: Switching units eligibility to

provide regulation on a 5-minute basis is --

MR. OTT: No, no, what you could do -- in other words, the way you do it is you essentially treat regulating resources, a min regulation time of one hour; okay. If it has been on regulation for more than an hour, during the middle of the hour, should you need to, you could yank it out. The concept of having that hourly commitment --

MR. RAMEY: Commitment?

MR. OTT: Commitment, right.

MS. KRAMSKAYA: The question as to who should be calculating the opportunity cost was raised, but I don't know that it was answered especially with respect to the energy storage resources if they would have an intertemporal opportunity cost and also the same for the traditional resources?

MR. OTT: I can start on that, if you want. I think this concept of an intertemporal opportunity cost, if they think they have one, and I'm sure they do, I think the most efficient thing is for them to include that as part of their cost of moving kind of offer.

The compensation for the regulation market clearing price would include the opportunity cost to the highest. That is probably the most efficient. I

don't know how you do the intertemporal thing accurately.

MR. RAMEY: That's co-optimization of hours, problem solved.

MS. KRAMSKAYA: Mr. Pike?

MR. PIKE: Yes. Just following up on that, I wanted to chime in to Mr. Quinn's question on agreeing to lost opportunity cost. I agree, but I was just going to add some qualifiers to the statement, that lost opportunity cost from the energy market, not just lost opportunity costs.

What you are talking about is a resource that could be in multiple products. He is requesting to be in one, or you are asking him to be one. I guess that is the key is this is lost opportunity costs from the energy market.

In the case of scheduling of energy storage resources in the New York design, they are not eligible to be energy market providers, so they wouldn't have a lost opportunity cost associated with being an energy market provider.

They could have a lost opportunity cost intertemporally of not being able to provide regulation at a later point in the hour. But that, as Andy said, would expect to be captured in within the

offer price of the resource submitting that bid into the system. We are optimizing every five minutes and settling every five minutes on regulation service. It's a ball.

MS. KRAMSKAYA: At this time, I would like to see if there are any additional questions from the staff or from the audience?

MR. ILLIAN: I have a couple.

MS. KRAMSKAYA: Maybe if you would like to sit at the microphone here.

MR. ILLIAN: First, there is one that I think you missed, Tatyana.

MS. KRAMSKAYA: Could you identify yourself, please?

MR. ILLIAN: Howard Illian, Energy Mark. One of the issues is related to opportunity costs. I guess the issue is if frequency response, the delivery of it requires capacity, is there an opportunity cost associated with the delivery of frequency response, rather than it just being good operating practice to deliver it?

In other words, can you have a fair market if you require the delivery of energy from a resource who has an opportunity cost, but you don't have a mechanism to reward them for it?

MR. POTISHNAK: There is not an explicit marketing compensation settlement scheme today for frequency response. We are actively watching the technical conference that I know FERC staff is organizing on the topic and NERC is working on.

Is there a future that there is a frequency response market similar to a regulation service? I mean, certainly that is an outcome you could envision, and there could be tradeoffs between those two product lines that would create opportunity costs, if that market was conceived and needed to be implemented that way. Today, that is expected to be a cost of service and captured through other mechanisms.

MR. ILLIAN: I have two other quick questions. One has to do with the net metering and LMP pricing. I am not sure I understand how LMP pricing can work with net metering when net metering essentially blends a whole bunch of periods together and LMP pricing differentiates those periods.

Is this giving some advantage to some participant in the market when you offer them net metering?

MR. LOWELL: I will respond to that because I think I was one of the first people to use the term. within our pilot program, a participant has a choice

to connect at the wholesale level, and then they pay their net consumption hour by hour at the LMP, at the note of which they connect. That is fairly straightforward.

If they are connecting at the retail level, and an example might be somebody who is aggregating the fleet of 20 electric vehicles who plug in at various locations, from our perspective that is up to them to make the arrangements with the local utility.

You're right, they would be averaging or aggregating over multiple time periods, but they are probably paying a flat or a more or less flat retail rate anyway.

The tradeoff that they need to make is additional cost of connecting at the wholesale level is just not going to be feasible for a fleet of 20 vehicles, and they would choose to pay the higher electric cost at the retail rate.

We have had participants choose both. It just depends on their circumstance. Our approach was to try to maximize the possibilities and then let the participant make the choice that they felt was best for them.

MR. ILLIAN: That clarifies what I was trying to raise, which is the question of netting

versus LMP at the wholesale level, which is what the storage participant would be faced with, and whether that is a fair way of doing it.

MR. LOWELL: If it was a large storage resource, a utility scale resource, it almost certainly would make sense in our system for them to connect as a market participant at the wholesale level and get the LMP. Now, if you are talking about the difference between 5-minute LMPs and hourly LMPs, that is also an issue. That is not how we settle today.

MR. ILLIAN: I have I believe one final question that I wanted to ask, if I can remember what it is. No, it's gone. I will just shut up right now.

Thank you for the opportunity to ask the questions.

MS. KRAMSKAYA: Is there an additional question?

MS. KRAMSKAYA: Well, I know that I am the person who is standing between all of you and lunch. I think we will entertain one more additional question from the audience.

NICK MILLER: (No microphone) Nick Miller, GE. Asymmetric markets are more complicated.

MS. KRAMSKAYA: Mr. Walawalkar?

MR. WALAWALKER: At least most of the

resources which we have went on demand response. If you end up just having one single rate within certain time, you may have the ability to move in just one direction.

Unless you are moving back in terms of providing the regulations, I think it would be difficult for most of the resources to just participate in a single reg down or a reg up market.

I think most of the cases at least which we have looked based on the interest which people have expressed in various markets, I think actually having the symmetrical regulation may enable more resources to participate.

MS. KRAMSKAYA: Mr. Todd?

MR. RAMEY: I think it is just a tradeoff in choice of lots of options. If you have a separate up and down regulation products that in one hand have some advantages, but the disadvantages are that it complicates your market design, complicates your optimization solution, and creates some additional complications for participants to manage multiple up and down offers.

Midwest ISO, that was debated hotly for months and the decision of stakeholders was one product. In terms of intermittance being qualified,

they provide regulation. I think it would be helpful to have separate up and down products because of the reasons stated.

But at the end of the day, where is the real value in that even to the asset owner. We are talking about resources that have negative real opportunity costs for providing energy. Those resources, if they are available, at least in our market today, except for a specific time and locational issues, those resources are going to clear to provide energy. There is not a whole lot of value.

MS. KRAMSKAYA: Thank you again for all of your patience. We had a really long morning session which went into part of the afternoon. I think the discussion was very helpful to us. We received a lot of useful information that we will be processing and reading over the transcript.

In the meanwhile, we would also appreciate if all the panelists as well as members of the audience and other market participants would submit comments, which we will be hoping to receive in 21 days.

We will be issuing a notice with exact days, the common due period. Thank you again. It was very productive. Thank you for coming here. With this, I

would like to close this conference. Thank you.

(Whereupon, at 12:43 p.m., the hearing was concluded.)

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