Case Study Interview: PJM Interconnection—Pete Langbein

Prepared for the National Forum on the National Action Plan on Demand Response: Program Design and Implementation Working Group

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Case Study Interview: PJM Interconnection—Pete Langbein was developed to fulfill part of the *Implementation Proposal for The National Action Plan on Demand Response*, a report to Congress jointly issued by the U.S. Department of Energy (DOE) and the Federal Energy Regulatory Commission (FERC) in June 2011. Part of that implementation proposal called for a "National Forum" on demand response to be conducted by DOE and FERC.

Given the rapid development of the demand response industry, DOE and FERC decided that a "virtual" project, convening state officials, industry representatives, members of a National Action Plan Coalition, and experts from research organizations to work together over a short, defined period to share ideas, examine barriers, and explore solutions for demand response to deliver its benefits, would be more effective than an in-person conference. Working groups were formed in the following four areas, with DOE funding to support their efforts, focusing on key demand response technical, programmatic, and policy issues:

1. Framework for evaluating the cost-effectiveness of demand response;
2. Measurement and verification for demand response resources;
3. Program design and implementation of demand response programs; and,
4. Assessment of analytical tools and methods for demand response.

Each working group has published either a final report or series of reports that summarizes its view of what remains to be done in their subject area. This document is one of those reports.

The Implementation Proposal, and the National Forum with its four working groups' reports, is part of a larger effort called the National Action Plan for Demand Response. The National Action Plan was issued by FERC in 2010 pursuant to section 529 of the Energy Independence and Security Act of 2007. The National Action Plan is an action plan for implementation, with roles for the private and public sectors, at the state, regional and local levels, and is designed to meet three objectives:

1. Identify requirements for technical assistance to States to allow them to maximize the amount of demand response resources that can be developed and deployed;
2. Design and identify requirements for implementation of a national communications program that includes broad-based customer education and support; and
3. Develop or identify analytical tools, information, model regulatory provisions, model contracts, and other support materials for use by customers, states, utilities, and demand response providers.

The content of this report does not imply an endorsement by the individuals or organizations that are participating in NAPDR Working Groups, or reflect the views, policies, or otherwise of the U.S. Federal government.

Case Study Interview: PJM Interconnection—Pete Langbein was produced by Program Design and Implementation Working Group chair Dan Delurey (Association for Demand Response and Smart Grid) for the Lawrence Berkeley National Laboratory, who is managing this work under a contract to the National Electricity Delivery Division of the U.S. Department of Energy's Office of Electricity Delivery and Energy Reliability under Contract No. DE-AC02-05CH11231.

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Regarding the National Action Plan on Demand Response, visit:

http://www.ferc.gov/legal/staff-reports/06-17-10-demand-response.pdf

Regarding the Implementation Proposal for the National Action Plan for Demand Response, visit:

http://www.ferc.gov/industries/electric/indus-act/demand-response/dr-potential.asp

OR

http://energy.gov/oe/downloads/implementation-proposal-national-action-plan-demand-response-july-2011

Regarding the National Forum for the National Action Plan for Demand Response project, visit:

http://energy.gov/oe/national-forum-demand-response-what-remains-be-done-achieve-its-potential

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Case Study Interview: PJM Interconnection—Pete Langbein is a product of the National Action Plan on Demand Response Program Design and Implementation Working Group.

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Introduction

The Program Design and Implementation Working Group acknowledges the significant level of experience and knowledge about design of demand response programs and products that exists throughout the electric industry, but recognizes that this information is diffuse and has not been captured in a way to allow best practices and lessons learned to be identified. Thus this Working Group has focused on interviewing and gathering information from DR practitioners and presenting it in a way as to allow others in the industry to learn from what has already been experienced.

This report contains a transcript for one in a series of live interviews conducted by Dan Delurey (Association for Demand Response and Smart Grid) with a number of demand response practitioners from both the retail and wholesale side of the industry. This interview with Pete Langbein, Manager of Demand Response Operations at PJM Interconnection, was conducted on September 19, 2012.

To date, transcripts for the following interviews are available:

Name	**Affiliation**
Col Smart	Con Edison
David Eggart	Gulf Power
Pete Langbein	PJM
Bob Donaldson	Progress Energy Carolinas
Bill Harmon	Reliant Energy
Paul Kasick	Southern California Edison

These "case study interviews" focus on identifying and capturing lessons learned from current demand response programs. The interviews were conducted via private webinar with the interviewee. In addition to this document, the interviews are available as webinar recordings, transcripts and downloadable PowerPoint presentations on the ADS website: http://www.demandresponsesmartgrid.org/CaseStudyInterviews.

Interview: Pete Langbein of PJM Interconnection

Dan Delurey: Today, we're going to be talking with Pete Langbein. He is the Manager of Demand Response Operations at PJM Interconnection. The focus of our discussion is going to be the evolution of how DR is participating in PJM's market. Welcome, Pete.

Pete Langbein: Thanks, Dan.

Dan Delurey: I know you want to talk about the evolution of DR participation in PJM's market, but I wonder if we could just take a moment before that and talk about PJM itself. I'm old enough and I've been around the electricity industry long enough to know that there was a time before there was an ISO New England and a PJM, and so on. Can you just provide a little bit of background for those who may not remember that or who were not around to experience the creation of RTOs and ISOs?

Pete Langbein: Sure, Dan. PJM is what's called a "Regional Transmission Organization." PJM is actually coordinating the movement of wholesale electricity across 13 states and the District of Columbia. It basically starts with New Jersey in the east. It goes out to Illinois and the Chicago area in the west, and down to Virginia in the South. The three main things that PJM is focused on is first, the reliability of the bulk power grid - and you can think of that as an air traffic controller, making sure that all the necessary units, generations units, are online to ensure there is enough generation to serve load it any moment in time. Second, PJM works to operate fair and effective wholesale markets and helps foster those. It makes sure that the right units are operating at any moment in time to help minimize cost across the region. Third, we actually are in charge of a regional planning process, but we really look at a broad interstate perspective to look at the most effective and cost-efficient improvements to the wholesale power grid.

Prior to PJM, each individual transmission owner performed many of those functions themselves within their own service territory, and then they would loosely coordinate with other transmission owners or electric distribution companies that they actually bordered on. PJM is actually now operating and coordinating at a much tighter operational basis

across a wider geographic footprint to bring additional benefits to the region.

Dan Delurey: You don't buy and sell electricity. You are, if I understand it, a non-profit organization that coordinates all of what you just discussed. Correct?

Pete Langbein: Yes. We are a non-profit entity. We operate a market. We don't buy and sell in the market. We operate the market which is similar to the New York Stock Exchange's role in the stock market. Similarly, PJM does not own generation plants or transmission assets. PJM is just there to coordinate across those owners that own them for the most efficient dispatch of the resources.

Dan Delurey: When PJM was handed the keys to do all of it, was DR part of that picture right from the inception or did it mainly consist of coordinating generation?

Pete Langbein: PJM is the longest operating regional transmission organization where some of our members have participated for 85 years. At the outset, much of that was really focused on generation and transmission lines across the different members. DR was done really on a utility by utility basis and was not a feature within the wholesale market itself when it was formed back in 1927.

Dan Delurey: Okay. Well, let's may be talk about how that began and then talk about the specific evolution over the past decade of demand response there.

Pete Langbein: On the slide being shown, it puts a little perspective of where we are today and where we started with DR being actually in a wholesale market, as opposed to just being operated on an individual utility basis. Back in 2002, there were some programs set up to try this out and see how these resources actually operated in a market structure. Then in the 2005-2006 time frame, those programs were actually converted into a mechanism that would be there in the tariff and available for the foreseeable future as opposed to just the pilot program with a short term view. That's when DR resources were able to actually get in the markets, participate, and they also knew that those rules would be available into the future and not on a pilot basis.

Dan Delurey: In the beginning, they were "programs" as the term might be used to talk about a utility DR program. Over time, they became simply a market within PJM.

Pete Langbein: Yeah, and you can think of it as they became another market participant that could actually participate in the existing wholesale market. The

market structure was there. This provided a gateway for these new resources to actually participate in those wholesale markets as opposed a more traditional generation resource.

Dan Delurey: Well, I know that you have different types of markets in which DR is now a participant. I don't know if you wanted to maybe explain those or if you wanted to simply talk more in general about DR at PJM and sort of how it's gone and what some of the lessons learned, and we can touch upon different areas perhaps where you might be able to comment on.

Pete Langbein: Let me just spend a moment at a high level. The larger markets in PJM are really broken into a few categories. There is the energy market, or the capacity market. That's also referred to as the reliability pricing model or RPM at PJM. Also, three different ancillary service markets: Synchronized Reserve, which basically means generation will be injected or demand response will reduce within 10 minutes; a regulation market where a resource will basically go up and down in real-time to help us manage frequency on the grid; and something called day ahead scheduling reserve which is really a 30-minute reserve product where a demand responder would get down within 30 minutes.

As DR was opened up within the wholesale markets, all of the markets have continued to grow for DR along the way, and our most recent one in terms of participation is that regulation market that tends to be a little more difficult to do because of the real-time nature and the fact that load needs to go up and down in order to meet that signal.

Dan Delurey: Part of the story is that this has become real --I mean DR is not at the kids' table here. It's at the adults' table and it's one of the key market participants in what you're doing there?

Pete Langbein: That's correct. I have a couple of numbers on that. We have grown in terms of revenue that was paid out to Demand Response folks from the 10 to 20 million dollar range back in the 2007 time frame up to today, where it is close to a billion dollars, and represents somewhere between 6 and 8 percent of the peak load on a capacity basis.

Dan Delurey: Turning to how this all got started or how it's been nurtured along the way, there have been principles that you've followed and it helped you develop goals and so on. Have they changed over time or are they still sort of what you originally set forth?

Pete Langbein: I think the high-level goals still remain intact in that we're focused on having another resource in the market that can compete, and trying to make the playing field level between someone like a demand resource

versus a traditional generation resource. Knowing that there are obviously fundamental differences, where those differences occur, we may need special rules. But the principles are still intact, and it's more a matter of peeling back the onion in terms of refining those rules over time.

Dan Delurey: Now, one of the principles that I see here is the idea of paying once, and I guess if I understand what that's referring to, you've got all these different markets or I might call them sub-markets or whatever. When you've got DR now being able to participate in many of them, is double-counting an issue that you have to deal with?

Pete Langbein: It is an issue that we do have to deal with. Again, we have leveraged the principles of how generation participates in the market and have taken those for demand resources in the market to make sure that we don't have those type of issues. We've been fairly successful at that over time.

Dan Delurey: I presume that you've got all sorts of parties that were interested in those principles and goals and how these things have evolved. Can you talk about that a little bit? I mean did you get that right in the beginning? Did you know who everyone was that you had to have at the table?

Pete Langbein: Yes. PJM is a regional transmission organization. We have a governance process that's basically set up. Again, PJM is a non-profit entity that is owned and operated frankly by the membership, and the membership is broken up into some different groups based on their interests, kind of as listed here on the slides. That governance process has been in place since the beginning and that governance process is what is used to determine what business rules become effectuated and what they do for the different market participants.

Dan Delurey: As you look back over the years on how this is all developed, anything to reflect on in terms of the stakeholder process? Did you have to change the voting rules a lot?

Pete Langbein: We did not. We did not change the voting rules, i.e. that governance process. Again, PJM has been operating as an RTO or what was called a power pool like that for a while, so we have a long tradition of having a governance process and how that works. None of that changed as a function of demand response. Demand response went through that existing process so that it could participate in the market.

Dan Delurey: Okay. One of the active parties in what you do is FERC, right? What exactly is the role of FERC? Did they actually have to approve what you do in DR?

Pete Langbein: Yeah. FERC, the Federal Energy Regulatory Commission, is our regulator and they regulate the wholesale power markets. We operate under a tariff and the Federal Energy Regulatory Commission approves all tariff changes. One of those tariff changes was to allow DR to participate in the markets, to set forth how they would participate in the markets, and establish how things like revenue and cost recovery work for those resources.

Dan Delurey: Okay. You've got a lot of committees, and I know because I'm on a lot of the PJM mailing lists and I've looked at the calendar before, and it looks quite daunting when you look at all the different committees that might be meeting in any given week. Do I take it, that's been honed and you've got the right committees and it works and all of that?

Pete Langbein: Yes. I believe the stakeholder process is effective. Our members have actually made some changes to that overall process over the last couple of years to make it more effective. One key point is that the membership felt that it's important to actually have a sub-committee really dedicated to some demand response type activities. That's been created for those members that are directly involved in the markets with demand response resources.

Dan Delurey: Before we leave the topic of stakeholders and so on, have the stakeholders all sort of gone along willingly? Has there been vigorous debate and disagreement among stakeholders as to how this has all developed?

Pete Langbein: Many of the demand response items that have come up have gone through a lot of debate. Yes, there have been a lot of discussions. There have been a lot of different opinions about some of the nuances of how those rules would work. They continue to be discussed as new challenges come up over time.

Dan Delurey: Let's turn to technology. From the work that I have done in DR for a long time now, I know the impact of technology, and as I remember some of the early regional DR efforts, they were pretty simple and straightforward. A lot of them were just based on simple curtailment orders or requests that were given to large customers and so on. Can you talk about the evolution of DR at PJM from a technology standpoint?

Pete Langbein: Yeah, sure. Really, when you look at DR and you look at how DR operates in the PJM markets, what we have tried to do is to break out what are DR specific business processes so that we can create or build applications that serve those purposes, and then those activities that are the same for a generation resource, handle the DR resource as we do a generation resource. We actually open up those technologies for a DR provider to be able to use. For example, for DR, we have something called our registration process and that's all about which customer is going to perform in which market with which DR provider at a moment in time. That's something very unique to DR. In the world of generation, a physical plant is built. We know it's there. We know where it's located and it goes into a network model.

We actually built an application, or actually worked with our business partner to build an application, eLRS. That lets us make sure we know who is participating where, but also make sure that we can measure and verify who did what and when, and then also get into some of the unique parts of settlements for DR providers. We use a system called our eMarket application which is basically how our participants come into the market and make offers.

We've actually opened that up to DR providers so that they can do things like align their offers into the market with the type of things that they're going to do to actually control load at the particular site. For example, if the price is a hundred dollars, maybe I'll curtail my air conditioning. If the price gets up to $200, well, I'll do that plus maybe I can turn off some lighting. If it goes to $500, I'll do those two things plus on top of that, maybe I have some access to some generation with the appropriate permitting that I can actually turn on. It gives them flexibility to actually make their offers align with that type of actions they can take at the facility. A lot of that kind of capability and flexibility has grown over the last five years in the PJM marketplace, so that we can make it easier for our market participants to be more flexible so it can align with what they can actually do at that facility.

Dan Delurey: Really, you're talking about the evolution of information technology and data management technology which you have there in--as you put it earlier, your air traffic control center. As your technology has evolved, has it been it easier for providers to bring DR resources to you?

Pete Langbein: That's exactly right, Dan. Then we have also spent a lot of effort in opening up protocols and leveraging protocols that are out there to allow more machine to machine communication so that our members can automate their business process downstream to the individual customers. One key point there: PJM is operating a wholesale market.

PJM is dealing with our members who then in turn are actually working with individual customers. PJM is not working with individual end-use customers.

Dan Delurey: If I'm a DR resource provider, do I have to talk to you to schedule something or is it pretty much close to automation?

Pete Langbein: You do not have to pick up the phone and talk to PJM. That process can actually be automated electronically, almost fully at this point. Frankly, it's a function of technology investment frankly on the DR member as to how much of that they would want to do on their side. We tried to keep it flexible. We're trying to strike a balance. There are small, less sophisticated folks that are in the market. We don't want it to be a barrier to entry that there's a large technology requirement. Then on the other side, we have some other folks that may have bigger investments in technology where we will enable them to be able to automate their process with PJM so it's not a matter of making phone calls.

Dan Delurey: That's interesting to me because, again, I remember when--you call a DR provider a curtailment service provider, CSP, I believe?

Pete Langbein: That's correct.

Dan Delurey: Okay. I remember when it was possible for a CSP to not rely that much on technology and yet still provide DR to PJM. You're saying that that's still possible, I guess, but that it sounds like the development of your internal technology is something that makes it easier and better for a provider, for a CSP. I mean that would be the way things are going, I would think.

Pete Langbein: That's exactly right. We do require some minimal level of technology. We have an application where curtailment service providers will conduct their activity. That's out there. That's available for them and they need to use that for certain functions, but we also do have, and we've taken that next step, to have things like web services available where our curtailment services providers need to go to something like an application interface to do things. They can all do that behind the scenes with different electronic transactions and then take those transactions and the information and automate that on their business process to actually communicate directly with our end-use customers.

Dan Delurey: What about the technology that a CSP or DR provider is actually putting into a customer's premises? I would think you're in a vantage point to be able to see how that's evolved regardless of some of the info tech communications that we were just talking about. We haven't really

talked about metering yet, but certainly, if your things were DR, you want to make sure that it's metered and verified, and all of that. I think I just asked you maybe two or three questions at once, but can you just talk about that a little bit?

Pete Langbein: Sure, Dan. Keep in mind, PJM is not interacting directly with the customers. That is exactly the business function that the curtailment service providers or DR providers are performing there. As we talk to our members who are curtailment service providers, we understand the type of things they're doing out in the field. From a technology perspective, there's a wide variety of things that are going on out there. There is, for example, a big transformation in things like traditional, residential, direct load control that have been done over the course of the last 30 years with things like radio frequency control, to actually using much more advanced and smarter two-way communication to those compressors and doing some really cool things around how to determine what pool of customers to cycle. How do you know if someone has been cycled too much to roll over to another customer? Just the quantum leap in where things were 20 years ago when it was a matter of pushing the button and everything hopefully worked the same.

There is a wide variety of what's going on out there in the field in the area of controls. We'll talk a little bit about metering, I guess, at some point, in terms of some of the things that the electric utilities are doing out there today.

Dan Delurey: All right. Well, you've just mentioned that you don't serve end-use customers and you don't really interact with them. You're doing a lot of this behind the scenes. Does that mean you've got to do any kind of outreach other than obviously with your stakeholders going back to those committees that you talked about? Otherwise, is this something that there's a need to do?

Pete Langbein: In terms of outreach, our members are doing outreach to customers to get them to see that they can help them take advantage of Demand Response opportunities. You just have to take a step back. In terms of our market structure, we allow any member to bring end-use customers to PJM as a wholesale resource. That entity, that curtailment service provider, it could be a traditional utility. It could be somebody who is like what we call the load serving entity. It could be completely separate in a more technology oriented company. It could be an energy service company. We have a wide variety of entities that operate as curtailment service providers that are actively out there on the street soliciting and talking to customers about some of these opportunities. I would say the

outreach is always helpful. It can only benefit customers to make them more aware of some of the things that they could be able to do, which ultimately would reduce their electricity cost.

Dan Delurey: I was a guest speaker at one of your symposiums a couple of years ago. So I know you through events like that and I guess you're doing that because as you just alluded to, it's good to let everyone know what the big picture is and then they'll maybe be more likely to actually implement DR which can then be sold to PJM.

Pete Langbein: Yeah, that's exactly right, Dan. I appreciate you bringing that up. We will host symposiums, we have some of the stakeholder forums to the extent we can help our stakeholders and the state commissions to understand what those opportunities are and how this works, we do that. We are creating basically the ability for other folks to bring in those resources in the form of a program or a product that they would like to do for those consumers.

Dan Delurey: A few minutes ago we mentioned that things were trending towards automation, or at least moving significantly in that direction. Yet, there are still things that have to be managed by you and the rest of your team there and so on. What would you say are some of the critical steps you've had to go through or that you have to deal with today in terms of the actual management? I know they're not programs but still the market has to be managed to a certain extent.

Pete Langbein: Yeah, and that's a great question. I would say, I think of the old adage, the difference between theory and practice, it's much greater in practice than it is in theory. The key thing there is the concept of the DR a lot of folks have talked about over the years. The nitty-gritty details to operationalize that can't be overlooked and require quite a bit of focus to make it happen - and to make it happen seamlessly within operations of managing the overall grid. To me, if we talk about things like lessons learned, I think that we'll have different folks suggesting what business rules should be. Sometimes kind of drilling down to that next level of detail to fully understand how that's really going to be implemented in a seamless and coherent manner across markets and operations is sometimes overlooked a little bit and requires quite a bit of work to make that happen the correct way.

Dan Delurey: Has it gotten better or easier over time?

Pete Langbein: With any new resource or new market type stuff there are always growing pains. I think we're no longer at the kiddie table. We've kind of graduated to the adult table in terms of how these things operate. But

there are always areas that we will continue to work on with our members to make it more seamless for them.

Dan Delurey: I've talked a lot about CSPs and DR providers delivering a DR resource to you. We haven't really talked about the role of utilities, so can you just talk about that for a minute? Are utilities bringing DR resources to PJM? Are they working with CSPs? What are the different ways that all of those interact?

Pete Langbein: Sure. A couple of different things in that area. One, when we actually have a utility customer that's going to participate in the market and we have this thing called a registration process. We are going through and doing validation to make sure we understand which customer that is and that another CSP is not also having that same customer in the same market so to speak. The utilities of the electric distribution companies actually are helping us by reviewing the registrations and some of the data that's contained there, to make sure it's clear on whom are we actually talking about. The utilities also themselves have some programs that they will turn into a demand resource and offer that into one of the various markets. That is common. It depends on the particular utility.

Dan Delurey: You're saying that there are different combinations or stand alone offers that are part of the mix there?

Pete Langbein: Oh yeah, absolutely and it varies depending on the utility, the type of customer and things of that nature. Let me note one other thing in terms of utilities . The role, some of the demand response, in many cases the service providers will rely on the existing utilities' interval metering. They will go through the utility on behalf of that customer to get that interval meter data which is one of the requirements to participate as of demand response resource.

Dan Delurey: I think that is the next frontier because you have a lot of smart meters being deployed in utilities for the residential customers. That's really a new resource that's being developed when it comes to potential DR. In fact, that's why--I know you mentioned it earlier I think in your slide about evolution, the Price Responsive Demand effort that is sort of the latest thing that you've done. That is tied into that?

Pete Langbein: Yeah, Price Responsive Demand is tied into that. Price Responsive Demand is really where there are customers that are receiving more real time price signals. Based on that real time price signal they expect to not have load on the system when prices are very high. PJM, working with the stakeholders, has created this product where if the consumer is not going to have load on the system when the prices are high, we can

then basically purchase less capacity for that customer because they're not going to have load on the system anyway based on the price signals. To enable things like that and to enable DR as one of those key components is to have the appropriate metering in place so that we can measure and verify what actually occurred and/or is occurring in those different instances.

Dan Delurey: Okay. One of the things that we talk about in these Case Study Interviews is cost. I mean obviously cost is a major issue which has to be budgeted pro forma when you're setting out to develop things and it has to be managed along the way. Actually that leads to the question of who approves your budget. Is it FERC, which you mentioned as approving your programs?

Pete Langbein: Yes. We have basically a stated rate out there. We also have a process depending on the type of cost we're talking about. There are different allocation processes. This slide really was just meant to indicate--to make demand response actually happen and to be able to really operationalize it especially in the wholesale markets operations. It requires time, effort, and money to be able to have the appropriate technology in place so that it can be effective. Over time PJM has continued to support the effort by dedicating those resources to have new infrastructure in place. This one in particular, this eLRS application which helped reduce that barrier for the curtailment service provider and took the administration they have to do to bring these resources to market.

Dan Delurey: Your money comes from market participants and utilities and I guess everybody in the region and you put it all in a pot and that's the PJM budget? Then it gets to spend part of it on DR?

Pete Langbein: Yeah, it's a little more complicated than that.

Dan Delurey: No, I'm sure that it is.

Pete Langbein: All I would say is our membership, and that can be anything from a transmission owner to a DR provider to generation owner, pay membership funds to PJM. Then we have a process that we go through in terms of allocating those various costs that occur. We have applications we need to support to operate markets and to operate the grid.

Dan Delurey: Has cost been a challenge in terms of trying to estimate and manage it, or is it pretty much within what you've seen as you've started out?

Pete Langbein: I would say it's in alignment with what we have expected in terms of our cost. We are able to effectively provide the framework to manage these resources.

Dan Delurey: Okay. Early on we talked about double counting a little bit as one of the critical issues that you have to deal with. What are some others and how are you dealing with them?

Pete Langbein: Measurement and verification is something that we have spent a lot of time and will continue to spend quite a bit of time on. Just to take a step back, a traditional generation resource has a meter that we know exactly how much electricity is being produced and injected into the grid. For Demand Response we have to estimate what the reduction was, which is telling us how to quantify the amount of electricity provided. We can't just hang a meter and say, "This is what happened." If you hang a meter you need to still estimate what the load would have been versus what the load was to derive a load reduction. That's been something that we've worked through quite a bit the last five years and we'll continue to work through that since it's such an important item to make sure that a megawatt is a megawatt.

A couple of other things, I think we touched on a little bit about metering rollouts. In order to participate in the markets, there needs to be some fundamental infrastructure that's out there. For example, interval meters. That has changed quite a bit over the years and we'd expect that it will continue to change. Without the appropriate interval metering out there for some of the end use customers, it can limit the opportunities for them to be able to push this data to the market.

Price Responsive Demand is listed here. Again, that's a fairly new product that's out there. We will continue to kind of work on that as members bring those type of resources or those resource to participate as a Price Responsive Demand resource in the future. That is fairly new. We're still getting our feet wet with that obviously.

Dan Delurey: You mentioned on one of your bullet points here the area of on-site generation and applicable laws including environmental statutes and so on. Does PJM monitor or estimate the environmental profile, e.g. air emissions profile of what it does in terms of dispatch of both supply and demand? I guess what I'm getting at, is it able to show an air emissions benefit from using DR? It's kind of a pointed question. If you don't know that's fine.

Pete Langbein: Yeah, I don't know. I think the key thing is that Demand Response can be effectuated in a number of ways. It can be somebody cycling an air

conditioner, turning off the lights, stop producing a widget, send people home for the day. They may have generation on site, co-generation, and that could be steam unit or it could be some form of diesel that they can fire up to reduce that net load. The key point here is folks that are going to use things like on-site generation to reduce their specific load. Obviously, they need to comply with all the appropriate laws and environmental laws that are out there. PJM is not an environmental regulator. We're focused on reliability and the megawatts that need to be there. We always emphasize with our membership that there's a requirement. They need to make sure they have the appropriate permitting in place if they're expecting to use that to effectuate the Demand Response.

Dan Delurey: Okay, thanks. As you look back, what are some of the things that you didn't expect and how did you deal with them. What things come to mind here? Did PJM just nail it right from the beginning and get everything right along the way?

Pete Langbein: No. We did not nail it right from the beginning. One of the important things I believe around Demand Response is you can get completely wrapped up in details of implementation and really never get out of the door. PJM, and obviously our stakeholders, took an incremental approach and that incremental approach was on purpose. As resources have participated and the volume of Demand Response grew, we have absolutely revisited some of the rules and some the "how to's" that have been out there over time.

One of the critical things you are going to need is flexibility. I think it would be difficult to have everything perfect out of the gate. Kind of going into this you're dealing with something that's quite a bit different than what an RTO normally deals with where we normally typically deal with generators. We probably have a couple thousand generators in the footprint. Generators are a physical machine that's in the ground and is different from demand response resources. Right now we have over one million end user customers participating as demand resources. These customers that participate, may participate one year and not participate another year. Some shift from one provider to another provider so it's a very different paradigm in terms of the volume and the flexibility of those resources.

What we found over time is that we need to adjust. There are going to be things that come up that we're not anticipating but we need to be able to kind of turn around and talk to our stakeholders about what rules need to be adjusted based on what's happening or how it's evolving. One of the perfect examples is something like measurement

and verification. How do we know which megawatt was actually delivered? We have made changes along the way and will continue to make changes in that area to make that more robust as amount of demand response continues to grow.

Dan Delurey: Pete, I don't think I'd ever heard that one million number or for that matter thought about it that much. What you said is that there are that many customers participating in DR at PJM either participating directly with you, some of them are being aggregated by providers?

Pete Langbein: I believe they're all being aggregated by providers.

Dan Delurey: Yeah, okay, but still that's a great visual example of this new world we are headed into. Many may be small, but it's one million tiny virtual power plants out there that are now part of the mix at PJM. When you think about it that way it's quite impressive. It's almost more impressive than some of the megawatt reduction numbers that you've racked up there.

Pete Langbein: Yeah, we've been fortunate with the structure that we have. We have a wide variety. These customers participate both geographically from New Jersey out to Chicago down to Virginia but also in terms of the business or the vertical that they represent, end use customers, giant steel mills, grocery store chains, the Wal-Marts and Home Depot kind of places. The diversity that we have right now in the market, we're very fortunate. What's nice about diversity too is the chances for things like single point of failure go down with the variety of resources that are out there as well.

Dan Delurey: Pete, anything that you haven't had a chance to talk about you'd like to mention before we close?

Pete Langbein: Dan, I think we pretty much covered it. My one thing that I would mention to folks, but maybe that's because I tend to wear more of an operational hat, is as things grow and people are focused on demand response, there will be a lot of opportunities to continue to operationalize those resources to make them more effective for the grid and at the same time make sure that we're aligning what the customer wants done and controlled at their house based on their preferences to what's going to actually happen as a resource in the grid.

Dan Delurey: Well put. Pete Langbein, on behalf of ADS and our viewers I want to thank you for spending the time with us today.