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P R O C E E D I N G S

MR. POPOWSKY: We have an excellent panel on storage issues to start us off, and we have some other reports from Ralph on some storage matters.

At the same time we do want to get back to the issues that we left open yesterday. So I'd say, at the end of your session, Ralph, but before the break, we're going to try to review the edits that were made to the two documents that were left open yesterday. So we'll try to get that done this morning -- both of those. And some people did some work, and Samir has it all down on the computer. So I think we should be able to get those done this morning.

And we will have one other voting item in the afternoon, on the Consumer Acceptance White Paper. And just, if anyone can let us know, let Wanda know, this morning if there are any edits or concerns that you have in advance, it would be good if we knew about those this morning, because we are going to take it up after lunch this

afternoon, and we might not have as much time to make any necessary edits.

So, for those who have read the -- hopefully, you've all read the Consumer Acceptance White Paper, if you do have any specific edits or concerns, just give Wanda a heads-up this morning.

Okay -- any other housekeeping matters? If not, Ralph, please go ahead. Thanks.

MR. MASIELLO: Okay, and Sonny, given that you want to close out the two items from yesterday before the break, the why don't I suggest the panel will go until 9:30, and we'll aim to be finished by 10:00 with the other issues.

Does that work for you?

MR. POPOWSKY: That's fine, although my hope is that those, both of those other issues can be done pretty quickly.

MR. MASIELLO: I think so.

MR. POPOWSKY: So I didn't want to take time away from you guys. I just did want to get that done, because I know a couple people may have to leave later this morning.

MR. MASIELLO: Good. So, this morning we have a panel on the topic of how to value energy storage for different applications, as this seems to be a burning issue, to one degree or another, in different places around the country. And our panelists have, fortuitously, seated themselves in the order in which they'll present, without any prompting. So that's a good omen for the morning.

So, let me paraphrase, shortly the biographies -- if you don't mind my truncating them, folks.

Rick Miller, is a civil engineer, senior executive with HDR in Charlotte, North Carolina. He's Vice President of Renewable Energy Resources, and has a long history in hydro-energy and pumped hydroelectric storage. And he's here to talk about energy storage especially from the pumped hydroelectric perspective.

One of our goals in the panel was to try to introduce thinking from outside the electric power sector. And we asked David Marchese to come

and speak about storage but, in particular, to bring forth experience and practices in the natural gas space, where storage has long been routine and, in periods of price volatility, is a commodity that traders use. So David will speak to that. He's with Haddington -- Resources, David?

MR. MARCHESE: Ventures.

MR. MASIELLO: Ventures -- Haddington Ventures. Good.

Ben Kaun is a senior project engineer with EPRI. And EPRI, along with my company, is engaged working in front of the California Public Utilities Commission right now. And we thought the CPUC work would be of interest to the group. California legislation, AB 2514, among other things mandated the CPUC to look at storage and, conceivably, even put forth orders regarding goals or mandates for storage.

So, EPRI and KEMA are working on the puzzle of what's it good for, and how much. And so Ben will present EPRI's work on storage

valuation, followed by Jessica Harrison, from KEMA, who's the project manager for the KEMA efforts on storage in California.

And then, finally, for something really outside the box, Dr. Jafari, from Rutgers University's Center for Advanced Infrastructure and Transportation, is going to talk about storage from the domain of supply-chain logistics and manufacturing where, again, there's been a lot of math historically done on how to use storage, and how to value inventory. So he'll bring some of those perspectives to the morning.

So, with that -- Rick, if you'd start. I've got to find your slides here. Maybe with a little help from our friends at ICF.

MR. MILLER: The no-name.

MR. MASIELLO: The no-name. Okay. Does that look right?

MR. MILLER: That's it.

MR. MASIELLO: Okay. Good. You can drive.

MR. MILLER: Good morning. This will be

a low- energy start to this morning, as you can tell.

SPEAKER: Microphone.

MR. MILLER: Okay. That's right. I forgot -- obviously. This will work.

And I've managed hydropower and energy storage in the grid operations, both here in the U.S. and in Brazil. And what I wanted to do today was to kind of tell -- I have a number of slides. The good thing is, not a lot of words -- at least not on the slide. To try to tell the rest of the story on how public policy is driving changes in our grid, and why we need to have some -- we need to look at the market structures, the market frameworks about incentivizing and valuing storage, but really monetizing strategic flexibility.

So, here are some examples of evidence of changes that are going on in the grid, and how things are being utilized.

Let's first talk about what's happening at Bonneville Power. I've been working with them

for about five years now. This is a graph in 2008, showing wind penetration and ramping rates. And there is a perception that adding more wind, you get geographic -- by default, you get geographic diversity, and therefore you can attenuate ramping effects.

Here, the ramping rates are on the order of 1,000 to 2,000 megawatts an hour, meaning -- this is 1,150 megawatts of capacity, ramping up over a 20-minute period. Here's that same week three years later. Now you have 3,800 megawatts of wind installed. The bulk of it's in the Columbia Gorge. There is no geographic diversity. We go where the fuel is, regardless of what the fuel is -- water, wind, solar.

The ramping rates here -- and, again, this graph is about two years old. The rate itself is about 4,000 megawatts an hour. This is not unusual within BPA's territory. They have a 10,000 megawatt balancing authority.

They have a daily operational challenge. They need flexibility.

I want to talk about, now, what is -- this is -- I've got a pointer here, there it is -- this is late September, early October, a seven-day window in BPA's territory. This was last fall. And let me walk you through what this graph represents.

Let's start at the top line: Blue is hydropower output from the federal Columbia River system. Red is load, following a typical diurnal pattern. This is a seven-day window here, and there's Saturday and there's Sunday. The brown line here is thermal. BPA has about 4,000 megawatts of thermal on their fleet, on their area to dispatch, about 1,000 megawatts of nuclear. The balance is coal -- or what is coal today. It won't be there much longer. And the green down here is wind. And the wind penetration on Bonneville's territory during this time period is about 4,300 megawatts.

So you see, during the week, virtually no wind on line. Wind picks up on Saturday night, drops off here on Sunday. And there's an

incredible ramping effect on Monday evening. And, as the flood comes through, Monday night, Tuesday morning, incredible fluctuations going on on their system.

So here's how Bonneville integrated it. So there's "load," and here's "thermal." So they followed load with their thermal fleet.

Here's what they did with the hydropower system. Almost a 90 percent correlation between wind and hydropower.

The wind picked up, hydro dropped off. And, inversely, when wind dropped off, hydro picked back up.

BPA has this flexibility in the fall and winter during low-flow periods. They don't have that flexibility in the springtime, when there's a lot of water and the river (inaudible). The point is, there's flexibility being provided to the grid. It's complementary technologies. How do we monetize that?

Another example of what's happening, in Idaho -- and then, this is just how public policy

is driving changes to the grid that planners never would do intentionally.

This is a hydro project in Idaho Power's territory. It's dispatch orders. There were 29 days, very stable, very predictable, and dispatchable. Here's wind in that identical, same 29-day period -- Day 1, there's Day 3, here's now Day 7, there's Day 14, there's Day 29. There has to be a complementing technology for flexibility to make, to keep this grid reliable. That's my continuing message this morning.

This is what many of you, I'm sure have seen -- the Cal ISO (inaudible). The Mark Roth at Cal ISO has been putting -- and his team have been putting this together. This is a net load graph of Cal ISO's future.

The net load concept is -- bear with me, and if I'm repeating things that everybody knows, just raise your hands and tell me to move on -- net load is simply the difference between demand or load on the system, and you subtract from that variable supply -- wind and solar. The remaining

load, the net load that is remaining, has to be integrated and balanced by non-solar asset -- gas or hydro or pumped storage, or any kind of storage.

So what this story tells is very little solar on line, and in the morning ramp, at six, seven in the morning, the solar picks up. And what these various lines mean is this is 2013 solar PV on line, the projection for solar PV by 2015, and then by 2020, all driven by the 33 percent RPS standard in California.

So what this is going to set up, from a markets perspective, I think, is in 2020 there's going to be so much solar PV on from noon to about two o'clock in the afternoon, so you only have 11,000 megawatts of net load here, there's either going to be solar curtailment, or there's going to be negative energy pricing because there's so much energy online that that's going to be a negative market in the middle of the day. Who'd a thunk it?

And then starting about four o'clock in

the afternoon, as the solar starts to crash, there's now going to be a 15,000 megawatt ramp over two to three hours -- every day. Well, what technology is going to be there to do that ramping? Is it going to be gas turbines that are going to have to be on (inaudible) reserve, and warm, in this area? So they'll have to pay somebody to take their energy. They're going to be online and getting paid, getting paid for resources adequacy, and then they'll be able to participate in that afternoon market. And then, of course, then you do your typical things at night.

It is completely topsy-turvy view of the grid in the future as it relates to storage. How do we shift some of this energy here to a flexible asset up here?

We need market structures that monetize -- or incentivize that flexibility. And, you know, Cal ISO's working on that, and CPUC, with their Flexiramp product, a 15-minute ramp product that they're looking at in California.

The Pacific Northwest is trying to do their own thing, and working with (inaudible), my comments yesterday to the commissioner is how do you remove things, arcane, like a vista restriction to allow third-party -- to allow system operators to procure ancillary services?

We need some new tools in the toolbox. Brad have talked about this graph many times. Here's the storage graph from ESA that provides, by technology, power, on the horizontal axis, over time, on a vertical access. And I'm thinking, how did batteries and all these technologies really provide all this capability? Because, again, I'm a grid operator from a utility. And here's compressed air, and here's pumped storage.

And then I realized -- because the message is batteries are only -- may be the silver bullet. And I'm thinking, intuitively, that just doesn't make sense to e from a grid-scale perspective. It makes perfect sense on distributive scale.

Then I realized, this is log-log scale.

So I converted the graph to linear scale, or what I call "real time." And there's your real-time graph right there. Battery, distributed supply is here. And so if you need a thousand megawatts over an hour or two, thousands of megawatt hours -- which is what Bonneville needs, which is what Cal ISO is going to need -- you need something with grid-scale capability.

And just to show that, you know, pumped storage -- there hasn't been one built in 20 years -- there are over 60 permits at FERC to build more -- not one is under construction. They can't get financing because of the market structures.

So what NHA and others in the industry are proposing is something that would create -- considering a storage asset. Look at the gas storage model, are there applications for electron storage? There are some thoughts that maybe there aren't similarities. I'm not sure why they're not, to be candid -- and create a total -- instead of forcing storage to be a transmission asset or a generation asset, create a new asset class of

storage, allow tolling agreements, so that the entity that charges your -- you're the project -- owns the electrons in whatever form that technology is, so that they can discharge it. And the facility owner simply is paid a rental fee. That's the way the gas-storage model works to some extent.

Can we -- should we look at that, and how it applies to electron storage?

And, with that, that concludes my comments. Thank you very much. (Applause.)

MR. MASIELLO: Thank you, indeed. Let's stay with the format of presentations and then group question and answer afterwards. So, David, you're up.

MR. MARCHESE: Good morning. I'm Dave Marchese, with Haddington Ventures. We're a private equity fund in Houston. And I'm understanding this is being recorded -- so, you know, this is funny, but this Dodd-Frank is a serious problem for both my industry, as well as storage. This is not an offer to buy or sell

securities. Everything I'm saying is my view, based on assumptions. And this is part of what we have to deal with, when you think about commodities, storing commodities, and how the world works today, post-Dodd-Frank.

So, again, they're forward-looking statements. They may be wrong. I will not update you if the forward- looking statements are wrong. And none of you, I think, are qualified investors -- no offense -- but that's another thing that I have to be careful of. So I'm not offering you any securities.

With that -- this is what I do for a living. I work at this private equity fund. We manage over $650 million of institutional capital. We invest that capital in what we call "midstream assets," and I'm going to tell you what we define as "midstream."

The founders of our firm were pretty interesting, and have a long history of developing assets in markets that are nascent. The history started with a company called Tejas Power Corp,

which ended up being called TPC because they had no power assets. TPC developed the first two merchant gas storage facilities in the country -- Moss Bluff and Egan. That company ended up being sold. They started it with a couple million dollars of venture capital, grew to 700 in revenue. They sold it to Pacific Corp in 1997, and then became Haddington in the private equity fund structure.

Our experience ranges from Moss Bluff and Egan which, again, were TPC. Then we developed the Lodi Gas Storage facility in California, that's a depleted-reservoir gas storage facility. Bobcat Gas Storage in Louisiana -- that's salt cavern. There's three 10-million barrel caverns. Magnum NGL storage -- we have a site in Delta, Utah, that one of our portfolio companies controls, that's next to the Intermountain Power Plant, for those of you that are familiar with that area. We are currently under construction of a natural gas liquid storage facility there, butane and propane storage. We

also are looking at caves at that site and natural gas storage.

Zechstein gas storage -- we're taking what we learned from the deregulation in the U.S. in natural gas, and bringing that over to Europe. We have a site in North Rhine-Westphalia, and we're developing merchant natural gas storage in Germany.

And then Fairway Oil Storage -- this is an oil- storage project in -- actually, just outside the city limits of Houston. Again, salt caverns, looking at converting some existing salt caverns to store crude and (inaudible), and also potentially do some blending.

So that's all of what I was asked here to come and talk about, but what I'm really going to talk about -- which they didn't ask me to, but I will anyway -- is compressed- air energy storage. And Rick sort of set me up for that.

I don't know if he's Don Quixote and I'm Pancho, or how that works, but we've been tilting -- figuratively and literally -- at windmills for

about five years. And, hopefully, at some point we'll either be proven right, or we'll just keep talking.

But -- so the three places where we have looked at CAESA first, actually, is in the middle of this slide, which is the Norton Energy storage facility. It was a limestone mine in Ohio. We are the only private equity fund that has successfully developed a CAES -- we're the only private company that we know of that has successfully developed a CAES site. Now, the asset has not been built. We sold the site to First Energy. Many of you know that PJM West is not exactly where you want to add capacity these days.

And then we have Apex CAES, which is in Texas. It's fully permitted, other than our greenhouse-gas permit, thanks to our governor. We now have the -- the State of Texas now has the EPA issuing their permits, which it has never done before. We've been in the queue about a year. We put our complete application in May of last year.

This is a problem for all Texas generation, as well as, actually, industry -- anything that has greenhouse-gas emissions. We're hopeful that we will be through that process. The EPA has put out a couple other permits for combined-cycle plans, so we think that we should be able to get through that. But we have a fully engineered, lump-sum, turnkey construction contract that we're ready to execute on that. We're out in the market looking for debt-financing currently for that asset. And I'm on the board of directors of that. I was on the board of Norton, and worked on the Lodi Gas Storage facility.

So, real quick -- because I was going to try and keep this quick, and I've already gone over what I had planned -- this is what we call the "midstream." And just, as you can see -- one thing I want to point out on this slide is that when you look at what we do in the hydrocarbon midstream, you'll notice that storage is on both sides of the, sort of that green area you've got, the storage that we invest in.

But you also have regulated asset storage. And this is how the storage market developed in the U.S. -- specifically in natural gas. Oil and natural gas liquids are different. I'll touch on those. But there are reasons why regulated companies need storage. They have different types of assets -- LNG peaker facilities, where you use pipeline-quality, or pipeline gas, you liquefy it, store it as a liquid, then you re-gas when you need it. Those are typically rate-based assets. There's one being developed in Florida, Merchant, right now. But they're typically small and very expensive, and they would be the equivalent of batteries, but they do the equivalent job that a battery would do, which is it is ultimate peak-shaving, if you will.

Just -- and we'll skip through this, but this is my "I'm not Mitt Romney" slide. If you look at what we do -- people think about private equity as buyers of assets -- Haddington is actually a builder of assets. Only 16 percent of

our assets under management have we actually bought a company. The balance, we develop and build.

So this is the question I was asked to address, which is the analogy. And I already touched on this -- prior to natural gas deregulation, when you had the same price from the wellhead all the way to the customer -- if you can imagine that now, with the shale, it would be interesting -- in 636, there was very little gas storage. And most of it was controlled by the interstate pipelines, or LDCs. And we used the balance of pipes that we used to meet the winter demands, and make sure that grandma's got her heat in her house when it's, you know, 10 below.

These were all on the rate-base, and this end, there were two types: Either low-cycling -- so you would, because once gas deregulated, you saw the timing difference in the use of natural gas between the summer and the winter, that came out in the price. And so what they've done is these longer-cycle facilities take

gas in the summer -- used to -- take gas in the summer, store it, and use it in the winter. Demand has changed quite a bit, so that's almost not the case anymore, given the changes in demand from CCGTs, as well as the change in supply from the shale gas.

And then the peaking facilities, which I talked about, and they smooth the season demand.

With the wellhead decontrol, different types of owners came about. Haddington was one of those in its first iteration as TPC. And what we saw was the ability to provide a service that hadn't been provided. Due to the unbundling in 636, it really allowed a format for competitive assets to come into the market.

And we would hope that electricity storage should follow a similar path -- slightly different, because we're already deregulated. And, like I said, we've done two projects already, the one in Ohio, which is now in the hands of first energy, and the one that we have in Taxes that we hope to build in the next year, or start

construction in the next year.

So, part of my background -- so, I'm a civil engineer. I have an MBA. And I actually worked on a commodities desk for awhile, structuring option-swaps, and derivatives. And so we were joking last night about those math classes that you have where you go through a whole class, and there's never a number, it's all Greek letters.

Well, when you look at how valuation of storage developed, it's calculus. And the Black-76 model is the model that's used to calculate the value on these, which is -- most everyone's heard the term "black shoals." The same professor that was working on black shoals in 1976 came up with an option model for interest rates, which is the Black-

Model. That was then adapted for commodities, because they don't have a mean reversion like you would have -- or, they don't have -- excuse me -- a growth rate like you would have in an equity, which is the difference between

Blacks and black shoals.

So, you split this value into two buckets, and then the third is sort of how we monetize the second bucket.

The first bucket is intrinsic value. So, a gas storage -- this is inject-in-the summer-withdraw-in-the-winter -- historically, like I said, markets are changing, this may or may not stay the case. Intrinsic value in power storage is the difference between the off-peak and the on-peak. And most of you all know the price differential as well the demand differential there.

Extrinsic value -- it's the ability to hold the commodity and profit from the volatility. Because what you have is the right, but not the obligation, to provide this commodity that you've stored. And that's key. That's the basis of all options, is an option is a right but not an obligation. And extrinsic value is, moving forward in time, as the holder of a commodity that's sitting in storage, I can either deliver my

commodity today, or I can wait and deliver it tomorrow.

Extrinsic value is the way that we put a number around the ability to wait and deliver tomorrow, or the next day, or the next day. And in gas storage, it's this rolling position to buy or sell in a cash market and offset that position with a purchase in the forward markets.

Using a couple of terms here -- so, "cash market" is, if you're familiar with commodities, you know, the cash market is a physical delivery market. We also sometimes use a misnomer, call some of the other positions in natural gas, "bal-mo," "bal-week," which are "balance a month," "balance a week" -- we call those "cash," but they're not actually physical delivery. Forward markets are, basically, the next month of delivery. And so what you have is the ability to -- you know, think about it very simply -- buy the commodity and hold it. At the same day you buy that commodity, you sell the forward, so you have zero risk position because

you bought and sold the commodity at the same time, and you profited from the fact that you have an asset that can do that. And that's, when you come back to the model that Rick mentioned, that's where the value of the person who's paying that monthly fee, they pay you, the storage owner, a monthly fee, and then they can do these things and profit.

But they have to work through time. They have carrying costs of actually having the inventory.

And then "hub services" is buying or selling intra-month, so what I'm calling the "cash," and you can buy and sell again, sort of in that shorter period of time. And that's where we see the value in power on the equivalent of what is gas hub services, we see the equivalent in the ancillary services market. Because that's the shorter-term market, that's where you're going to be paid for some of the other services.

Just a quick rundown of -- you know, you look at the corollaries between what I'm calling

now "ancillary services" -- you've got natural gas, this high deliverability, high injection, very similar to regulation. Gas parking line packing, that's very similar to energy imbalance. So what you're doing is you're managing the molecules, very similar to managing the electrons, though at, obviously, a different time scale. Pressure regulation, emergency exchange, and supply balancing -- these are some of the things that you see the LNG-peakers doing, reactive supply voltage control, operating reserve scheduling.

So you can see where there are a lot of products that sort of match across the two commodities and the two markets.

Now, I've got a couple of slides, real quick, on ERCOT, because that's where we're building our first asset.

I know that, other than me, no one here cares about ERCOT because we're on our own little island over there. But it's interesting, the trends that have driven the value for storage in

ERCOT -- because I get this question all the time when I do talk to accredited investors who say, "Why are you offering me this investment, because I don't understand why you're doing this now?"

This is the answer, which is that you've this wind saturation and an island market. So what that has done is made a nice little sort of -- and I keep forgetting that, you know, Rick has -- BPA looks very similar, though, you know, they can lean a little bit. But it's a nice area that you can see the impact of wind against a market that can't lean on other assets -- so, very clean from an econometric standpoint.

And then we've got these new rules that are changing. Unfortunately, or fortunately, however you look at it, there's no capacity market in Texas, so the price caps are part of the value proposition you have to have when you install in capacity there. The increase to the price caps, we think, is going to be helpful. We can look at prior years that have great value without the price caps, but this is helpful in sort of

smoothing out. Because with the lower price caps, you would have less years that might be profitable for us, or a CCGT, or any other asset that's in Texas.

And then some of the price floors on responsive and non-spin, those are helpful, as well.

We have this 5,000 megawatt ancillary service market. They buy ancillaries every hour, every day, every year. And that's important, too, because that's what allows storage to be built, is that ancillary market, where they are out every day buying, deploying, and dispatching ancillary services. And there's a 12-year record of that in Texas. That's very helpful, as well. I'm getting a lot of questions about that as I go around and talk about this project.

There are a couple of rules -- and, actually, FERC was ahead of the PC on this. We worked with FERC on this back at the Norton project. There are a couple of things that are important. The first is that load-use for storage

is treated as wholesale, not retail. No one ever builds a business on buying retail and selling wholesale. That would be a really bad business plan.

And the other thing is that you're not subject to sort of the retail fees. And the reason behind that -- and, again, the FERC got here, as well -- is that, you know, you are a resource for the grid to manage variability. The load has to pay those fees and charges because they can't be turned off, and they can't do what the grid operator wants them to do where storage is under the control of the grid operator.

And then, on the cyclical trends -- and ERCOT is a perpetually short market, so supply and demand looks very good. Also, all the supply that's getting built is base- load supply, whereas all the demand growth is in the peak.

And, then, hopefully, gas prices will improve some. Low gas prices are a challenge to CAES.

And this is -- real quick -- the

business model -- and I can tell you a little bit about how we came up with the value of each one of these. So this is the business model of running a CAES plant in ERCOT. You buy electricity for compression, and you're also selling interruptable load service. You can sell regulation off of that compression. You're buying natural gas, so think of it as an asset that has two fuels: Air and natural gas. And then you're selling these ancillaries. You've got reg up and down.

Also, I guess germane to the conversation here, the fact that the regulation market is split between reg up and reg down is very helpful. Some markets have a reg up- down product that's a single product. It's much more helpful to have both of those separately. That's a five- minute response time. You have to be synchronized. Responsive reserves also synchronized 10 minute. And then non-spinning is 30 minute. And you get less and less competitive as you move down those as a storage asset, because the big thing with our asset is we keep this

spinning all the time, so we're always synchronized, and then we can provide nearly the whole name plate in 5 and 10- minute ramping. We're actually limited on regulation by the ERCOT rules. We could provide more than they allow us. They're at 20 percent of name plate. But on the responsive reserves, we could provide the whole name plate.

So, you know, as we look at that, again, we spent -- this team in Texas has been working three years to get us to this point. And one of the things they did in that three years was we built a quantitative staff that has their own proprietary dispatch model that forecasts ancillary services, because we couldn't find a model out there that did that.

Bringing this all back to, you know, where I see this as applicable to some of the groups, the constituents that are here today, and the EAC, is that in areas that don't have markets, I don't think the area is, well, everybody's got to have a market that looks like ERCOT. The

applicable answers are, you need to know and be aware of the value of flexibility. We happen to have markets that do that, but to the extent you can do that with regulators, with cost-of-service, I think that's a fine model.

You know, I will say that in our model, we are owning the electricity and storage and then reselling it. We are looking at tolling the entire asset so that our customer would pay a monthly fee for this asset, they would bring the gas and power, and they would take the power away.

That's like a storage deal, like a gas storage deal. And I would tell you that as we get closer, and have one or two of these plants operating, I think it will be a lot easier to get to that point.

And I apologize to the rest of the panel for going on a little bit, but I appreciate your time, and hope to hear what everybody else has to say. (Applause.)

MR. MASIELLO: Thank you, David. I'm sure we're going to get some questions following

up to these two presentations.

So, Ben, you're up.

MR. KAUN: Good morning, everyone. I'm Ben Kaun. I'm a senior project engineer with the EPRI Energy Storage Program. So, today, I'm going to focus more on some high-level valuation and methodology, and not get too in-depth with the expertise areas of the other panelists, who know, you know, a lot of the details about regional specifics and different market rules.

So, I'm with the Electric Power Research Institute, or EPRI. We're an independent, non-profit, collaborative research institute. We have close to a hundred programs, looking at every aspect of the electric power industry, from generation down to the end customer.

Our members represent about 90 percent of the kilowatt hours delivered in the United States. And our energy storage research program has over 30 funding utility members.

To start off with, energy storage valuation can be really confusing, especially for

those who are not living and breathing it every day. There are a lot of different services and benefits that are being thrown around as, you know, potential ways of creating value with energy storage.

Some of these benefits are direct, as a result of the operation of storage. Some are indirect.

Some of these terms, people use the same term to mean different things, or different terms to mean the same thing. And some of these things can potentially be done with the same asset, and some of them are introducing competing objectives.

And so, as a result of all this, I mean, really, energy storage has a lot of difficult being characterized as any of the traditional asset classes, either generation, transmission, distribution, or a customer-side asset.

So, really, when we back away from storage and is complexity as an asset, I mean, what we come to is that what we care about are the services that storage is providing. And so these

services are things that can be technically defined in terms of what storage would need to provide, in terms of capacity, duration, availability, et cetera.

So, audience-left here, on the left side we have the cost of the storage, which is a combination of its fixed cost of building the asset, as well as its variable costs over operating during its lifetime, charging costs, O&M, et cetera. These four or five bars to the right are some specific services, kind of generalized, that storage can provide to the system. In this particular case -- I mean, there could be so many permutations or combinations of storage technologies, locations, and services that the storage is providing, this is just one of them, perhaps a distribution sited storage system, which may be able to simultaneously, with a single storage asset, be able to defer an upgrade in the distribution system, and may also be able to provide capacity to bulk system, timeshift energy, you know, provide spinning reserve, or regulation.

But, we look at all these individually, we see that the cost of storage -- and this is almost in every case that we've seen. There may be some niche examples in the frequency regulation market where this is not the case -- but essentially, in almost all cases, the costs of storage exceed the benefits from providing a single service.

And so, really, what we want to do is start focusing on how we can take the flexibility of storage and its numerous potential uses, and start stacking these benefits into something that looks a lot more appealing from a cost-benefit standpoint.

So, when we get into stacking benefits, things get more complicated because -- you know, in the previous slide I showed all of those bars being stacked up. In reality, it's not the case. Just -- the first bar here, I call "technical potential." So without, you know, taking into account all of the different monetization challenges introduced by regulatory regimes or

different policies, storage is still going to have those technical requirements and specific ways of calculating the benefits. And when you look at technical requirements, availability, capacity, and duration, you're going to find that some of these services may be able to be provided in full, and other ones may be competing against the objective of high-priority services.

So, the next step -- technical, or monetizable potential -- there may be third parties that have to be introduced. There may be regulatory barriers -- and so, not necessarily all of the technical potential can be monetized for the storage owner. So it's getting a little bit worse.

The next step I'm calling "monetizable potential" would be "nth unit." So, as you start putting out large quantities of storage to provide certain services, it may begin to eat its own lunch and start to really compress the margins that are available in providing those services. So it's getting kind of uglier and uglier as we go

to this side.

However, there may be societal benefits. We may find that the production costs of the entire system are being reduced as a result of increased asset utilization of all the generation, and T&D assets, or there may be some, you know, greenhouse gas benefits, being able to accommodate larger amounts of wind and solar, et cetera.

And then you may, at the end, be in the situation where the storage owner, in monetizable potential, can't get all of the value to recover their costs, but if you were to include kind of the second order and societal benefits that, you know, maybe the existence of storage on the grid is actually a net positive. And so, you know, something would have to happen, then, to fill that gap -- either the costs would have to go down, or something would have to push the value up.

So, it's a complex process but, you know, huge stayage. There's kind of a milestone that you can imagine here. And we just need to make sure that when we're talking about the value

of storage as, you know, as an energy storage community, that we are clearly communicating where we are in this process, and that we are making the right decisions about whether or not to go forward in the analysis, based on what we know about the cost-effectiveness -- say, if we're here, or here, or here.

If the bar is only this tall, like, we probably don't want to spend a ton of time digging more in-depth with it for further phases.

So, what we've done at EPRI is try to clarify these different phases of analyses, with a valuation methodology. The first step, which I've alluded to a couple times, is defining grid services. So that really is all about defining the technical characteristics for providing the service, as well as the benefit calculation methods.

The second step is about use cases, which is starting to combine these different benefits into these stacked bars that we were looking at, and to approximate the lifetime

cost-effectiveness of the storage use (inaudible). There are many different combinations to look at, of technologies, services, and locations.

The third step is to then take those cost- effective, or approximately cost-effective, options and start to look at how these are performing on a system, and how, perhaps, different penetrations of storage doing these specific use-cases, of specific technologies start to affect both the prices -- or both the values that the energy storage is able to provide, as well as, you know, any secondary impacts to system production costs or environmental.

And then the last step is to start really digging into all of the complex barriers and specific regulations, and see where large opportunities can't necessarily be realized because of the structure of the regulatory system.

So we also, at EPRI, created a tool we call the "Energy Storage Valuation Tool," ESVT, which is really to support Step 2 of that process, to get a high-level idea of which combinations of

sites, technologies, and service combinations are cost-effective for storage. So we take price and load data, either from historical data or future-year simulations, financial assumptions for the entity that is owning the storage, and we have a model of cost and performance for different storage technologies. We then run that through an hourly simulation over its lifetime to understand at a high level what the cost-benefit comparison for storage is, and its net present value. And then we provide a lot of different outputs, both on the operation of storage, and these different regimes, as well as the cost- benefit analysis over its lifetime, and the financials associated with it.

When we applied the Energy Storage Valuation Tool and this methodology to this California Public Utility Commission proceeding -- this is just one example of a base case that was defined by the CPUC, which was a two-hour, 50 megawatt battery. So we looked at about 35 different scenarios focused on bulk distributed

and an ancillary services-only case. These scenarios were defined by the CPUC and a group of stakeholders that contributed to that, including the California Energy Storage Alliance, and the three investor-owned utilities in California.

We'll be issuing a public report -- this says June 30th. As of yesterday, that seems to be moved up to June 14th. So, in the next week or two we should have a public report available that goes through all of the results from the analysis that we did for the CPUC.

As Ralph mentioned, KEMA is also doing an analysis. These are complementary analyses that are looking at somewhat different scopes. At a high level, the EPRI analysis is more of a broad survey of the different applications, some different technologies and use cases. And the DNV KEMA group goes a bit deeper in some of the areas to understand the impacts of energy storage.

And we're going to be showing most of the results of this analysis in the term of break-even capital costs, rather than stating, you

know, storage is cost-effective under this certain group of assumptions. We'll be looking for costs where storage might be able to break even, because in a lot of cases we've not observed storage costs that are cost-effective with the benefits that can be realized today.

So it will provide some targets, potentially. And that is the end of my presentation. Thank you. (Applause.)

MS. HARRISON: Thanks for having us here today. I'm going to speak a little bit, also, to the CPUC cost-effective analysis that we're working on, but I also actually want to raise some of the issues that we are facing, and some of the challenges with actually executing some cost-effective analysis for storage.

Is that better? Okay. So, some of the common pitfalls we're actually seeing with storage valuation -- which gets to some of the complexity of valuing storage -- is the use of historical prices. And there's a couple of issues with that. One really is that we're seeing, particularly in

the wholesale markets, a good set of changes which are likely to evolve prices in the market. And, in addition, really, we're going to see needs for the different products and services also evolve. So, really, using historical prices can be sort of misleading when you're trying to actually value what the future potential of a storage investment is.

The other sort of intricacy, which I'll show in a bit more detail, is obviously the feedback effect where, as you add more energy storage to the wholesale market, you'll have an impact on that market and, in turn, affect prices for future storage investments.

We've also encountered some challenges and some approaches people are using, where you have a model energy storage value using deterministic behavior. So, really, that flaw leads you to an overly optimistic assessment of the value of storage, in part because you are relying on perfect information, which we all know you won't actually have when it comes to figuring

out how to operate the asset.

The other key point here is really the potential to ignore system effects. So we see that both on the distribution system and in the wholesale markets -- in part, because you want to be able to look at the aggregate effect and, to Ben's point, bundle up the full benefits so you can account for all the value that storage offers, but also because again, as you add more storage to the system, the next incremental unit will probably have a different cost- benefit equation than the prior unit.

One other point here is that we're noting that traditional production costing tools are not necessarily designed to maximize the system benefit for storage. And so we've been using some production cost analysis that is helping us try to assess storage and its impact on the wholesale markets, but there could be some more additional evolution there.

So, here, I want to just demonstrate some of the system effects, and the

individual-level effects of energy storage, and how some of those pitfalls are actually realized, and illustrate those.

So, in the top chart here we have a graph which looks at regulation requirement, across the x-axis, and fast resource's percentage share of total resources, across the y-axis. And, really, what we're trying to show here is that as your portfolio has an increased share of fast resources, the actual total economic growth requirement for the market can change. And, initially, we can see a diminishing need for regulation requirements. However, beyond a certain threshold, we actually see decreasing performance, and so, really, there's a diminishing return to the benefit of energy storage in the wholesale markets, in terms of its regulation requirement effect.

This particular graph is from a PJM FERC 755 filing, that basically highlights the systems-level effect of storage on the wholesale market, total regulation requirement need.

In this particular chart here, what we've done is, with a lack of historical prices -- pay-for-performance, in many cases -- we've tried to do some modeling where we looked at, okay, if we add a certain amount of storage to the market, what's the net effect on regulation needs and the net effect on prices? And then, in addition, under the different pay-for-performance schemes, what is the likely price for energy storage?

So, when we do that actually -- here is a sample day -- in the blue, you see the price without storage, and in the red you see the price with storage. And it's got a net effect of reducing price in this particular model. But you can see that the hourly prices can change pretty significantly under that future scenario of increased storage and pay-for-performance. So if you're trying to do an evaluation from an individual unit perspective, and you're simply using historical prices to, you know, count up what your total value is, you're potentially mis-accounting for what the true value would be in

the future.

This is another set of analyses for the distribution system. So we see similar effects here, where at the system level, and also at the individual, you really need to take a systems view.

So, on the distribution system, we initially started to model a case where you had energy storage sited with PV to help with PV integration. And you would basically be able to avoid some of the upgrades necessary to enable larger PV systems down on the feeder. That, in effect -- that was the primary application. You can see that's actually the primary benefit -- this is a pie chart of the benefits for that particular application of storage.

We noticed that there were two indirect effects. One was that we had a change in losses on the system. And you can financially value that if you want. So, through that simulation process, we discovered an alternative benefit.

In addition, PV, in itself, can do some

peak reduction, but storage provides an incremental benefit where PV can't either necessarily cover the full peaks -- so storage can shift the peak production to cover more peak -- and also ensure its reliability, so that you have a smooth production outcome.

So, basically, through this storage application, and through that systems analysis of simulation, we were able to actually extract two additional applications that were indirect effects of energy storage on the system.

From an individual level, here, we did an analysis where we looked at -- you know, we modeled energy storage on the distribution system. We had a projected load forecast for that system at this substation. And what we ended up doing was we redid the analysis assuming an error in that load forecast. So, develop an analysis with a basic load profile, tweak that load profile, and then find out what happens to the economics: Are you still correct, roughly, about what you assumed in terms of cost-effectiveness?

And what we found -- you know, in some cases it wasn't a huge impact. In other cases it was quite a significant impact. So, on the left here, we have an original load profile. We show just sort of a barely cost- effective case, where the benefits outweigh the costs. On the right, we show that same load profile with a 3 percent error on a daily peak estimate, over and under, and we find that the cost-effectiveness actually decreases quite significantly, so that you're no longer passing that cost- effectiveness threshold.

So, again, from an individual unit's interest in trying to value their asset, it's pretty important to try to avoid deterministic analysis.

So, to the CPUC case, there's a series of cases that they're analyzing. We're helping to some analysis for ancillary services, substation-sited storage, and behind- the-meter storage. And those results, as has been noted, will be coming out fairly soon, so I won't show all these results, but I'll show some teasers, and

talk again about the methodology.

So, for our analyses, what we've been doing is a simulation-based approach, where we can try to basically monitor an asset within its real environment. We're using Kermit and Plexos to try to assess the wholesale market impacts and, again, look at that feedback loop between storage and the wholesale needs.

On the distribution system, we've been using -- basically, it's an engineering power float model that we're calculating all the actual net effects, physical effects, on the system, and then converting that into a financial assessment.

For the microgrid optimization model, as we call it, it's an end-user simulation, again, where we're looking at energy storage in the context of a particular customer load. The nice thing about this is we can start to look at the interactions of energy storage with photovoltaic, or any other types of assets that a customer might have. Again, in particular, you might find that these storage benefits change pretty significantly

when you're looking at storage in isolation, versus storage with a PV.

I'll sort of go over this more quickly, given that we're running out of time here -- but, again, the steps for the ancillary services analysis was to simulate unit commitment and production costs for varying levels of storage penetration -- basically, look at what the actual regulation capacity awards and costs and commitments are, doing all of this through production cost simulation in Plexos, using Kermit, then, to actually simulate the operations, to take advantage of the fact that storage, in many cases, could be a fast-response resource. So that gets into the pay-for-performance scheme.

And then, estimate the benefit-cost analysis by looking at the bid and the dispatch signals, compared to its actual operations, and exploring that through the actual for-performance scheme.

So we basically do that without storage, and with storage, and then we can look at the net

effect of energy storage, and also the cost-effectiveness of storage.

For the distribution model -- this is an example of our case where we're looking at PV integration. So we have a substation here. We have feeder lines identified in blue, and we have a large PV system at the end of a long feeder line, where we site storage pretty close next to it.

And we're doing actual hourly simulations, so we have estimates of load profiles across the network. And we're basically creating dispatch signals to the storage device in order to facilitate renewable integration, both in line-limits and in terms of voltage management, and in terms of shifting PV to allow the maximum usage.

So, from all of those, we can take information like load-tap changes, capacitor changes, the actual physical effects on the system, and try to convert that actually into a financial benefit. The approach here, we believe, helps you look, again, at the indirect benefits

you might not have initially targeted, but you're actually accruing by having that asset on the system.

With behind-the-meter storage, simulating the customer's storage and PV for bill management, that was the primary application -- so, looking at the demand charges and the energy charges for a specific time-of-use tariff. And also, actually, fairly importantly, is incorporating some of the incentives for energy storage to show how that can impact the net cost-effectiveness.

So, the CPUC rulemaking is -- we're sort of in the midst of it, and we've had a long set of discussions already. We're helping, really, to develop use cases to help explore methodology. We're not making recommendations, per se, about methodology, nor are we making determinative statements about cost-effectiveness. We're trying to illustrate some of these system effects, and some of the range of cost-effectiveness results we see with different applications and storage costs.

Some of our initial results are available online. And, again, the final report will be coming out in mid-

June. You'll see a variety of cases where we explore energy storage and, again, look at a variety of forecasted costs, forecasted benefit streams, and then also a range of storage sizes and durations.

Again, what we're seeing, that on the end-user side, we are seeing some potential cost-effective cases, but really what this requires is a special coordination of time- of-use rates, load profiles, and incentives.

On the deferral side, again we see some cost- effective cases. The sizing is obviously a fairly important component, so to the extent that you can focus and hone in on the primary benefit, you may get some incremental benefit from a larger system, but that doesn't always prove to be cost-effective.

So that's basically a summary of we're up to, and some of the challenges we've faced with

valuation.

Thank you. (Applause.)

MR. JAFARI: Good morning. As you might have guessed, I'm coming from a different world, it's logistics, production systems, and it's really very nice, very honored to be here.

The value of storage or, as we call it, (inaudible) systems in production, manufacturing, logistics area. It has been known for many years, and it's very mature. And there are many techniques around it in that world to value it and to understand the economics of it, the social benefits of it, the business benefits of it, and so on and so forth.

So, what I am going to do in the next 5 to 10 minutes, hopefully, I'll try to promote the idea and stimulate the idea of, okay, if we can use any of the lessons from that world, and we can bring some of the methodology and thoughts from that world to the power world.

By the way, I'm not a power expert by any means, and my introduction to the energy

world, power, came about 2003, 2004, when I started doing one day a week consulting work with Siemens.

So, with that said, this is a joint work with one of my Ph.D. students, so let me just give you some idea. Again, please pardon my ignorance on the power world, but I'll try to do my best.

What I am going do is -- this is not in order, but I'm going to try to basically make some, or draw some parallels between what we're talking here today and what is it in the logistics and production world. And so I'm going to talk about some of the risk-management and some of the management issues there. From the previous panel members, I heard about the flexibility, where that's a very big buzz- word in the manufacturing world. It started in late 1970s, 1980s, 1990s. And as you may know -- and I'm sure we are all enjoying it -- flexibility is a really big part of manufacturing and logistics world now. And, as you know, like U.S. manufacturing does, it's very mature. It has been using this technique and this

idea for over 20 years.

Well, let me give you some analogies in the grand scale of how these two worlds could compare.

I can't tell you much about the world on the -- well, this is my left side. As you see, we have -- which one is the -- oh, okay. Well, as you see, here we start from the raw material. And this could be natural or physical, or it could be human-made. When it comes to what we call "manufacturing plans," like the generation sources, and then moves to the warehouses -- this is like your storage, power storage -- and then moves to other distribution centers. Depending on the type of system -- like if this is Walmart, this could be like international warehouse -- and there are good number of them around the country -- and this could be like distributive centers, or distribution centers. Eventually it comes to the retail, and from there it goes to point-of-sales.

Well, I'm sure you can see the analogy between this and power systems. And,

interestingly enough, nowadays you can -- I'm sure you hear like "foods from farm to your table," well we have these producers, local producers, distributors, that basically bypass this very complex network and bring food or some products -- mostly food -- to your table and the points-of-sale. Well, nicely enough, this resembles what you have, or what we are going to be experiencing in the future, of distributive generation next to your house, and this is where you are in your house.

Now, in both worlds, you need to deal with demand and risk. You need to manage the demand and risk in both worlds. So there are lots of commonalities. And I'm hoping that today we can explore a bit of it.

Well, we talked about demand management -- so what's that -- I have "demand management," "risk management" up there, so let me start with demand management.

Well, if you look at the logistics-production world, well, the generation

of a demand is actually is a very complex process. And over the years there have been many ways of dealing with it. And even now there is, depending on what company you're dealing with, it can be push system, from source to sink, it can be pull system, from sink to source. And I'm sure you have heard about "just in time." It was buzz-word in '80s and '90s, maybe not so, because technology has changed a lot.

In terms of meeting the demand, there are lots of technologies in this world that are being used, from (inaudible) control that was introduced by Toyota in 1970s, for the enterprise regulations, line balancing for flow regulations, manufacturing execution system, which somewhat resembles what you do in a day-ahead planning scheduling in power world, to manufacturing material requirement planning, MRT, and finally to ERP, or enterprise resource planning.

These are all the tools that come together to basically make these complex logistics that one end of it could actually start somewhere

in Southeast Asia, and the other end of it ends in your house, in your home.

In terms of risk -- so, if you think about the risk for this type of network, actually there are two very big components that contribute to the risk. One is the demand uncertainty. Now, I don't know how it is in power world, where there are some variations, fluctuations, but the demands variation and stochasticity in this world could be very complex and very serious. So you really need to deal with the demand uncertainty and demand fluctuations, seasonal and otherwise.

Well, the other one is lead times, transport and delivery, you know, times. There is a big variation on it, when you have things coming from, for example, China to U.S.

I'm sure you understand there would be lots of variations that you have to deal with.

Now, with these risk elements in place, you have to understand what type of risks and costs that you have to deal with. Well, loss of sale, and the penalties that may come with the

contracts is a big element of it.

The inventory carrying cost or the storage carrying cost is a really big part of the cost of the whole supply chain. And then there are devaluations and depreciations that you have to deal with if you do not optimize your inventory system.

And, finally, you have to put all this cost together and compare it to your mitigation and what is it that you are getting out of the risk (inaudible) mitigations.

So if you draw the parallels in grand scale, you will really see some very nice similarities. I'm not going to go over this. These slides are available to you. We can really see some nice analogies, or parallels between the two worlds. And maybe this is what we can really start using and understanding how the two worlds are connected.

For example, if you look at the lead time, for instance, there is really a connection into the power world in terms of the lead time.

If you look at the demand generation -- well, as I said, we have just-in-time, push- or-pull -- well, as I understand from power experts, it used to be just-in-time, and perhaps its moving in different direction of a combination of push and pull.

And here we are today, of course, for inventory systems, we called it "inventory buffer," you call it "storage," but, really, they are very connected.

And, if you look at another element that, in this world, which is dynamic rerouting, or routing, and that's very important component of supply chain. You have something similar to it in power world for dynamic switching.

So, if you take a closer look at these parallels, what you are going to see is that, well, we deal with flexibility in these logistics. That's a very important component of it. And there may be something similar to it in the power world.

And, again, another element is, if you look at the "redundancy" in here you see the

capacity margin and reserves that you have it in power world.

But one thing is very common to both worlds, and I would call it "vacation capacity," and "charge-discharge" control of inventory storage. This is something that both worlds have it in common. I don't know what to call it in power world but, if you don't mind, I'll just use the same term to refer to the same problem that both worlds deal.

Now, this brings us to the issue of inventory management, how you manage your inventory. By the way, in a typical supply-chain inventory may be millions and millions of dollars at any given moment. You need to manage it.

Well, first of all, you need to understand why is it that I'm having my inventory? Why is it that I am having my storage?

You can really start from a detailed inter-process from a process level, and look at the regulations, and how it is used to dampen the variations and stochasticity in the system --

which is part of that system. And you can move onto a bigger picture, in terms of warehouse and storing the finished overall material. And that's a very important component of this network.

Arbitrage -- well, it is used. Believe it or not, it is used a lot in supply-chain world. And, of course -- and there are many models and practical models around it that storage inventory helps you to maximize your performance and throughput. You talk to any manufacturing system and they will agree with you on that.

But then how do you do it? How do you do storage or inventory in this world? There are different models. There are very established, mature models. You can do continuous type of monitoring and control on your storage. You can do periodic, or you can do single period. WE all know about this. This is called, in my world, the traditional, it's called "newsboy problem," because when you take your newspaper every day it's made for that day. And I'm sure you can appreciate the fact that how many newspaper you

make for that day is a very interesting problem. And it changes from the day, depending on the story, and so on and so forth.

And then the problem comes, where and how big? Where do you want to put this storage, and what capacity do you want to assign for it? And as I hear from your community, this is a similar problem, what you have in power world, in power storage.

So, let me give you a simple, very simple example, which is a very typical, classical example actually we use in classrooms. But, believe it or not, it is used out there. If you go to any manufacturing plant, you will see it, or any supply chain.

So, down here, you actually see a process. You have stations, as you see. You have raw material, I do some sort of operation, machining or whatever on this -- more machining, and then I package it. And then, in between, I have these buffers. These are my storage. And this is the products, I have the buffers.

So, what happens, that under this condition, this is what we call -- this is blocking this part. So, it means that this station cannot do anything. So, as you see, I need more regulations here. And on the other hand, this station is starving. And this is a big issue. If you are running a manufacturing plant, you never want to have a system like this. This is very inefficient.

So, what you would do is, you would actually add buffers to it. And this buffer, basically, will start regulating this process.

Now, clearly, the value of this buffered storage speaks for itself here. Because now I am regulating, and nothing is starving, nothing gets blocked. Remember, these stations could mean millions of dollars. You don't want to have a station sitting there unutilized.

You can also look at the storage from a different perspective. Like, I look at it as a warehouse, and in the warehouse -- this is a typical, classical view of inventory.

If I look at my inventory over time, I can have this type of policy, or I can define a safety stock. Now, this safety stock is a storage that I have in this inventory level to actually dampen against all those variations.

We talked about location and capacity. So, what I'm going to run for you, a very simple example. I cannot show you the cost values. This is a real model that we ran for a company.

So, let me just show you how the location of storage is going to play a big role in what you decide, and also its capacity. I cannot show you the capacity, I cannot show you the cost values, but I hope I can stimulate the fact that this, indeed, it is important.

So, if you look at the whole heat map of the U.S. In terms of population, and you look at three centers for my storage, and do a simple calculation of what we call "pm," "population mileage," that's a unit that we use. And, of course, you have to multiply it by cost, but I'm not showing that.

So, if I put my storage in these three different locations, there are going to be different numbers for the pm unit. But let's see those numbers change. If I make it to "dc" -- "dc" stands for "distribution center," my numbers will start changing, depending on where -- you know, I basically divided the country and my pm number came. Clearly, you can see the value of one additional storage here. And if I make it three, it's coming down again. Again, the value is clearly -- if you just look at it at dollar value, it's very clear how the value shows itself. And you can just go down even further.

Of course, there is always fixed costs associated with it. But even if you tie -- that the whole cost comes down, depending on the storage.

So, you can actually now draw more parallels between inventory and storage. Again, I'm not going to go through this, but there are very exciting and interesting parallels between the two worlds.

We talked about flexibility -- again, this is started in late '70s, '80s, when, if you remember -- some of you are old enough to remember those days -- manufacturing world was going through lots of problems, especially in U.S.

And Toyota came with a number of good, very interesting concepts.

Well, one of the concepts was flexibility, how I bring flexibility to my production floor, to my supply chain, to my network. And with that, in the '80s came this very complex and expensive machinery -- automation came in the '80s, if you remember GM and some other major companies started adopting these technologies. A typical machining center, or operation center, would cost $4 or $5 million. So, the issue came about, if I have a machine like this, and I'm only using it half of the day, for example, every day, that's a big loss. So how am I going to solve this problem?

Interestingly enough, this is very similar to the storage problem that we're talking

about.

So, with that, came the idea of flexibility. And this mixed ratio of parts, that you would actually -- or services that you would provide with that machine. And there is like almost 20 years of history behind, you know, around this. And there are lots of mathematical models and commercial software packages that deliver that to the manufacturing systems or supply chains.

So, if we look at the flexible manufacturing or production environment, it is very well defined. You have flexibility at the machine-process level, you have flexibility at the routing level. So you can actually do things with different ways of, you know, in terms of operations. And this gives you a lot of flexibility in terms of size of the production. Believe it or not, some manufacturing operations can go to (inaudible)-size of 1. And, of course, this reduces the set-up times and costs.

Interestingly enough, with my Ph.D.

student, we looked at some of the functions that the storage can provide, and you can nicely relate it to the fact that maybe I can use these function at different times. Maybe I can use a combination of these functions, and optimize the use of my storage.

So, if you look at the analogy of the parallels between the two worlds, this is what we call "flexible systems." This is a typical storage, with the different types of functionality that it can provide you. And perhaps there is a, you know, connection between it, if you look at this part, mixed-ratios, and the technology that supports it.

And then there is more analogy, in terms of this flexible systems and what is it that can be done with the storage systems.

So, lessons learned, what is the punch-line here? Well, the fact is that, in manufacturing, logistics, supply-chain world, it works. We know it works. And very interesting, or interestingly enough, not only is it mature,

but the solutions are very simple. Perhaps you have heard about economic order quantity that people use in supply-chain world. For your information, this was the first function that SAP, which I'm sure you know, software package, started providing -- EOQ model. You go to many companies, they use EOQ model with a simple, what's called "rR" policy.

So, solutions are simple and intelligent. And that really, truly solves the problem of the value of the storage.

And so, the key is really the intelligence. And, again, I'll be very short on this. We have already started working on this with my other Ph.D. students who are looking at some aspects of it. She already has some simple solutions along the line of how you can actually discharge, for example, a storage system, some very simple (inaudible) control solutions. And you can actually see the value, in terms of if you apply these simple EOQ-type models to storage, how it can save you.

And, with that, I'll stop, Ralph. I see that you are looking at me. (Applause.)

MR. MASIELLO: Good. Thank you. So, let's take time now for question and answer and discussion.

Okay, Brad, you've got a placard up.

MR. ROBERTS: Quick question for Dave Marchese. You said that the ERCOT market was 5,200 megawatts for ancillary service, and a 12-year history, that it was being paid for? I thought the ancillary services generators had to provide the service at no additional charge.

MR. MARCHESE: Ancillary market works is that the load-serving entities have a requirement to buy ancillary services, and then the generators provide ancillary services, and that clears through the ERCOT market.

So, each load-serving entity has a requirement to buy those 5,200 megawatts. That's aggregate across the 70,000-megawatt peak-load, or 68,000-megawatt peak-load in the ERCOT.

MR. ROBERTS: That seems to be a high

number. Is that because there's so much wind?

MR. MARCHESE: It's -- so, first of all, 5,300 includes reg-up, reg-down, spinning, non-spin, and the reserve.

But, no, overall, I think it's grown about 4 percent a year. So, historically, across those 11 years, even before we had the 11,000 megawatts of wind, it was -- you know, that's sort of a reasonable size for all of those products.

MR. ROBERTS: Okay. Thank you.

MR. SHELTON: Yes, between -- I mean, that's a smaller system, so it's, I think, 10 percent. It makes sense. Larger systems are about 8 percent.

MR. MASIELLO: Go ahead with your question, Chris.

MR. SHELTON: I wanted to say I really enjoyed the last discussion. I think, for this body, that type of thinking is something I think we need to think about, because it could help us think about where DoE could focus and break new ground, and inform, really inform, the legislature

on the future. So I think -- and the community.

So I think it could be really helpful. So I really appreciate it, it was quite refreshing to see -- and it's something we've toyed with a lot in our company, thinking about, from when we first started thinking about storage. So I really appreciate that work. And I look forward to learning more about it.

You know, I think, from the other discussions, there are a couple things that I would like to get some clarity on for the group here, because I think there were some statements that were made that perhaps could be misunderstood.

So, I think Jessica said -- and maybe I'll just say what all of them are, and people can respond -- Jessica said that this diminishing return of storage in the wholesale market. I think it might be helpful if you could clarify what that means. So, if you had an infinitely large storage system that was infinitely fast, you're saying that that's bad for the system? Or

no? I mean, I'm sure there's some type of clarifier there.

And, I think the other question I had was for Ben -- you know, the statement about, in all cases, storage is more expensive than its value. I think that might be something that we could clarify, as well. Because I think it's also true that, for incumbent technologies, it's also true for -- I could make a statement about CTs, that the assumed value of a CT almost always exceeds its actual value -- right?

So, I'm not sure that those statements are helpful. And I think -- I want to make sure we clarify that, because I think we're applying the incumbent measuring stick to a lot of these thoughts, rather than looking at the needs, and saying we have a bundle of needs for our society, going forward, how can we meet them?

So, those are thoughts and questions that I have.

MS. HARRISON: I think for that particular analysis, I should note we were looking

at regulation market only, so not all products in the wholesale market. We were also looking at a particular dispatch algorithm for storage.

So if you change that algorithm, you will get a different result, basically.

And I think, also, really, we're looking at a percentage share. So, if you had an asset that had infinite storage amounts and infinite response capabilities, but you also had other capabilities, I think that would be a different equation than if you're just talking about having only assets that run quickly, and you don't have the rest of the stuff that you need.

MR. MASIELLO: You know, to further address that, Chris, some of the storage suppliers had pressed PJM to have a five-minute, zero-net energy in the algorithm -- right? So, if you had all the regulation resources having five- minutes' energy only, the system performance degrades after a certain penetration. And if you'd move that to 15 minutes, that point of diminishing returns would go up. So the resources weren't infinite.

MR. SHELTON: I think you know that I know that. I just wanted to make sure --

MR. MASIELLO: I know. That's why I added it. Ben.

MR. KAUN: So, I guess, to review the question, it was the slide that showed that all of the individual, discrete services that were identified were less than the cost in the example.

So, first of all, you know, storage is unlike any other asset. It can provide a lot of different discrete services to generation, transmission, distribution. Each of those services will have different competitive technologies that sort of -- it would like a Venn diagram, you know, you have interlapping circles. So, in some cases, it would compete against an avoided cost of distribution, or an energy provided from a CT, et cetera.

And so, for example -- and the CT also provides multiple services. And Chris' point, I believe was that a CT would not necessarily show up as cost effective as looked at by individual

services.

So, take a step back. In most cases, I think if you define services in the way that I put them on that slide, which is "technical requirement," "benefit calculation," for a discrete operation of the storage, that -- so, with regulation services, AES is performing at -- you know, there may be opportunities for that to fully recover the cost of storage through that one operation. That's a thin market, it may not be there forever as a profitable use of storage. For the rest of them, putting multiple services together could potentially achieve cost-effectiveness.

I don't know if that -- did I address your question, or did I miss it?

MR. SHELTON: I think you did. I was just trying to give you an opportunity to clarify it, because you were making a statement, essentially representing EPRI, making a statement that storage is never cost-effective, you know, in a single application. That doesn't seem like what

you wanted to say, but maybe it is.

MR. KAUN: Yes, typically, except for some specific cases.

MR. SHELTON: And, really, I'm focused more on what it means for this body than trying to defend something I did. I know what I'm doing in my business, right? So I'm not trying to defend that, I'm trying to make sure that we're not setting, unintentionally setting certain types of givens into the thinking of a body like this, that it's not cost-effective.

And also that somehow it needs multiple streams of revenue, but other things don't. All generators have multiple streams of revenue, in terms of generation, for instance. So it's not an additional hurdle for storage, that it has to have multiple streams (inaudible).

MR. MASIELLO: Good point, Chris. Bob, I think you were first up, there.

MR. CURRY: Okay. This is a question for Ben, as well. And it just speaks to my ignorance of how EPRI works.

Within the last couple of weeks, three Senators -- Wyden, Collins, and Bingaman -- have introduced legislation in the Senate to give significant tax benefits to energy storage.

At what point, if at all, do you all, in calculating the possible benefits to the user, plug in -- obviously, this is premature, it hasn't passed -- but at what point do you plug in the tax benefits as a factor, in looking at the efficacy of storage in this instance?

MR. KAUN: So, in terms of the methodology -- are you talking about EPRI as a whole, or you're talking about the methodology that I presented?

MR. CURRY: I'm talking about, first, what you presented, but, of course, it's not yet enacted, so you would never factor in speculative legislation, or you would never do anything else.

But, generally speaking, is that a component of your -- is that one of the tools in your analytical box? Do you use that as an (inaudible) in calculating the efficacy of

something you're studying?

MR. KAUN: We have not addressed that. So, are you saying the benefit to the public of tax benefits? Is that --

MR. CURRY: I'm talking to the benefit of the people who pay for it.

MR. KAUN: The benefit to the owner.

MS. HARRISON: Well, I think --

MR. MASIELLO: I think Clark is waiting to jump in here, Bob.

MR. GELLINGS: Yes, there's been a couple of comments about EPRI. EPRI does not engage itself in policy. EPRI does not take positions on technology. EPRI tries very hard to only be factual. EPRI is not interested in engaging itself in the political debates surrounding storage.

What EPRI is trying to do, on behalf of our members, is to provide credible technical information to help them make decisions. And we are happy to engage in the debate, but please don't think of it as some advocacy group looking

towards policy for storage.

MR. KAUN: I would just add that, specifically with respect to storage and the methodology, it would become relevant in the business cases. So there was a stage for, you know, looking at storage cost-effectiveness to the owner.

And, you know, we're not engaged in that specifically, but it's something that would come into play, you know, for the owners of storage.

MR. MARCHESE: Bob, if I could jump in, because the first Wyden bill -- so, you know, Haddington is in the business of investing in assets, and we invest in storage assets. And so when the first Wyden bill -- when the Wyden bill was introduced back in, whenever that was, '09 or '10, when we looked at the capital structure -- so, what I do on a day-to-day basis is I look at how to finance a project. I look at what kind of debt I can put on it, I look at the cost of the equity, and then that is where -- and at the point that I would look at a tax credit. So I would

say, okay, as I'm putting together my return cases to get my approval to go make this investment, it's at the investment- decision point, I would add that there's the development period, which is very important, that during -- so, think of it as two periods, development and construction -- certainty around everything -- anything you can put certainty on is good during the development period. Because I have so many other risks -- like I said, I've been funding these, you know, 12 guys for three years, building models, and getting permits, and there is no revenue. You know, we're all basing that on the expectation of a market being there, and the ability to make money building an asset.

So, the earlier in that development cycle that I know that there's certainty on a tax credit, then I can put that into my economic model. It helps me with pricing to my customers. So, you know, part of what I do is go out and market to the customers before the asset is built. Again, as early as possible, before the asset's

built, when I set my prices on my services, and then, finally, at the point of financing when I decide how much leverage, how much equity, and what types of returns -- those are the points when that piece of information comes into play.

Does that answer your question?

MR. CURRY: What it really says is you would not expect EPRI, or anyone else, to do that calculus for you. You'd look at, when it's placed in service, do you have the benefits that you expect when you priced it in the first place.

MR. MARCHESE: That's right. But, remember, I'm sort of different, because I'm this private capital group. And I think there are other constituents who don't have the same risk tolerance that I do, that would look at it at a different time, other folks that would own that asset. So I'm only one of sort of several types of people that could build and own an asset. But that's where I would look at it.

MR. CURRY: Thank you.

MR. MASIELLO: Rick, you've been waiting

awhile.

MR. MILLER: A question and an observation. The question goes to, really, to the KEMA team, Jennifer (sic), and also to you, Ben. And then an observation about, you know, some of the modeling would say that maybe storage isn't really valued, or doesn't have a benefit greater than cost.

So I guess the comment is, that seems to contradict what we're hearing from the professor about you wouldn't need a warehouse to have a supply chain that's functional.

So I'm thinking -- my question is around the modeling: What is the input, in terms of variable supply, into your modeling cases for the CPUC? So, is it historical supply? Or is it what we think we're going to have in 5 or 10j years, which is going to be fundamentally different than what we've seen for the last hundred years.

How are you modeling that variability? Is it on an average scale, or is it a more granular, daily type of output?

MS. HARRISON: Well, so for the wholesale modeling that we've done, the wholesale-market modeling, we used cases from the LTPP process at CAES, so looking forward, 2020. So those do reflect current estimates -- of course, they're all estimates -- about what the market will be like in the future.

The simulation uses a sample of days, and sub- hourly, very detailed simulations with those. And so we're incorporating directly the variability from those cases.

On the distribution system, we have hourly profiles. That case, in particular -- not that it has to be -- but that case in particular is a hypothetical using a public IEEE circuit and some load-planning profiles.

But I definitely think incorporating the variability is a key point of trying to value the storage, particularly because that is one of its primary benefits.

MR. MASIELLO: But, Jessica, I don't think you said storage doesn't have positive

value.

MS. HARRISON: No, I didn't say that.

MR. MASIELLO: You misheard, I think.

MS. HARRISON: Yeah.

MR. MILLER: I must have.

MS. HARRISON: Yeah -- no, we're finding some cost-effective pieces.

MR. MASIELLO: Ben?

MR. KAUN: Yeah -- and so, this is essentially the same, as far as the cost-benefit comparison, same point that I made to Chris' question, which was that the story wasn't that storage does not have -- doesn't have costs that exceed all of the potential benefits that it can derive as an asset. It's providing the discrete services and the complexity of putting those things together, and understanding the value of the system's performing multiple services at the same time or at different times in the same location.

As far as our analysis for the CPUC, we're not using average prices, we're using scaled

and escalated different scenario assumptions on historical prices. So it is granular, in the sense that, you know, the storage is planning and dispatching on an hourly basis. But it is not, in this analysis, using derived price and load curves from the LTPP. We didn't have that information available at the time when we did the study.

So, they'll be, I think -- are you using any historical prices, are you using only forward-derived? Okay.

So, in our case, we'll be, you know, using historical prices as a basis, and with different escalations. And in their case, they're going to be using some prices and loads derived in a production simulation.

MR. MASIELLO: Okay. Merwin?

MR. BROWN: I have two questions that -- if that's not fair, I'll ask the one --

MR. MASIELLO: Go ahead.

MR. BROWN: The one, probably for Professor Jafar [sic] -- did I pronounce your name correctly?

MR. JAFARI: Jafari.

MR. BROWN: Okay. First of all, I liked your presentation. It resonates with some of my simple-minded thoughts about energy storage and how it fits into other commodity businesses, and so what can we learn from that? So, I thought that was great.

But I keep coming back to the fact that the electricity commodity market has some extreme differences that puts it kind of perhaps as an outlier. And I'll give you some examples in a minute, but I'll ask the question and then give you the examples -- is will these extreme differences distort or stretch the analogy to other commodities so much that they break down?

And what I'm getting at -- first of all, on a human time scale, the electric business is a true just-in- time business. As soon as it's manufactured, it's delivered and used. Does that make a difference?

Another one is that the delivery system can be extremely unstable and so it becomes very

important to manage the flow of the material in such a manner that the system doesn't collapse. And I don't know if there's any other commodity business that faces that extreme of a disruption.

And -- let's see, there was another one -- oh, the obligation to serve. In other words, it's been the classic example of we'll tolerate a busy signal, a busy tone with our telephone. We'll tolerate the cell phone, to a degree, the cell phone service breaking up -- those kinds of things -- where there's almost no tolerance for not delivering the product when you want it.

So, to me, you know, they're some examples that put the electric business in way, way off into the boundary conditions. And my big question is, does it matter, or can we still look at these models and use them?

MR. JAFARI: I'm not looking for one-to-one analogy between, you know, power systems and traditional logistics supply-chain systems. I, rather, want to learn some of the elements that have been matured there, and used

there, and there is a technology around it, and see if we can migrate it.

Give you an example: (Inaudible), value and flexibility. In '80s and '90s, there have been lots of discussions about how to measure, what should be the metric system to measure the value. And, interestingly enough, if you go around and look at some, there are many papers, both in academia and industry, that it's not just based on the cost, based on dollar-sign.

But there are many methodologies you can measure the flexibility, and eventually put a dollar value on it. So, I would suggest that, you know, looking at the value, it's not really -- so, there are things that we can learn from that.

But going back to your point, in terms of just-in- time -- just-in-time, it's true that, you know, the rime scale is different, electrons go much faster than products.

But, believe it or not -- and I'm not claiming they'll go as fast as electrons -- but there are some in the (inaudible) manufacturing

industries -- and I had the honor of working with some of them in 2000s. Give you an example -- maybe you are all using it -- mail-order pharmacy. You know, you receive your --

If you look at the scale of some of these plans, the production of these are like 11 million prescriptions per week. Now, I'm not, again, connecting it to how fast electrons go, but if you look at the analogy between the machines and all that, they really go very fast. But they still use some of the principles of the supply chain.

So, yes, it may be an outlier, but it doesn't mean that we cannot use the lessons learned from it. Again, this is not a physical analogy, but rather conceptual analogy that we want to look for.

MR. MASIELLO: Good. Clair?

MR. MOELLER: Yes, at the risk of taking us back to the dead horse on value -- we used to worry about things like on-peak and off-peak, which was pretty simple. But the question is, did

any of your analysis push the cost of on- peak to the cost of off-peak energy to the breakeven point on storage?

What we're seeing is the on-peak/off-peak differentials are just miniscule at most projections, particularly as gas has hit the $4 per MMBtu.

Did anybody (inaudible) -- to see is it, you know, $13 gas, or $20 gas, where storage starts to make sense again?

MR. MARCHESE: I guess I'll sort of take that. And, again, I want to be careful on what I say about this project. And, again, my disclosure -- everybody's heard that.

As you look at the value of storage, the breakeven point is sort of $3 gas. That's when we start to get hit hard in ERCOT.

Again, very system-specific. I'm actually fairly -- you know, I was more familiar with MISA when First Energy was part of it, as we worked on Norton. What I would tell you is that, in that scenario you've still got value in the

ancillaries, and you're leaning hard on the ancillaries. But what it does is it pushes the economics down to sort of breakeven economics, to where you're only providing ancillaries, because you can always beat a CCGT in ancillaries. So, no matter what, even if the on-peak and off-peak are flat, I've got a thermal advantage against a CCGT, which is -- in the scenario you describe with cheap gas, so you're providing the ancillaries on a CCGT that can only ramp 20 percent in the plate, et cetera.

MR. MASIELLO: Let's take one last question. Pat.

MS. HOFFMAN: I'm sorry, I've got like a three- part question.

But, first of all, Professor, I think that was great work. One of the things I'd be interested in is how the thought process would change if you took the California (inaudible) diagram and asked your students to look at that. That's one thing.

The second thing is, as we move forward,

and as you look at it, the valuation, going back to that, I think, whether you talk about Senator Wyden, or you talk about the work we're doing, it kind of comes back to helping us define what is the range of that gap from a cost-effectiveness or a valuation point of view, where things do become more profitable.

So, is the incentive structure -- does that take, you know, 20 more projects and dump it over the line, you know? And it's getting a sense of what is that range, or what is needed, it still is an incentive process.

And then the third question I had was, I think what the CPUC is doing is very interesting. And are there other States that could look at that process of thinking about energy stores as part of, you know, the PUC role in looking at -- and having other States do a similar methodology as we look at is storage valuable?

MR. MASIELLO: Okay -- Pat, were you addressing to one or to all?

Why don't we each take a minute to

answer Pat, and we'll wrap up. Go ahead.

MR. JAFARI: Actually, it doesn't. And it even gives me more motivation to look at the problem in a bit of a different way.

I think there are some challenges we need to overcome. Believe it or not, the questions that you are asking today here -- and pardon me for the analogy, but this was being asked, or it was asked in '80s and '90s in the manufacturing world. And I'll give you a very simple example, and I'm sure we all experience it every day.

When Walmart brings TVs from China, they don't bring TVs. They actually bring components of the TVS, and they put what they call a "value-added warehouse." In that warehouse, what they do is, depending on your orders, they customize those TVS to your orders. So what they did is, basically they took a space and cost and changed it to value by customization. They don't do it in China, they do it here. And they do it based on just-in-time.

So, they actually put a different solution, and the market, and the business model changed. And, by changing the business model, your value metric changes.

And, again, if you look at the value, not only from this point of view, but also what other things that it gives you, some of them which may be not quantitative, so the challenge will be how do I quantify all this, and come out with a new metric system for the valuation?

So, to me, the challenge are out there what should be that metric system, and how I'm going to value this, and what type of data I'm going to feed to that model to get the right number.

MS. HARRISON: To your third question, about the CPUC rulemaking and its application in other areas, I think there's three interesting, you know, factors that have come out of that rulemaking, apart from definitive statements about cost-effectiveness. And one is highlighting the barriers, and also the successes, of energy

storage in a public setting, and have that becoming very transparent to policy-makers, especially.

And then the other is even establishing a framework for regulatory approval of energy storage. And I think that's a huge opportunity. It would greatly expand the market for energy storage, particularly where you have a commission who wants to understand how to go about assessing whether to approve -- rate cases, as an example.

And so I think that process opens the doors, perhaps, hopefully, for other commissions. Obviously, the cost-effective analyses will be fairly different, because you have some regional aspects that you have to consider. But it's an interesting process.

MR. KAUN: Regarding the CPUC analysis, following up on Jessica's points, I think that there's some valuable things that came out of an open stakeholder process where we were able to get inputs from a number of different parties, in terms of assumptions, as well as different data

sources within California, and understand a very broad range of storage use cases, sites, and regional impacts for storage.

If you go to other regions you might have a different set of use cases, technologies, and regional considerations to take into account.

So I think we have a good framework to build off of. And there's probably more work that needs to be done in that area, but that there's, you know, definitely a need, going forward, to customize analyses to specific regions and sites.

MR. MARCHESE: I'll quickly hit your second question, and, you know, what I bring that down to is that certainty is the best thing that could be provided to developers of energy storage assets.

And the second is that understanding the value and -- you know, I appreciate the fast response and what's happening there, but, to me, I would call that sort of a push valuation, where "Hey, look what I can provide," and trying to figure out the value to someone of what I can

provide.

I think going the other way, from a pull, look at the cost of -- the real cost of ancillary services today, the real cost of keeping the grid up. The more work and understanding that can go into that, including things like reliability, must-run, including things like, you know, some of the ancillary effects to the assets that you don't see.

And the third would be to provide that framework for people who don't have organized markets. I think the organized markets have done a good job of providing that information, and that's why you see me, as someone who's allocating capital, looking at the organized markets. I would love to allocate capital in markets that are traditional utility-dominated markets, markets that might have cost recovery. I think there is a need, and I see, I have several places where I'd like to go look at developing a storage asset, but the customers don't have the tools they need to say, "This value is equivalent to the value of

building another thermal asset."

And I'm going to throw one more plug in there for the Wyden bill, in that -- you know, again, not taking a position, a political position, but the point is that if you look at what something like that could do to a specific asset-type CAES in helping show the value proposition to a customer that's not in an organized market, by bringing down the capital costs through that tax credit, it makes it more comparable. Because we're so close to CCGT now -- I get to say, "Here's your two options. Build a GE Frame 7, or build this asset." And with a tax credit, the capital cost gets a whole lot closer -- even though we're providing a lot, and the value proposition is much greater, it's very helpful to have that capital cost set that way.

MR. MILLER: How do I follow that? To try to be succinct -- Pat, some really good questions -- storage and flexibility has been part of the grid since the grid was started, but a lot of it's been -- it's been built in, it's been

taken -- not taken for granted, it's just been, it's been implied, and it's always been there.

And it's still there, but the value of that has not really been monetized in the market structures. And I think that is what, I think, fundamentally, if we're going to incentivize flexibility and storage in the future, we need those market structures to do that, to be able to pay for it.

Those market frameworks don't exist today. And FERC, I know, the Office of Energy Policy and Innovation -- they're looking for solutions to help recreate some of that grid going forward. And if we can create the linkage with the work of this committee and with FERC to have those smart market structures going forward, it will be critical.

My last point is that most of the models that are out there, of looking at the grid flexibility in the future, or value and benefits in the future, rely on simulated data.

There are not many that take real-world

data and then integrate that into what really is the grid going to be like in the future?

And if we could keep an eye on that, and make sure the data is ground-truth, and it is reflecting the reality of the way the grid's being operating going forward will be key.

Thank you.

MR. MASIELLO: Okay, Rick, that was almost a great lead-in to the next agenda item.

MR. MILLER: I tried. Before I do the business model white paper, which was distributed to the full committee last week, and also to the panel, let me take the easy one, which was: At the start of the year, the subcommittee had on its work plan to write a white paper on valuation. We got as far as an outline, and then put it on hold. But after hearing this panel, you know, is it reasonable for me to ask for a show of hands? Should we now go forward and start working on a white paper?

And the comment, of course, if you put your hand up, you're going to get asked to

contribute, probably 00:02:43.

Any sense on that? Yeah? Okay. We'll start, but we need more than one or two sacrificial people.

MS. KELLY: I'm going to put up my card, knowing from past experience that that's usually a bad move, from a personal time-management standpoint.

MR. MASIELLO: Right.

MS. KELLY: But the reason I'm willing to do this is because I do feel it's important to consider the viewpoint of consumers in all of this. We've seen comments filed with FERC in the energy storage dockets, indicating that storage facilities want to be considered both generation and transmission. They want both cost-based recovery and market-based recovery. They want an all-of- the-above approach, you know.

MR. MASIELLO: Yep.

MS. KELLY: And that's not sustainable. You know, they're going to have to fish or cut bait.

So I'm going to be willing to serve on this committee because I'd like to bring a kind of consumer perspective, and a not of fiscal responsibility to the proceedings.

MR. MASIELLO: Great. And that, too, is a great lead-in, because that's one of the points in this.

This is a draft white paper. I'm not asking for a vote of approval. That, we'll put off until October. But I just thought I'd outline the key points in that white paper.

So, why was it drafted? To try to identify the existing business models that work in today's regulatory environment, and talk about how does the value proposition for storage align with existing market structures and regulatory constructs.

And then, specifically -- your point -- quite a few people in the storage committee argue for a bundled benefits calculation. You remember, we saw it slides -- it explicitly includes things like T&D deferral, or voltage control on a feeder,

which are regulatory cost-of-return investments today, along with participation in the wholesale market products and services like regulation and reserves.

And, right now, anywhere in the country, you can't do that. A vertically regulated utility, of course, could harvest all of those benefits, but it would be looking at completely different economics. But in any restructured market, organized market, that bundled capture is not positive. Later in the paper we talk about a model that could make that work but has other challenges.

So that was the purpose of the paper -- and to try to identify places where DoE could contribute. And one, for instance, is getting a better handle on what the technology risks really are for widespread adoption. Because it's one thing to have pilot projects, but if a utility in California were to propose spending $250 or $500 million on 500 megawatts of distributed storage, then the whole question is going to come up of how

confident are we that we're not going to be writing that investment off in five or seven years? We don't want it to become a stranded asset.

So that was the motivation. Questions that are raised in the paper around storage as a generation asset: What's its capacity value? Should it have access to capacity markets where they exist?

I think you heard from a number of the panelists, today's product definition in the markets don't fit storage that well because of the limited energy aspect of storage and the duration requirements on the different products.

Where States and regions have kicked off long-term renewable portfolio integration, or integrated research plans, storage isn't often considered because it is new, and also because existing tools struggle to deal with it.

I'm going to ask Gordon to amplify the fourth point. A very common misconception is that the markets clear prices to get the lowest cost of

energy, and that's not true. But the big debate we had was, should the markets co-optimize the storage? In other words, to take the example of storage as a new asset class, and then merchant-operators rent the use of the storage, when they bid in the market, they have to bid when they'll charge, and let the market tell them when to discharge according to the bids they submit. So the market isn't co-optimizing the storage.

There's strong arguments about this. The regulation market's the one that's attracted the merchant-developers today because it's accessible, it's transparent, and fast-storage fits it. But it's a very thin market, and we've seen at least one iso-market where significant entry of a new player in the regulation market caused a price collapse. And that changes the picture.

So, Gordon, maybe you want to comment to this before I move on.

Sorry about that.

MR. VAN WELIE: Thank you very much.

MR. MASIELLO: You articulate it better than I do.

MR. VAN WELIE: Ralph and I had many hours of conversation on this.

I must say, I agree with you, Sue, that one cannot look at storage and sort of treat it as everything, and it has to be paid for everything that it does. I think storage assets have to decide what place in the market they're going to be playing in, and then derive the revenue stream from that particular place in the marketplace.

And I think, you know, as I've reflected on this, I think a lot of this conversation stems from where you're coming from. And if you're in the mode of trying to advocate for additional revenue streams for storage, I think you make one case. If you're in the mode of saying we want to plan the system on a centrally planned basis, to achieve reliability and maximize integration of renewables, you come at if from a different perspective. If your objective function is to procure reliability services at the lowest cost,

you come at it from a completely different perspective.

And so the problem is, when one starts having this conversation, you need to know what space your counterpart is in, otherwise you can be completely missing each other in terms of conversation.

So, when I answer the question, I come at it from that last space, which is, when I look at it from a grid- operating perspective, all I'm interest in is procuring the lowest cost (inaudible) energy available to keep the grid reliable. And I don't care where it comes from. So we don't take into that, into account, the environmental benefits. That's completely -- we're agnostic on that.

And so the issue then becomes, what is storage, really? What is the difference between -- I could get a lot of the benefits that were described for storage from a gas- cycle, line-cycle, with a big tank of (inaudible) to it. If an objective is to lower energy prices, all I

need to do is to put in a more efficient machine, with some cheap gas in it, and I'll get the same market-clearing effect as I would with the storage device.

If I want to time-shift energy, what I can do is take gas out of pipes when there's a lot of high demand on the gas pipeline, compress it and put it into a gas storage facility, and then run it through the combined cycle at some later point in time. In fact, listening to what David's doing, he's sort of in that space already to some degree.

So, when I look at -- you know, listened to what the panelists were saying, the one I agree with the most is David. Because that's sort of the purest articulation of a model construct.

And if you look into what he was saying, he was saying you need to get the price right. This is a scarcity- value associated with providing reliability in the moment, when the wind's not blowing, for example, when you're short of operating reserves. The price of managing the

market really needs to be reflective of that scarcity, and that scarcity should also be valued in the ancillary services market.

And then what you do, you step away, you say: The resource that gives me the firm energy at that moment in time is the resource that ought to get paid -- irrespective of what it is.

Now, that's sort of the market-operator view. I think policy-makers will always seek to advance the cause of certain types of resources. It happens all the time. We see it with regard to wind, et cetera.

And so I think if there's a policy initiative to try to stimulate a particular resource type, then the best way of doing that, I think, is through a bill like what I'm hearing Senator Wyden is trying to do, which is to create some kind of tax credit that's available to all resources in a particular (inaudible), like a production tax credit for wind, or if you wanted to create something comparable for storage resources, we could do something in a similar

vein.

The wrong place to try and create the policy initiative is inside the market design, in terms of restructuring markets, because if you do that, you completely distort the economics within the market, and you create other knock-on effects within the market. And, ultimately, what you result in is a market that is not going to be sustainable within its own right, you have to prop it up through other mechanisms. And I think we've some of that play out.

And so, you know, a longer answer than what you wanted, Ralph, but I sort of gave you sort of a lot of ancillary information that's linked into this issue of what are you really doing with regard to the wholesale market design. And it's really about optimizing, from the perspective of grid reliability and maximizing consumer surplus., and the grid operators' not taking a side on who receives the distribution of that consumer surplus. You're not -- we're agnostic as to whether it goes to producers or

whether it goes to consumers.

MR. MASIELLO: Good. Thanks, Gordon. Yes, Chris -- go ahead.

MR. SHELTON: I agree, for the most part, with what Susan and Gordon are describing. I think it has some assumptions built into it, though. And I think we need to consider those. I think that's the whole point of these types of discussions.

In particular, the incumbency of technology, and the inadvertent impediments that are created by the incumbency of technology -- the technologies that we're talking about don't require day-ahead scheduling, real-time need. These technologies don't need to have -- any number of the storage technologies don't need to have fuel security and other facets that drive how we dispatch the incumbent solutions we have today, in the current market definition.

And, in addition, I think we can't just compare solutions like a pumped-hydro to a combined cycle -- which, I agree with David, that

if you could do that cleanly, you're done. It's very clear. But you're ignoring the whole load side of that resource. The resources has twice its megawatts of a combined cycle, because it has the load side.

So we have to be thinking about these things. And if this body doesn't think about them, I think, you know, no one's going to think about them.

This is very important. You have -- any resource you put in as storage is twice its name plate in megawatts of flexibility. If you needed those same number megawatts of flexibility, like California needs, you have to build twice as much generation as you would have to build storage.

And we haven't even talked about that today.

MR. MASIELLO: I think that's to the valuation.

MR. SHELTON: And to Susan's point, I don't think that storage should be straddling the classes. I agree with you. But I think we also

have to look at where we are today in an incumbent perspective of our current market rules, the way things work. And PJM, over their five-year planning cycle, there were two large transmission projects that were planned. And PJM came out recently, with FERC, and said these are no longer needed. Over $100 million was invested in developing those transmission projects in the planning cycle. And both of the utilities that were working that are going to recover that $100 million that they spent in development.

Now, why would we accept that as an incumbent position that we should keep? So we can't just talk about the new stuff. We have to think more broadly in these discussions.

And the thing that solved the problem for PJM, to where they no longer needed those projects that had been developed over many years, was fuel-switching of generation, and demand response, neither of which get rate recovery.

So, I think we have to stay broad in the way we're thinking about it.

MR. MASIELLO: Yes, and that's a great lead-in to just one point from this slide.

Pacific Gas and Electric has proposed a novel construct to get around the bundled application problem across regulated and merchant classes, which is to say: Well, what if we contracted for storage on the distribution feeder via a thing like a purchase-power agreement, and we bought the use and the capacity of the storage for photovoltaic firming and peak reduction on that outsourced basis. Then the third-party investor could also play in the wholesale markets, with incremental investment in the asset.

So, that's an alternative that gets around that regulatory cost-recovery merchant barrier. But it creates a different problem from the utility standpoint, because you've shifted capital expenditure in capacitors, and tap changers, and whatever, to operating expense in the purchase-power agreement that is directly passed on. And many utilities don't like that particular transfer, for reasons.

So, that's discussed in this paper, as well. And then another problem that's also kind of familiar in the generation space, if you look at storage as a way to relieve transmission congestion -- especially congestion as a result of a contingency constraint -- storage can be a very cost-effective way to alleviate the congestion compared to generation. But by the simple act of alleviating the congestion, you destroy the potential revenue stream. And that's a conundrum.

And a great example would be Manhattan, northern parts of New York City, where congestion costs occur due to fuel switching because of transmission constraints -- the so-called "thunder storm alert." Storage would be a great, cost-effective way to alleviate that. But, by the act of alleviating it, you destroy the value stream. And you can't get that value stream as a regulated asset unless the regulatory commission blesses it.

And on the community energy storage side -- you know, this is putting the battery next to

the pad-mounted transformer -- if the utility does it as a regulated asset, it's a reliability benefit to the consumers on that secondary, how can you rate-base something that only those targeted customers benefit from? On the other hand, there's no model that says you can get together with your neighbor and put a battery out there on the secondary for your own reliability and, in effect, create a little mini-island when the grid goes down. So, you know, that's another business model conundrum.

So, look -- read the paper and comment electronically, because we will try to schedule a vote on it in October, for sure. Okay? Good.

MR. BROWN: A moment ago, on the slide -- two back, I guess -- you mentioned the congestion issue, and the conundrum for storage.

MR. MASIELLO: Yes.

MR. BROWN: But, I think, didn't Chris make the point that the incumbent approach is that you can bill transmission and you're doing the same thing.

MR. MASIELLO: Yes.

MR. BROWN: But, from a societal or a customer's point of view, it's deemed to be the optimal solution to reduce costs to a minimum.

MR. SHELTON: (Inaudible) one of those methods, but it's not going to de-risk the generation demand response or storage method -- right? But it's de-risking the transmission version.

MR. MASIELLO: Sonny? Oh -- go ahead.

MS. KELLY: Oh, I'm sorry. I was just going to say that under Order 1000, the consideration of non- traditional, you know, or non-transmission alternatives in the transmission planning process will hopefully address some of the issues that you raise. I concur, it seems like -- you know, somewhat unbalanced.

MR. MASIELLO: Okay. Sonny -- I think, back to you now. Oh -- one more. Gordon -- sorry, Gordon, I didn't see you.

MR. VAN WELIE: Just a moment, I was just going to say one can relieve congestion

through many different resources. You can relieve it with a generator built in the right place, as well.

So I think, to Sue's point, what you now get into is the discussion of if you're in the space of trying to relieve transmission congestion, should there be equal access to all kinds of resources to receive cost-of-service (inaudible), because that's what you're going to hand down to the transmission development. You know, is there a possibility of doing that for other resources like a generator and a, let's say a storage device -- the so-called "market resource alternative," or demand-transmission alternative.

The issue, though, to sort of reinforce the point that Sue made earlier -- once you're in that space, and you're getting a cost-of-service treatment, by definition, your costs are covered. But you shouldn't be able to double-dip, and (inaudible) market revenue.

MR. MASIELLO: Yes. Good. Back to you, I think, Sonny.

MR. POPOWSKY: Well, first of all, thanks for this terrific panel, and to Ralph for an extremely enlightening morning on some very difficult issues.

So, we are actually now back ahead of schedule, so we could probably take our break now -- maybe take a 10- minute break. We'll come back, and before we do the consumer acceptance panel, hopefully we can take 15 or 20 minutes -- I'm sorry, hopefully we'll be able to take 15 or 20 minutes to finalize the two documents from yesterday. So -- but, first, we want to hear from Pat before we take our break.

MS. HOFFMAN: I just wanted to say, before we close, an update on what we're looking at with the energy storage paper for Senator Wyden.

Where our thoughts are right now is -- and I'm going to ask the Subcommittee on Energy Storage, but also the EAC Committee, in general, to help with the reviewing and the vetting of this paper as it moves along.

But we're looking at probably taking an analysis around the technology, energy-storage technology, and then also a cut at it from the applications point of view. And we'll probably have a section that does look at valuation, performance of energy storage, some of the projects, and some of the lessons learned from that.

But also what we'd like to do is hold, probably, two workshops, to gain input from the community and the stakeholders around technology and where technology is, and where some of the costs and performance should be, and also to take another dive around some of the applications. So maybe we'll run into, once again, some of this challenging discussion that we're having here on the application side.

So, I just wanted to give you an update. We do have to present a schedule and a timeline to the Senator. And we will do so, and do that on time.

MR. POPOWSKY: Thanks, Pat. So, let's

try to get back here at 10:45. Tom?

MR. SLOAN: Oh, just a question for Pat -- or two questions, actually.

Pat, what's the timeline for getting back to Senator Wyden?

And, two, given that we have maybe more flexibility because we don't report to the OMB, would a separate report, that you could recognize in a footnote or something of that nature, that might let statements be made that you can't make? Would that be beneficial?

MS. HOFFMAN: I think it's always valuable if the committee would like to look at gaps that we did not cover in the paper. I think that's always of value.

The timeline was 30 days from his confirmation. We are to provide a schedule to (inaudible), and now I just don't remember the exact date, but I know it's coming up in another, probably, 14 days.

MR. SLOAN: Thank you.

(Recess)

MR. POPOWSKY: We'd like to get started. Okay, if everybody could take a seat and come in from the hallway, we'll try to get this part of the agenda done pretty quickly.

Okay, thanks. I'm hoping that this will be a fairly straightforward discussion here of the issues that we left unresolved yesterday.

There were two papers that we were not able to vote on. There were some edits made during the evening by, first, with a subgroup of members of those subcommittees, and then some work done by Samir to get this into a readable format. He did get it e-mailed out to everyone last evening. Hopefully, you've had a chance to review it. But even if you didn't, I don't think the changes are that significant that we should have trouble following them.

I'll do "The Race to the Top," and then, maybe, Gordon, you can go through the changes on the transmission.

Let me just start with "The Race to the Top." The first one's probably the most

significant.

This was in response to Billy's point regarding the overall recommendation of the group. They first changed it from a summary to an introduction, and our basic finding now is that, "The DoE Electricity Advisory Committee has reviewed the publicly available information regarding the Race to the Top proposal, and supports the concepts embodied in this important initiative.

"The EAC sets forth below five principles that we recommend to the DoE regarding the proposal."

That's the first change. Let's see if we can go through this pretty quickly.

And I'll ask for comments at the end, if that's okay. Like I said, there's only a few.

The next one is in paragraph four. There were a couple changes -- one in response to an addition that Granger proposed, and another in response to an issue that was raised by Jay Morrison.

Let's do Jay's point, first. He did want to get in the concept of cost-effectiveness, in terms of our recommendation. And we've added some language there in our Principle No. 4, which says that, "Phase 1 funds..." -- remember, that's the qualifying phase -- "...should be used to support development of innovations, programs, policies, regulations and/or laws that advance energy efficiency and energy productivity in a manner that provides benefits to customers in excess of costs." So we added that language.

We then added a sentence -- this has been edited, Granger, from what you had originally proposed, cut down a little bit. But, in terms of Phase 1, we are saying that, "Because the successful adoption of many energy efficiency measures often depends on human preferences on behaviors, the EAC believes that DoE should consider the provision of tools and technical assistance that incorporate high quality behavioral social science." We made that addition.

One last change -- this is in response, I think it was you, Merwin, who raised this question about -- we repeated a sentence from the DoE regarding the fact that, "as stated in the State of the Union blueprint, energy efficiency achievements would also drive investments to enhance manufacturing competitiveness, improve grid resiliency, and cut carbon pollution..." -- we just deleted that sentence in that place. We include it in the description that was provided by DoE, but we don't then re- adopt it as our own finding.

So, with those changes, do we have any further discussion of the "Race to the Top" document?

Yes -- I'm sorry, Dian?

MS. GRUENEICH: Could you go back to the sentence on the behavioral science? I just had a question. It says we should consider the "provision of tools and technical assistance that incorporates high quality behavior science."

What kind of example of a technical

assistance that would incorporate behavior social science? Because I obviously don't know --

MR. POPOWSKY: Well, I guess that was Paul's language, and he's not here. But, Granger, do you have any examples of --

MR. MORGAN: Well, it's your edit.

MR. POPOWSKY: Oh, okay. I'm sorry. Oh -- the technical assistance part. Yeah, okay.

Well, I certainly know what you were -- in terms of what you were getting at was just the concept of behavioral --

MS. HOFFMAN: I know what we did on the (inaudible) grid projects with consumer behavior studies. We provided some technical assistance on how you do a design of that study so that you were statistically correct and statistically neutral, and you could figure out whether the behavior you were seeing was due to the -- you know, was due to the different things that you changed, i.e., (inaudible) structure versus other externalities on the system.

So, anyway -- I think there is design

assistance as you look at how you'd want to conduct a study that could occur.

MS. GRUENEICH: Okay. I was just wondering like if there's some technology out there. Okay. Thanks.

MR. POPOWSKY: Okay, thanks. Thanks for that. Any other questions, comments? In that case, could I get a motion to approve this?

MR. CURRY: So move.

MS. REDER: Second.

MR. POPOWSKY: That was Bob Curry, and second from Wanda.

All in favor?

(Chorus of ayes.)

MR. POPOWSKY: Any opposed?

(No response.)

MR. POPOWSKY: Great. Thank you. So, you want to put up the transmission -- okay, thanks.

MR. VAN WELIE: So, perhaps the best way to do this is that the -- we made the edits along the lines of the discussion yesterday, and rather

than trying to walk you through every one of the sort of tiny little edits there, I thought we could probably, most efficiently, do this by exception. So, I'm hoping everybody's had a chance to read this, and if there's something in there that you don't like, or would like to add or change at this point, perhaps you could raise your hand and we can respond to that.

(Pause.)

MR. VAN WELIE: It looks like we're in good shape. Tom, did you have something?

MR. SLOAN: Well, I'd move to accept.

SPEAKER: I second.

MR. POPOWSKY: VAN WELIE: Okay, well, did -- was there any just further discussion about this issue, in addition to the edits, which I think, as Gordon said, were really just to make it more generic. I think it's basically all the changes basically make our recommendation more generic, as opposed to the specifics of that particular version of the compact.

But are there any other comments, or

questions, or -- before we vote?

Okay, all in -- did we get a motion and a second? Okay.

All in favor?

(Chorus of ayes.)

MR. POPOWSKY: Any objections?

(No response.)

MR. POPOWSKY: Great. Thank you very much. So, now, I think we can turn to the next portion of the program. And Bob Curry will be moderating this panel.

So -- Bob.

MR. CURRY: Now we come to part of the program where you do not have to have done any homework to understand what's about to happen. This is a review -- first an overview, and second, two case studies of smart grid acceptance, focusing on consumer acceptance of something that many people in the business think is almost an axiom, but are finding, in the real world, that some folks dispute it.

As I was working my way through another

set of issues in Arizona, the current fight between the solar PV people and the incumbent utilities, I stumbled across a letter dated May 23rd of this year, from the Arizona Corporation Commission to all the participants in a case that addresses the health risks associated with smart grid deployment.

Now, we met six months or more ago, and we were fairly content that, while we didn't need the Mayo Clinic or the Harvard Medical School to say grace over the health risks, that people would sort of get it. Yet, within the last couple of weeks, the Arizona Corporation Commission reopened this issue.

So, it is a timely issue, at least in that part of the world. And the way we're going to address it is, first, with the help of three experts in the field. First, Judith Schwartz is going to give an overview. She's an entrepreneur, a marketing strategist, and communications professional who deals with the forefront of sustainability issues, smart grid. She's based in

Silicon Valley, which is near, I think, the Napa. So, you know, that's a good place to go visit if ever you have to get to her. The name of her company, since she's from New York originally, is To the Point. So, those of you who like New York and sort of the insistence of being that space can identify with that.

She designs human-centered strategies. She conducts research and meta-analyses, creates narratives and messaging, facilitates cross-stakeholder conversations, and develops communications and outreach programs.

After Judith's presentation -- and she may have to leave a little bit early -- Elisabeth Brinton, who is the chief customer officer -- which, to me, is a really good idea. I recommended this at a Macquarie gathering about three years ago, saying that utilities should get marketing officers who have dealt with the real world, and should get their focus groups from political campaign consultants who could get real-world people who have very sharp views on

things. And I was, of course, laughed off the stage. Well, maybe things are coming along here, I'm not entirely sure.

At any rate, Elisabeth runs SMUD's 1.2 billion retail electric business, comprising about 550,000 meters. That includes customer operations, services and programs like energy efficiency, renewables, and advanced energy solutions. In addition, her role includes corporate strategy, brand, marketing, communications, economic and community development, and advancing SMUD's already excellent reputation and their partnerships.

And this is -- I'm giving you the sequence of the introductions in the order in which these ladies will speak.

Angela Nichols is from Oklahoma. And I think I certainly speak for all of us when I say that we convey our sympathy and support for all the people of Oklahoma, given the kind of travails they've had in the last month or so, in the face of this spring's events. Angela reports that she

lives right near the last major incident -- and, nevertheless, she is here today, and we're very pleased with that.

Her job is marketing manager for Oklahoma Gas and Electric, roughly 750,000 meters. And she's the key sponsor in driving change in the utility company experience to leverage new technology and business practices. And she comes up from a rural-loads consumer experience manager -- again, a role that all of us could easily fill, we're all experienced consumers.

With that very brief introduction, I would ask that, Judith, if you'd be kind enough to lead off.

If we could, let's hold questions until the end, unless it's a point of clarification.

Thank you very much. Thank you, Judith.

MS. SCHWARTZ: Hello, everyone. Thank you for having me.

What I wanted to do to set up sort of my remarks was to sort of show you a very short video that speaks to an issue that I think (inaudible).

I think that we spend a lot of time being very worried about people who are complaining about things, and not enough time talking about why there will be millions of people across the world who will embrace smart grid and other kinds of technology advances. And so, I just want you to sort of look at his as a way to start to get the enthusiasm that can occur.

(Audio played)

MS. SCHWARTZ: So, that was from the Worcester summit, and what we did was we brought 300 people from throughout the community, including regulators, and consumer advocates, and low-income youth, and business people, and civic leaders -- the whole gamut that represented this community. And we brought them together for two days to frame smart grid from the context of what were their goals in terms of sustainability and economic vitality.

And, from that perspective, it completely changes the dynamic of the conversation.

And so what I want to talk to you about today is that what I've observed in the last six years as I've been working in this space -- as Bob mentioned, I come out of Silicon Valley, and have been part of introducing disruptive technologies for the last 30 years. And when I came to work at Apple 30 years ago, you know, no one knew what a personal computer was, and we had to explain to people why they would want one, and why should they care.

So, as we look at who the customers are, one of things that Granger brought up yesterday was this idea of, well, what is the social science research telling us? The whole discussion -- not everybody cares about the same things. And one of the things that I think has happened is that the tech enthusiasts have been leading the charge. And so you get something like a Google PowerMeter, where the people who come up with that are perfectly happy to put in data all day, but maybe the rest of us aren't.

And so I think that one of the

challenges that utilities have -- when you're a product company, you can start with the early adopters and just market to them. So, when you watch the number of Teslas, this, you know, $90,000 to $100,000 automobile that is running -- how many of them there are in Palo Alto, it's unbelievable. I mean, you see them everywhere, and they are gorgeous cars. And those people are not buying them to save, so they don't have to pay for gasoline or something. It's not -- it's sort of, when you're at that edge of the curve, you really care. So, Tesla can say, okay, I'm going to sell to the people who can afford this first.

The challenge that utilities have is that they have to deal with everyone all at once. But that doesn't mean that everyone cares for the same reason.

And I think that one of the things that's happening is that the doubters at the far end of the curve have been -- are very small, but they have been dominating the conversation. And I think if we're going to see enthusiasm, we have to

say the green altruists, who care about saving the planet, and care about climate change -- and for them, this is a pressing issue -- they are going to be people who are going to move this thing forward because, for them, there's something that matters more than just the lowest cost.

Now, for the people who care about cost as the primary, okay, well, then you have to give them price signals, and you have to give them an interface that's meaningful, and it isn't kilowatt hours. Okay, so a lot of the things, the interface hasn't changed.

And so I think that, as we talked about yesterday, there are going to be people where the way they choose to participate is they're not price-sensitive, but they'll pay for automation. And they're happy to help.

And so I think that one of the challenges has been is that a lot of the research has been let's try to find the perfect rate when, in fact, it's not the same thing for everybody. And some people will help out 15 times a year, and

some people prefer routine, and some people would just rather have a flat fee that they pay the same every month. And I think that that's one of the things that -- where there's such a good opportunity.

So, why should they care? Okay, we know why utilities care.

Well, if this information, or these incentives, or the automation makes it easy to reduce or defer their electric use, well, then it's no big deal, okay? Then fine, they'll do it.

If you want it because they're going to be able to integrate clean generation and transportation, that's important to a lot of people. And it will become even more important.

And then, the fact that the operational benefits that you can reduce and restore more quickly and pinpoint the outages -- again, that's something that comes up over and over again.

And so I think that there are plenty of reasons, from the customers' perspective, why they should care. But it's not to flatten the load

curve.

So one of the things in the handout that I gave you -- I gave one at everybody's desk, and my colleague over here has extra copies if you didn't get one. But the point that I wanted to make with this slide, and it's in your handout, is that not every utility is going to be in the same environment. So, some are appropriate to fly under the radar.

So, ConEd is a good example of a utility that just sort of didn't make a big deal about it. They're doing all this stuff. They have information there. But they're not putting it front-and-center -- okay?

People who -- utilities who got ARRA funding, and put the meters in first, they have to go out and actively engage customers, because the customers are aware of it in a way that people like Bluebonnet, where they put the back end it first, you know, they don't have to know about it right away.

So, I think that that's one of the

things that you really see, that it's appropriate that there are different regulatory environments, sequencing, everything that makes it also with slow build -- the idea, this is the way that a lot of the coops and munis have done it, where they just, you know, pay as they go. They've done it very slowly. They get approval for a piece and they go forward.

And, again, it's something that is very reasonable, to have more than one approach -- okay?

Now, one of the things that comes up in this space now is that you now have a design life-cycle of your introducing new products, programs, in a way that utilities haven't had to do before. So, whether you're talking about customer experience, or the outreach programs, there's this cycle, this iterative cycle. So if you understand who your customers are, and you listen to them, and you collect feedback, and then you create products that are going to fit them, and then you build awareness, and you deliver

through appropriate channels, you're going to get a lot more bang for the buck, in terms of how people respond.

And one of the things that's been challenging is that this doesn't fit the normal regulatory model, and how pilots are done, and how -- you know, even when you look at -- Bob talked about the whole idea of focus groups, okay? So one thing I want to point out about focus groups, they're a great research tool. They can give you impressions. But the whole idea of a focus group is that you're supposed to be neutral. Whoever is interviewing the people isn't supposed to have a frame of reference -- okay? -- point of view to the person they're interviewing, okay?

And so what I want to talk about next is something else. So this is a very important idea of what's changing.

And, hopefully, in the discussion, we can talk a little more.

So, when you look at sort of an example of this -- this is, I am a big fan of Georgia

Power's Rate Advisor Tool. And what I love about it is that, as you look at the different -- the tool up in the corner -- the different sliders, customers get to pick their priorities. So they get to tell you the utility what did they care about -- okay? And how important is the environment to them? How important is saving money, relative to other things? And then that allows this tool to say, "Here's the program that's good for you," okay? And what this avoids is you're not putting anybody in a box. You're not telling them, oh, I'm pigeon-holing you -- you're not doing that.

And so the advantage of this is it allows the user to self-select. It allows the individual to frame their own priorities, and yet the utility can come back and say, okay, well this makes sense for you. And it's really well done.

Now, what you also have in your packet is a picture of the communication channels. Okay? And what I did there is you'll see it goes through and it gives you, for each one, it goes into

detail, and it says, "Here's what it is, here's examples from different utilities that are doing different things."

The good news is there's a lot of wonderful stuff that's being done out there. But I think what it behooves us to do is to look at this in a systems perspective. Because it's very easy, when people are focused on their program silos, or they're responsible for one channel, that they want to just sort of -- they don't think about the 40 other groups that are putting something through that same channel, and what's the experience to the consumer.

Because the consumer may be getting all of them, or they may be getting some of them, or they may be getting none of them. And depending on who you are, you're going to be more and more receptive, more or less receptive. So, if you're one of those doubters, and you've been identified as such by something you've done to self-select, maybe it's not such a good idea to send them helpful tips about how to reduce their energy use

every month because it just makes them annoyed -- okay? And so this is the thing of, like, matching channels to what you're trying to get across.

And I think that I'll go through a couple of them quickly.

So, in terms of account contact, there's something that's been done at San Diego, and NV Energy, that's called a 90-60-30 Protocol. And the idea is to get people aware of what's happening before things are happening, through community meetings. But them, 30 days before, send a letter, be very clear, and say, okay, here's what's happening. So, the idea of keeping people in the loop, but recognizing that at different stages you need to do different things.

And so they leave a fact sheet and a door-hanger on installation day. But one of the things I hope that you'll talk about more is that, Elisabeth, is that one of the things that SMUD learned was that simple was actually better for door-hangers, because people, most people, don't get educated by their door-hanger. So it can be

simple. I was there.

Proactive customer support -- what has been really true in a lot of places that I've seen -- Duke is a really good example, Austin Energy -- again, it's happening all over the country, where they've really stepped up their game. One of the things they do for the people that express concerns -- and, again, I know this is one of the areas where SMUD's really been good -- is having people talk to someone. Because you can't know in advance what someone's going to care about. But if you're responsive, that works.

And so you have to address the claims quickly. And I think one of the challenges we saw in California was when what became known as the "Bakersfield effect," when people called PG&E and said, "I have a problem with my meter," and they got told, "No, you don't." Okay? That is not good customer service. That's going to inflame anyone.

So, you know, it seems basic, but it was sort of -- they were feeling like, oh, well, we

put this stuff in, it really works. So, it wasn't that they were wrong, but it was not the right, necessarily, response.

So what I'm going to talk about next is, in my opinion, the killer app. This is the way to use online, is interactively. And so one of the things that happened at Energy Louisiana is they let people know about this idea that they are operation storm-ready ahead of time. This is ahead of the storms -- okay? They make a big deal about their people who are there. And then they have a really good outage map.

Now, you're seeing outage maps in a lot of places -- okay? One of the things that also happens is that people will send you pictures of, oh, there's a tree down in my area. Or they want to get a Twitter alert about what's happening. When am I going to be restored?

This is the place where people will voluntarily give their information to the utility, and say here's my phone number so you can text me. This is a place where people will reach out. And

if you get the information ahead of time, then you have it and you're ready for when people are doing it.

One of the things that is also really good to support this is -- San Diego, and now PG&E has these trucks that can go around and, when there's been a widespread outage, so people can plug in and charge their cell phones -- okay? Because, obviously, you can't go online and look at it from your computer when the power's out. So -- in any case -- so, and people like it. And the responses have been very positive. And I think that this is the point that giving people another opportunity online can increase the scale.

Building on the existing energy efficiency -- that was why I asked the question yesterday about this report, because it's all electricity to the customer. And so there are already things that are in place that people have trusted relationships, with either the utilities, or partners who are putting things out there. So, I think that tying in with that, and integrating,

is a very important thing that we're seeing done well.

Not to mention San Diego, but San Diego was another one that does really good multilingual outreach, that they really are trying to get to people. And I'm seeing, again, a trend that more people are starting to do integrated content. And a lot of groups are doing really wonderful demo centers, just so that people can see, and touch, and feel, and see what all these materials are.

And so, constructive engagement is my pet thing. And so I'll wrap up by talking about these kinds of things.

These are large meetings, like the community summits. And I want to point out that what these kinds of events can do is they can inspire people. They can get people excited. The connection can be made to what they care about. The idea of seeing the community together is really valuable for regulators, to see not just the people who take time to come and complain at a hearing, but what is it about when people really

are excited about this stuff. And that's the thing that's so good about smart grid, is that it gets you there.

Now, one of the other things that we're also starting to encourage, see and encourage, are the idea of energy literacy workshops, and ways to reach out to community-based organizations who already have trusted relationships. And the reason I'm running off after this is because we had worked with Pepco on this energy literacy workshop in D.C., and now we're talking to them about doing a community summit. So, keep your fingers crossed for me.

But I think that one of the things that really is key is that it doesn't just stop at an event, it keeps going. And one of the things that -- San Diego has been evolving their partner program. So, they went from, their initial one was 15 CBOs, now they're up to, three years later they're now up to a hundred. And so, with very modest grants of $2,500 to $5,000 to support these groups, people are going out and talking to their

communities in their own words.

And I realize that one of the challenges of this is that marketing groups in utilities have been rewarded for being, having a very tight control on the messaging. And it's very hard to say you're going to go to a third party and let them help. But I just want to say that there's very ample evidence to show that this works. And it works not just on smart grid, not just on meter, on all kinds of energy efficiency, and having the integrated story be part of it.

And so my summary to you is that there are clear patterns present. There's plenty of research to support it.

And that these customer behavior changes that we're all looking for are possible. But it means that a lot of utilities are going to need to change outreach practices that they've been doing. There have to be the regulatory policies and incentive to be there. You know, if you think a lot more people in your audience are cost-conscious, and you don't give them

price-trigger -- guess what? You know.

And then that there needs to be funding -- my final plea for funding to support energy literacy. Because this is one of the things that it's not clear how you get cost recovery, it sort of falls through the cracks. So, if we've been spending billions of dollars on equipment, and millions of dollars on branding and marketing, things like that, we've been spending pennies on energy literacy outreach in most places. And I think that this is one of the things that will need to change if we're going to see -- if we really want customers to embrace all these great things that we're investing in.

And the little picture there, there is a link there -- from the work that I did with a DoE working group on customer engagement, we pulled together a lot of materials. So I've got a little toolkit on my website that I'm starting to build on, to sort of collect all the different best-practices. Since I'm not bound by the same rules as DoE, I'm allowed to say I think this is a

good one.

I recommend this. So, anyway, I hope you will all come to the workshop we're doing at the National Town Meeting on July 9th. And there's information about that, as well. So -- thank you. (Applause.)

MR. CURRY: Thank you very much, Judith. That's an excellent overview.

Coming from New York City -- because, as some of you know, my grandparents were too stupid to move from there when they got off the boat -- we have a lot of renters. Literacy and electricity aren't necessarily uttered in the same phrase. But in the Sacramento Municipal Utility District, they are.

So, Elizabeth, you're up, and you're on.

MS. BRINTON: Well, good morning. Thank you very much for the invitation. It's an honor to be here. And we so very much appreciate the partnership that we've had with the Department of Energy related to our smart grid projects.

I'm going to start my presentation with

a question to this esteemed group: How many of you drink coffee? Raise your hand. Ah, I see quite a bit of anonymity there.

Well, how many of you spend a few minutes a day pondering the ecosystem of coffee? The infrastructure, the supply chain, whether it's fair-trade, which country your beans came from? You know, what the cost per pound of the coffee was? Raise your hand?

Okay. So we have one person out of the entire room. Oh, two -- two people out of the entire room.

And I start with this question because I want to be provocative and just -- the very title of this group, which is "The Consumer Acceptance of Smart Grid." My point is that this isn't about the smart grid to the consumer, just as coffee, it's not about the supply chain and the infrastructure, and the shipping and the beans, and environment, et cetera, et cetera, and the farming -- for the average consumer. It's about the coffee, and whether it's decaf or caffeinated,

or, you know, hot or cold or iced, or what have you. It's about the value to them of their coffee.

And so, with that in mind, I'm going to start my talk.

So, first of all, thank you very much to the DoE. And this is our official disclaimer, which your wonderful technical folks have hammered into ours, as well. So, we appreciate, again, the partnership -- and on the disclaimer around the data. And I'm going to note, too, that for the Smart Pricing Pilot, and some of the other consumer things we're working on with DoE, I'm not at liberty to go into the data yet with that. They will be coming out, actually, shortly this summer -- by July, I believe. So, this is -- the lessons-learned here are not a summation of specific statistics, but rather an overview of themes and trends that we're seeing.

Just a quick review, this summarizes, for those of you in the audience who may not be completely familiar with our grant projects, you

see we have a variety of different ones that we've been focused on, both on the technical side of the distribution side, as well, of course, as our meter implementation, as well as our pilots with our customers themselves.

SMUD, we're a community, customer-owned, not-for- profit utility. We're a special district in California. And so we really serve -- we're by and for our customers. And what that means, as I get into this a little bit, we have lots and lots of relationships with them, and conversations. We are directly governed by an elected board of directors, seven members directly from different wards within our service territory. And we're underneath the California Municipal Utilities Act as a special district.

So, how we do things -- going back to my question, and the fact that we're all consumers -- is we really take it directly to the streets. And so, really kind of following on some of the things that Judith said, we have been actively engaged way before the era of smart grid and smart meters,

in actually going out and talking with our customers. So, for example, when we do a rate process, we typically do well over a hundred community meetings.

And when we say a "community meeting," we don't host them at SMUD and expect people to trot into our auditorium. What we do is we partner with the churches and the non-profit organizations, and the community organizations, and the neighborhood associations, and the chambers, and we go directly out to where our customers are -- because that's how they live their lives. And one of the most important things to recognize when you're talking about acceptance or understanding about energy is the great human factor that we're all dealing with, which is time scarcity.

People don't have time. They're focused on their needs and their interests, whether it's raising their kids, trying to figure out how to juggle between very busy professional lives and getting the kids to soccer practice, or if they're

elderly -- I mean, everyone has -- they have health issues.

People have their particular needs and issues. And that's how they live their lives, and that's the paradigm and the view and the lens through which they view everything, whether it's how they want their coffee, or how they want their energy.

And so Judith touched on that with "segmentation," which we talk about in terms of marketing terms, but it's really very personal. These are people that we're talking about.

So, we've recognized that. We've been engaged with them in the community for many, many years. And social media, now that we have these new tools, we love it, we use it, we have a Facebook site, we have a Twitter account. We're very engaged with our customers. We are really actively involved with texting them, and Tweeting with them, and so forth.

And so this level of engagement is very, very positive, and people love it. And the young

folks love it.

We start, we do a lot of work in the schools. And so it's multi-generational, and multimedia, and multi-channel, and really emphasizing aligning those interests of what people care about to the right channel that's going to work for them.

So, this kind of mirrors the beautiful mural above us, but this is sort of our new, modernizing smart grid, where we're going with the utility of the future -- which is very exciting. And when we talk about what this means for consumers, again, it's not about the wires and poles and meters and devices, it's really about more flexibility, more comfort, more convenience, more cost-certainty, and understanding about how they can manage their bill. It's about all of those different personal things for consumers.

So, I was asked to kind of go over the smart meter section a little bit, so I'm going to go through that specifically.

One of the things we did -- and you have

the case study in the draft of the paper. And I want to emphasize and congratulate the Advisory Committee with this. It's a very good paper, and we again thank you for the privilege of being focused in it, as well. So you have a lot of the nuts-and-bolts detail in the appendix.

But I want to highlight one sentence, which is on page 4 of your draft: "Most consumers do not understand how the electric grid operates, nor do they need that comprehensive familiarity."

So that's a really -- I really, totally agree with that sentence, and I urge you to continue to keep that in the draft.

And that's something that's very important for policy-makers to understand, because there's a great desire to get in and try to make consumers understand smart grid and smart meters, and smart this and smart that. And consumers are, like, "Uh-uh." Again, time scarcity. We just want to drink our cup of coffee.

So, one of the things that's important when we've talked about the rollout, is

translating it into simply terminology that really directly connects with the benefits that consumers are going to feel. What does this step forward for the utility matter to me as a basic consumer? And so we developed and designed a process that was really linked to that value equation, and being able to communicate that.

These are some of the specific things that we did. We did a tremendous amount of pre-work. We made sure we really tested our network, had that well established. And we also made sure that, through the installation process, it was going to be as simple and convenient for customers as possible. So, for example, we allowed customers to make their own appointment window. And this wasn't, you know, like for example you work with folks who are going to deliver like, let's say, a washing machine and they give you a day. That's not convenient for someone's time management. We literally gave them a one- hour appointment window.

That level of respect for our customers,

making sure that they could manage their time -- very important. And it definitely led to the success. We got 97 percent customer satisfaction measured through our installation process.

So, these are some examples -- and Judith mentioned our door-hangers. So, we used simple iconography to really highlight both the convenience, the environment, the different benefits of the meters. And we had brochures we mailed 14 days before. Some of the details in the appendix of the paper -- so I'll just highlight it here -- but, underscoring the human touch, over 200 community presentations. And, again, we're a relatively small community. We have roughly 600,000 meter points, which represents about 1.5 million total population in our region.

We're a fairly small utility in the grand scheme of things. And so one of the things -- and I'll talk about this a little bit more -- when we talk about sustainability, and go forward, engagement with the consumers, you can actually absolutely change customer behavior. You can

absolutely engage your customers, but it's very, very expensive. And so that's something that, from a utility perspective, we have to weigh and balance. And, to be quite frank, we would not have been able to do this level of engagement and outreach relative to the new technologies if we hadn't had some of the funding from the ARRA grant. It just would not have been able to pencil for the utility itself.

So, that's something that we need to have real good conversation about going forward, as we continue to push the envelope with more and more technologies with consumers -- how can we have the affordability and the business model for the utility to be able to do this level of hands-on communication, outreach, hand-holding, engagement. As was mentioned by Judith, we literally -- we had roughly over 3,000 people that initially refused a meter installation. And we called every single one of them. We talked to every single person personally. And we have a customer advocate, we have a couple of them.

And we got that down to under 400 refusals which then, since then, since we then put the opt-out policy in place, we got that down to just around 300. Again, huge amount of personal touch. Lots of time on the phone. To give you an example, our average -- and this is across, whether it's a bill inquiry or what have you, and I run operations, so I'm responsible for this bottom line in the P&L -- is that our average call, whether it's a bill inquiry, or a smart meter question, it's about $14 a call. And so you do the math pretty quickly as the call volume goes up. It's forever changed our business.

Since we've implemented the smart meters, and we have all of these new channels, including the website and other things, our call volume has not gone down, it's gone way up. So people -- for example, they'll go to Facebook, and they'll have question, then they call. And so it's something that we're really wrestling with now from a cost perspective, is that our customers love our contact center, they love being able to

talk to us. That's our most expensive channel.

So, I just want to put that out there, some of the things that, as a utility, we're wrestling with. We know it's the right thing to do. For example, one of the things I did is I changed our metrics in our call center. We used to have a metric that was about, you know, being able to get people quickly through and processed. And we realized that actually wasn't the best customer experience. And so now it's first-time-resolution is the new metric, as opposed to getting people off the phone.

So that's, again, better customer experience, very positive customer service, but very expensive. So these are the tradeoffs that we're balancing.

So, some customers wanted out, as I mentioned. So this was something that we had hoped we wouldn't have to actually do. We love our network, we love our meters. And we realize, though -- again, as community-owned and public, we had to provide choice. We had to provide an

option. Also, the California PUC, although they don't regulate us directly, they made a ruling for the IOUs in California, so that made it virtually politically impossible for our elected board to go a different direction.

So, you see here, we developed what our fee schedule was. It's $127 up front, with a $14 a month fee. We have -- and then this is where it gets really interesting, is that we had initially developed -- because the primary, in our service territory, the primary concern was about the supposed health effects of RF from the meters.

And so, one of the things that we thought to answer this, as well as sort of our network whole, and keep our direction going, we thought, well, then we'll offer, as the default meter for the opt-out program, a digital, non-communicating meter. However, what this does for the utility, it still enables us to get interval reads, which will enable us to have time-of-use pricing and other benefits. Customers will still be able to see their data and

participate in advanced programs and energy efficiency. We thought, "Perfect."

Well, not perfect from the consumer's perspective. They think the digital meters cause "dirty electricity."

So they were furious. So they refused the digital opt-out meters. All they wanted are analog meters.

So, what we had to do is we had to then -- they came back to the board, and this gets into the "fierce opposition" slide--they committed that they were going to come to every single board meeting. And, to give you a context, because we're fully transparent and community- owned, we have, open to the public, a full board meeting every other week, so two a month. And so we had -- this is a small number,.07 percent of our entire population concerned, but they are incredibly motivated, and a large number of them -- well, it's not too large in the grand scheme of things. To be precise, it's about less than 20 individuals. But these 20 individuals have

dedicated their entire life now to stopping the stopping the utility and stopping the meters. And they literally, they said, "We will come to every meeting," and they have. And they still do, by the way.

So now we have implemented the opt-out program. We work with them. We've made the concession to allow analog meters. And yet they're still unhappy.

And one of the things that I want to make a note of is this is very small -- and I'm going to get into the positive stuff in a minute -- but it's forever changed the life of our utility. And the reason why is because we are public, and we conduct these meetings. These people, there's small number of them that are incredibly angry, they're irrational, and they're dangerous. And in California, under the Open Meeting Act, and as a public entity, we are not allowed to have a restraining order, for example.

So we have now had to spend the money, and have full-time Sacramento County Sheriff's

protection at all of our meetings, for all our elected officials and our executives. I've personally, since I run Customer, have received threats. My staff, my customer advocates and my staff in the call center and direct customer service -- employees have now received threats. It's very scary. We have some of these individuals who, they call probably 12 to 15 times a day, and the only way that you can cease a conversation is hang up on them, and then they run to the media. I mean, it's -- I cannot emphasize enough how it has physically and fundamentally changed our utility.

And it's been very, very painful for some of our employees, including one of our customer advocates, who really led, who was the one who was kind enough -- he's so amazing, he's so gracious and so kind. And he was the one who did most of those calls, and personally spent hours walking through the questions and answers with these customers. His name and identity has been dragged all across the internet, called

horrible names, has gotten threats. His family is concerned.

So, now we are actually at a point where we're having to implement a policy of actually aliases for some of our, for our customer service professionals. We have unions who are concerned with employee harassment. And I will kind of stop there.

But I just really want to emphasize, for the DoE and for the community to understand, that even though the numbers are small, it has a material effect. And it has a morale effect and a safety effect. And as the management over my employee workforce, I'm having to make daily decisions around the fundamental physical safety of my employees. So I'll leave it at that.

Oh, I covered that already. So, now, on to the positive -- very exciting. So, we've had a very successful pilot, and we're thrilled with the partnership we've had with DoE. And to earlier conversation about how DoE helps with consumer behavior, the technical assistance with the

research design, and help has been invaluable, and we're very grateful for that.

And so this is a quick summary of what that grant has enabled us to do. We've had about 70 to 100 customers participating in the Pricing Pilot for the opt-in. And then we have about 3,300 on the opt-out.

And so some of the lessons-learned here is that, on the very positive basis, what we were thrilled to find out is that customers were really ready to participate. And so we got great response from our marketing. People were really excited. You can see here that even though we had a lot of activity that we did to educate -- and it touches on what Judith said about energy literacy -- when you get that engagement, people jump in and they're very happy. And they don't back out.

And so you have the persistence, and you have the participation, which is very, very exciting. So we're really excited about this.

These are some of the things that we did. We used follow-up postcards and things, we

confirm. As a matter of fact, we had our first call for our pilot yesterday, for the summer heat -- we're in a heat storm right now. It's supposed to be 107 -- tomorrow when I get home.

So, people are participating, and they appreciate the communication. And, again, it's not a one-time communication, it's continuous engagement, and continuous dialogue that customers really resonate with -- and appreciate.

So, these are some examples of the material that we used for the opt-in. As you'll see, it features a child, very friendly -- again, human. It's not about technology.

And this is some of the lessons about the best marketing from other industries. One of the things that's so brilliant about Apple -- and we hold it up as an example in marketing -- is that they didn't go out, when they launched the iPod, they didn't go out and talk about gigabits, and bytes, and technology. They simply said "a thousand songs in your pocket." How cool was that?

And so what's neat about the technology is that we have a "coolness" opportunity in our industry that we've really never had before, which is very fun.

This is an example of the micro-sites. Each of the pilot groups -- again, to keep the research clean we had micro-sites. And one of the things to note, as well, is that I'm showing you the specific material we used for that pilot, but surrounding that is all of SMUD's other material, like our regular smud.org website, our Facebook page -- all the other materials, the bill-stuffers, all the normal things we do to communicate. So they are surrounded with a whole family of multiple channels of communication.

So, again, examples -- you have the connection with being able to do the right thing. Not only you're saving and getting the benefit for your bill, but it's helping the environment. So we came up with this line, "Reward yourself, and the environment, too." We did a tremendous amount of research on the language. People really

resonated with that.

One of the other key findings that we found that has been very interesting for us is that the additional carrot of having an in-home digital display or technology was not the mover for the customers. So, we were surprised about that. So, what we're finding, it's really about, in terms of participation and engagement, it's less about the technology, and more about the information, and they're ability to make their own choices.

So, this is a good example about how we talked about the pricing, in terms of really showing people the difference on peak, how they'd be able to save -- again, basic education in a very simple format, easy to read, understand, with an education about why it's important, how their help can -- help them with peak. SMUD has a very spiky needle-peak in the summer, about 40 hours. But it's significant. It's basically another power plant if we don't manage our peak.

And so we help them understand that,

actually, through their energy efficiency, through their participation, we can actually save them money in the bigger term by not building another plant, not using certain types of power-source fuel, and so forth.

So, again, this is a good example of a door-hanger campaign.

Multi-channel -- and this is the other thing that's important for the communication. As you see here, to get the engagement, and keep the engagement, it's not about one letter, or one website, or one door hanger. It's all of these channels, utilized in a very sophisticated campaign- type of way, to really get that engagement and participation. Brochures.

So, some of the other things -- this goes back to what I mentioned earlier -- you know, we have our utility benefits which are very important for us, but it's really about the value proposition for the consumers. What do they care about? They care about being able to understand when their outage is going to be restored, what's

happening, information, those types of things.

I'll share an interesting thing we've learned about outage, however. We have a great outage map, and we've been very much engaged with that, and see that as a great customer benefit. We're finding that -- because, again, we want to under-promise and over-deliver, so, being conservative and very, you know, engineering-oriented, we're all like, you know, very precise. And so, when we put the outage information, the restoration time, out there for customers, you know, we give ourselves a little room. Because, you know, there's dynamics. And you don't really know until a troubleshooter's gone out there, and there's lots of physical things that still have to be done to restore.

So what we found out is, we thought, oh, great, it's going to be awesome. We'll restore, and they're going to be really happy because it's on sooner than they thought.

What we found out, overwhelmingly, is that when consumers, when we tell them, let's say,

it's going to be, "Power will be restored in two hours," and we're really proud of ourselves because we actually restore it in 45 minutes, they're mad. Because they're like, "What's wrong with you?" They want us to be precise. And that has been a really, really mind-blowing discovery -- and a challenge for us. Because how, in our business, with so many dynamics, are we able to get that level of precision.

So that's going to be a challenge for us, going forward, because now the technology allows for precision, and the consumers are expecting precision because they have real-time information, what have you. Yet the reality of our business out in the field can be anything but necessarily precise, in terms of dealing with trees, and automobiles, and poles, and all sorts of other things.

So, we're trying to figure that out right now. That's a current challenge, or opportunity, that we have, is, in terms of our outage portal and outage communication, how do we

balance the cover that our field crews want and need, and how do we balance that with the precision and the instantaneous access to information accuracy that the customers want.

So, finally, I was asked to give a kind of a window into some of the exciting things of where we're going.

Really, the smart grid, for us, is a platform, very much like the internet was a platform. We are so excited, because as we put these systems in place, it allows for possibilities that we're just beginning to imagine.

And what it's changing is the paradigm with our customers. Rather than having just a simple transactional relationship, we can truly begin to partner with our customers. We've already been doing that for many, many years with our commercial and industrial customers, and now, with the new technology, we're able to engage in more truly partnering relationships at the residential level.

So, some of these pictures -- this, of course, is a big commercial warehouse. This is a lighting project we did at Blue Diamond Almonds that's been a very exciting energy efficiency project. We have sensors. It's all interoperated. It's very sophisticated. It utilizes meter technology, and their ability to now really see, in real time, their usage and how that's changed. And behind the scenes, as well, we've got dynamic controls. We redid air-conditioning -- many, many, many deep, deep comprehensive changes to that warehouse, which is really helping them.

And that touches on an energy productivity paper that I gave to Pat as a draft yesterday. There's so much opportunity in the area of energy productivity, as well as energy efficiency. And I enjoyed your conversation that the Committee had on that topic, as well.

You see the integration of rooftop solar, that thin film. Very exciting technology, new types of micro- grid relationship -- of

course, plug-in electric vehicles. All these are types of programs that we're rolling out, or have already rolled out with our customers.

So the future is really one of lots of apps on a network, being able to have more and more customization, more and more choices and options for our customers to interact with us.

And, again, it's about the energy, it's about the coffee. That's what the customers care about. That's what consumers care about. And as long as we can challenge ourselves, in the industry, to use very simple terminology, translate, engage into the things that our customers care about -- their convenience, their comfort, their economics, personal or in terms of their business -- we are going to be very successful.

So -- thank you for your time.

MR. CURRY: Now Angela will give us a view from the center of the country.

MS. NICHOLS: Can you guys here me okay? Well, thanks for having me out here today. I'm

really excited to talk about what we've been able to do at Oklahoma Gas and Electric, with our smart grid. I can echo a lot of what was said. I'll try not to duplicate too much, but I definitely think there's a lot of similarities.

So, a little bit about what I'm going to talk about today. I'll go into high, high level background on what OG&E is, talk a lot about smart grid-enabled programs.

I won't focus so much on the grid itself -- and I'll get into why, here, in just a minute. I'll show you some of our education and engagement activities, show you some of the results that we've been able to achieved, and then what we've learned from that.

Disclaimers -- well, I won't leave that up too long. We've already seen this once today.

So, where did we start? We had a smart grid started for us back in 2008. We got a very, very small pilot -- 25 customers -- from a customer standpoint. 6,600 meters were put in. But, again, from the very beginning, when we

started with the meter rollout, we also started with what's in it for the customer? That's really the customer perspective, right? The operational benefits are great for the utility, but customers want to know what's in it for them, what do they get out of it? So, we started from day one, looking at what's in this for the customers.

In 2010 and '11, we moved into a broader statistical study. The first one was really just, "Is there a there, there?" Do we want to understand, okay, what does smart grid look like for our customers? It was a two-year study looking at two different rates, and various technology options.

Based on that study, what we found was variable peak pricing, coupled with a programmable communicating thermostat provided the most customer benefit and demand- response benefit. I'll get into that next.

So, where we are today? After launching the program in 2012, we had 40,000 customers last year. We're up to, now, 63,000 customers. And,

to put that into perspective, we have about 750,000 customers. When you break that down just to Oklahoma jurisdiction where this program is available, we're almost at 10 participation already.

So what were we trying to achieve with this program? Similar to you, Elisabeth, mentioning the need for new generation, obviously that was the big driver in this -- delay the construction of additional fossil-fuel generation.

We wanted to get about 20 percent customer penetration, which is very aggressive, especially in such a short time frame. In order to delay that generation, that equates to about 1.3 kW per customer that we needed to achieve, or about 300 megawatts.

So how did we do that? There was a lot of customer research that was involved. This is just a really high level. We did focus groups -- as was talked about earlier today. We had web panels that were set up, and these were kind of going throughout the program. We did baseline

surveys to understand what do customers know today, how do they feel about us? Do they trust us? Really get a baseline.

We did participant and non-participant feedback, what did they like about it, what do they not like? For those that didn't participate in the studies, what issues did they have?

Conjoint pricing studies, to understand what tradeoffs our customer is looking for in pricing -- on-peak, off-peak, customer charge, all of those.

We did town halls, bringing in customers in the community to talk about their experiences in the smart grid.

Social media was a big part of our customer research. During the two-year pilot study, we had a closed social media group, where customers that were participating, the 6,000 participants, could come, talk about the study, really, really engage with us what they liked, what they didn't like. And that was very, very insightful.

We also laid out what we call our "guiding principles." There's probably three more that I didn't list here. I really wanted to focus on these. It was all about customer empowerment.

So we didn't have any direct load control on this -- no direct load control on equipment or appliances.

It was purely opt in. Customers will be provided time-differentiated pricing, and be allowed to choose their balance between comfort and control -- I'm sorry, between cost and control.

All customer participation is voluntary. And the enabling technology will be provided at no cost to the customer. So, again, all of these were focused on the customer, and lay it out clearly what's within the scope of what we're going to do.

We also had some key messages. And we talked -- you know, we thought environment was probably important, saving money, technology. There were lots of things we looked at.

What we found was, really, for our customer, saving money was the most compelling reason that they wanted to sign up. The other benefits are there, and I think they appreciate them, but what it came down to most was money.

They also liked the idea that they control it. This idea that there's no direct load control was very important to our customers. We give them the tools and technology, and then they make the choices to save money. Any devices in their home -- we send price signals, the appliances respond, but we can't go in, as a utility, and change that thermostat, or guarantee that reduction.

We also had a first-year best-bill guarantee. So that was something that customers were -- this is so new, and so different than pricing structures they've had in the past. We said if, in fact, you pay more on this new program, we will refund you the difference at the end of the year. Fortunately, over 99 percent of customers saved. Less than 1 percent qualified

for this best-bill guarantee.

They also had a choice. We offer price-plan options that they could choose what works best for them.

And, again, the delaying of a new power plant was probably a secondary message in all of this, but we couldn't leave it out because customers had some skepticism in understanding why would the utility want me to use less of their product? So it was important, even though it wasn't the primary benefit, to have that comprehensive message of "There's a benefit for the utility, and a benefit for customers."

So, this is a little bit about what our pricing plan actually looked like. We had a residential and commercial plan. We had four -- or, I'm sorry, two pricing tiers, on-peak and off-peak. The on-peak was from 2:00 to 7:00, Monday through Friday, and the price could vary with a day-ahead notice between those four levels: 4 cents, 9 cents, 20 cents, or 44. These are actually our 2013 prices, maybe a couple of

decimal places, or -- 4.5 last year. So it's a very minor change from what we saw in 2012.

We also have a critical overcall provision, or a critical peak price, that we can call with as little as two- hour notice. So, the day before, we're going to send the customers, through their method -- they can get an e-mail, text, or phone call. They can also go online, go on our website. It's kind of a push or pull on how they get these.

We send them that message the day before this critical price -- which is the same as our top, 44 centers -- that could go at a two-hour notice. We try to give, also, a 24- hour notice on that, as well. But that wasn't subject to the 2:00 to 7:00 window. It could be a smaller window, it could be 5:00 to 6:00, or it could be a longer window.

And the technologies -- talk a little bit about those. We have two thermostats that customers have available, the Energate and the Carrier. We also have a web portal. The web

portal is available to all customers, whether or not they're on the pricing. So all customer with a smart meter can go out to the web portal, engage in that, understand how to reduce their costs. There's bill estimates on there -- so, if I continue my usage, what is my expected bill going to be?

Other benefits of this web portal are a rate comparison tool, which I think is very helpful, both for our employees, when they're talking to customers, as well as to customers to just go out there, and they can say: If I were to switch to these new pricing plans, how much could I save?

And you can also do some what-if analysis. So they say if I shift 10 percent of my usage, how much can I save? If I shift 20 percent, how much can I save? So, it's really beneficial for those customers that aren't really sure if they want to make that leap.

Now I'll talk a little about the education and engagement that we did with our

customers.

So, again, these are the primary education mechanisms, but by no means is this a comprehensive list of everything we did. These are some examples, on the bottom, of the e-mails that we sent. E-mails were a big part of this. We had direct mail. We had mass media -- TV, radio, and print. Digital media was part of that. Social media was a big piece. That included the closed Facebook group that I talked about for the study, as well as other things like blogger outreach. So, we reach out to kind of the follower, the bloggers within our community that had strong outreach, talked to them about the program, and asked them to blog their real experiences on the program with their readers. That was very successful.

Press releases were a part of it. We worked with community-based organizations -- lots of community outreach, engagements, on our end, as well, and that included various constituencies, some directly for the senior market, and other

markets. So, a very broad range of education mechanisms were used.

Here are some other examples. On the top is one of our print ads that went out. We had TV and video -- or TV and online videos. These customers that you see in these pictures who are actual customers -- so, that's another thing we found very beneficial is customer testimonials. So, instead of us telling the customer why this is important, customers wanted to hear from other customers on what did they experience, and what did they like about it. So we found testimonials to be very beneficial for our customers.

We had targeted e-mail. Some were focused on the free thermostat, some were focused on saving money. We tried various messages here, as well.

And we had direct mail. That bottom piece in the right-hand corner is one of the direct-mail examples.

The news media was also very important in getting our story out. We were lucky enough to

get a lot of earned media with this, as well -- so, the community out there talking about our program. So that was very helpful.

So, what did we see? So, we engaged 6,000 customers on a pilot. We had 40,000 at the end of 2012. And, to date, as of the end of May, we're up to about 60,000 customers. And, actually, I have even newer numbers than this, and it's about 63,000 customers on the program.

We're just now in -- Monday was our first pricing signal day. It only runs June to September. So we're just now getting into our summer pricing season. Hopefully, this continues. Our goal is to get about 70,000 customers this year -- or 80,000 customers this year, I'm sorry. And we're up 17,000 new customers.

Skip over this one, actually. But I want to talk about customer impressions.

So, what are customers seeing from this? And it might be hard to read those bullets there, but that purple line at the bottom, that went from about 35 percent to roughly 65 percent is the idea

that "Does its best to keep rates as low as possible." So customers are really starting to understand, or change their perception of the utility to understand what this market provides them. "It helps us keep rates low."

The other one that's really, really changed -- and I'm really proud of -- is that green line, which is "Cares about its customers." So, asking customers -- we started in -- these are six month average. We actually started tracking these in '10. I don't go all the way back, there.

But we went from about 50 percent up to about 80 percent agreeing with the statement that we care about our customers. So it's been really good to offer programs, in this case, so the customers really understand what the benefit is for them.

So what have we learned from all of this? Technology and savings create sustainability. The primary customer driver is savings. Technology is only important if it helps the customers facilitate savings. So, the

operational technology issues -- ah, that's not as important to them. The technology that helps them save is what they're interested in.

Automation is the key to sustainability. They want to set it and forget it. When we had -- so, customers can decide whether or not they want to take the programmable communicating thermostat. They can just opt-into the rate, if they want to. When they take the rate only, without the automating thermostat, they save about 20 percent less. So the automation here, where the thermostat automatically responds to the price signal really helps customers save additional money. They can do it without the thermostat, but it's a lot more manual work.

Pricing is very critical to the success of the program. The differential between the on-peak and off-peak pricing was important to help create that demand shifting. If there's not enough difference between your on- and off- peak -- there needs to be that incentive there to get customers to shift their usage.

Sending high prices and requiring customers to respond every day creates fatigue. So, one of the things we tested, as well, or that we looked at during that pilot was what was the impact when we called that critical event? There was a time that we called several in a day, and you could start to see, kind of, that fatigue in customer response. So it's important to really think about when you're calling those high-priced events. There's a lot that goes into it than just the economics. There's a customer side of understanding when to call one, as well.

Communicating prices daily does create awareness and focus -- so that helped customers really stay engaged during that summer season.

Another piece of it was involving employees in the process. So, during the smart grid program, we had a smart grid ambassador effort, which is now rolled into what we call our "Smart (inaudible) program." So, customer -- or, I'm sorry, "nimbers," what we call our employees, are engaged to tell their friends about the

program, become aware of the program. And they can actually be incentivized to sign their customers up. So we had an employee contest to see who can refer the most friends and family to participate. It really helps them understand what exactly is the program, because we know they're getting asked every day, from friends, and family, and neighbors, "What is the smart grid," and really helping your employees understand it is important.

Some other lessons learned -- customer enrollment has to be easy. Online enrollment and a dedicated call center both helped us meet that effort. We don't want to make it difficult for the customers to do business with us, we want to go to them on their terms.

We also had automated tools for enrollment, order fulfillment, and scheduling -- so those were all important.

Education and engagement are very key. We used, as I mentioned, multiple channels, TV, radio, print. You name it, if it's available,

we're looking into how do we optimize that for customer enrollment and engagement.

We had extensive use of customer testimonials and educational videos. So, that was another thing that we found beneficial, is customers are going to have questions about how to use the thermostat, so they can go on, rather than -- you talked about the cost of calls being very high.

We have videos of customers walking through tutorials on how to program the thermostat for various things -- how to set it for when they go on vacation, or how to change it when the prices are high, how to reprogram it. All of that, they can go on line and watch videos on, as well.

IT and effective processes, quality assurance, solutions delivery life-cycle were both important. Trusted partners and regulators will be your best friends. So it was very helpful to engage our regulators early on and throughout the process.

So, that's all I've got to share. And I guess we'll turn it over to the moderator.

(Applause.)

MR. CURRY: Thank you all very much. You did an excellent job presenting, and we learned a great deal from it -- although one of the key take-away I had a couple of years ago was when the president and chairman of the Long Island Power Authority was asked by one of the local newspapers why rates were going it up, he said, well, it's because people are using less electricity -- one of those badly kept secrets in our profession that you normally don't utter to the New York Post, because they put it on the front page.

But, let's go from there to more positive results. One question I had, Elisabeth, from your presentation, is it sounded to me to some extent you were saying but for the support of the DoE, it would have been very difficult from a financial standpoint to have the kind of TLC delivery to your customers that you ultimately

were able to provide.

Is that a fair recollection of what you said?

MS. BRINTON: I didn't mean to -- (inaudible) like a rock star. I'm not going to sing, I promise.

The key is pacing. And so, to answer your question, yes, the additional funding from the Department of Energy for the smart grid investment grant was critical in order for us to scale and move at the level of scale and pace that we were able to do, without compromising our customer experience.

So, as I mentioned before, SMUD has been deeply dedicated to a hands-on approach to our customers for many, many years. But we would not have been able to do such a huge project so quickly, at its scale, without the additional money, because of the cost of the marketing, and the cost of the hands-on, feet-in-the-street, that type of engagement.

So part of the question comes in, on a

go-forward basis for utilities who did not receive the grants, and are at different stages, is pacing. And I think you mentioned that, Judith, you showed that slide about moving slowly, about do you -- how much of the apple, as it were, do you bite off at one time? And so these are the types of the things to balance.

And so I think the lesson learned for the utilities who have not yet begun on this path, is to put customer experience first. If you put that first, and then figure out a realistic road map that you can scale at the pace that's going to fit your unique community, and your stakeholders, then you'll be successful.

MR. CURRY: Thank you. Wanda, do I see your card up?

MS. REDER: Yes, I was just going to put a little context here.

For those of you that aren't aware, we had a smart grid paper that was released last fall. And, you know, in part in response to a lot of the ARRA funding that went into smart grid, a

bit theme that came out of that was just the importance of the consumer acceptance.

And, you know, it's easy for us to kind of get gravitated into what technology should we be pursuing, but I think, coming out of that paper, it became really evident that we needed to escalate the importance of consumer acceptance, putting the consumer first. And even though there might be only a handful of people that object, it can totally change the direction that we're going.

And I believe you all really highlighted that well, in that this is truly a paradigm shift of how we do outreach, how we think about what we're pursuing. And even though technology might be, you know, kind of at our foundation, if we don't rethink the approach to this, because of the social media tools, and the ways that consumers can have a voice that's much different than it was a few years ago, it's actually getting us to a point that we have to rethink the approach.

So, I want to applaud all of you. I think your messages were spot on. Fundamentally,

the reason we timed this panel the way that we did, this really keys up the issues in the background that was put together with the paper that Mike Weedall led, and ultimately, then, frames the recommendations for DoE going forward.

So -- well done. Thanks, Bob, too.

MR. CURRY: Okay. Thank you. And I should just note our thanks to Mike Weedall and Sue Kelly for arranging the panels.

Phyllis, I think you were next up.

MS. REHA: Yes, thank you. I was just curious if you could give us a sense of the scope of the marketing and the customer acceptance speed. What percentage of your budget -- and this will go to Oklahoma and also to SMUD -- was for that outreach- customer acceptance marketing?

And then a second question is did you hire outside consultants to help you with the marketing campaign that you had?

MR. CURRY: Do you want to start, Angela?

MS. NICHOLS: I don't have the exact

percentage of our overall budget. I will say it was -- it was low in the scheme of things. I mean, certainly, the operational costs are the bigger piece of it.

As far as engaging outsiders, we definitely worked with vendor partners on the education piece, as well. We had several partners in that. Some of the website tools were built externally.

We also worked with partners on the marketing piece. We have an advertising firm that we worked with closely on developing the messaging. Some of the research involved third parties, as well.

So there was a big collaborative effort. It was definitely not all internal.

MS. BRINTON: I also don't have the exact figures in my head. It's something that we can provide.

But what I want to say, too, is that if you look at our normal -- because you have your normal marketing and communication and engagement

that happens all the time. And so, around, for example, this specific smart meter rollout, that was on top of, by a couple million dollars, our normal marketing and outreach campaign.

So, you do get the benefit of a cumulative, leveraged effect, and that's something that was really important with our planning. Because we need to make sure that we're optimizing our budget.

Because one of the things, too, as a public power organization in a monopoly service territory, we also have very vocal customers who go to our board and say we shouldn't be doing any marketing, advertising, or communication at all. And so we dealt with that, as well.

So we are always -- it's always a balance, it's always a balance.

And we did use some outside consultants to help us, similarly to what Angela described, to help us really fine-tune some of our collateral and our pieces, and help us really -- and part of that wasn't that we could not do it ourselves, it

was the time frame -- again, is that we wanted to build a sustainable model. So we engaged some -- really, more it was like staff augmentation, in a sense, bringing the agency partners in to help us. Because we could do it ourselves but, again, we just didn't have the personpower to be able to do it that quickly.

So that's the good thing, I think, that one of the things that SMUD has done, and I think it's a best-practice, is we, a number of years ago, before the smart grid process started, we went out and built a very professional marketing and market research organization. So, for example, the gentleman who heads our market research I stole from Toyota.

So we have some really, really phenomenal, best of class professionals that could hold their own, and have held their own in some of the best agencies and best consumer product companies in the world.

And so that's the key. And that's the key foundation that SMUD has invested in on a

go-forward basis.

And then, for the purposes of moving this out quickly, then we engaged some agency help, as well.

MR. CURRY: Judith, do you have an overview comment, from your experience?

MS. SCHWARTZ: Well, I want to make a comment from the perspective of -- and this is, again, coming out of the Silicon Valley background where, when we were introducing the internet, and we were introducing all these things, we didn't always have big ad budgets. And one of the reasons we did targeted marketing and we came up with unusual ways to do it was because we didn't have big budgets to do it. And when you look at all the start-up companies that are out there that take off, most of them don't have big advertising budgets.

And so, one of the reasons that I tend to be so bullish about these highly leveraged models of working with other organizations is because they are more cost-effective.

And I think they are more effective in a lot of ways. And I think that this is one of things that maybe I'm challenging what the status quo is, because I think that there's a lot of investment in sort of very high quality branding that's happening these days, and I would argue that a good conversation, or five good conversations, with people that they trust are going to be worth more than the ad campaign.

And I think the fact that you did these things, where you, like, sent your people out and talked to them, I would be willing to bet that your employees that get five of their friends to do it and sign up, or their family, really has a huge impact.

And so I just want to maybe challenge that a little bit -- respectfully.

MR. CURRY: Thank you. Mike, do you have a comment?

MR. WEEDALL: So -- a great discussion. Obviously, right down the plate, for a guy like me, who has believed for many years that, as an

industry, you know, we've really been, you know, just missing the customer.

So, the other thing, you know -- and I know, you know, I've talked to a couple of you about this -- this is a journey. I mean, it's an exciting start of the journey.

So what's the next step? Where do we go from here?

I mean, it's great to hear about, you know, starting to get the early adopters, et cetera. But what does it take to really change the industry?

MS. SCHWARTZ: Well, you need more, I mean, there has to be more money for this part of the -- you know, for what these groups are doing. There's got to be funding for it. I mean, it's like, you know, you invested a lot, but it was high-touch, it was worth it -- okay?

Apple sells the products for a much high price. You can buy the same phone at the AT&T store, but it's not the same experience -- okay? And sometimes the fastest distance between two

points -- you know, it's not -- the cheapest way to do it isn't always better. And if you have people who are taking you down, and stopping your whole process, and causing those delays because you don't have 95 percent of the people who would be supporting of it saying, "Hey, wait a second, Joe, you're wrong." Okay?

I mean, it really, in the long run, is money well spent. And I don't know -- you know, the regulators in the room, how do you come up with a different way of valuing and allocating money? And the utilities in the room, how do you say, hey, wait a second, this is a really important part of our business, and we have to fund it?

And whether it gets cost recovery or it doesn't get cost recovery, I'm sorry, I think it needs to happen.

MS. BRINTON: Well, thank you, Judith, I agree with that.

It is a very, very important part. And, as I touched on in my comments relative to the

contact center example, it's not getting less expensive. So, the high- touch, the focus on real customer experience, what that really means as an operating entity, is very expensive.

And so, the illusion that all these new technologies, like social media and these new channels that are available to us are actually going to lower the operational cost of the utility, that's not the case. It actually is more expensive to do it right and to do it better -- and from a consumer-engagement perspective.

And so what we're doing at SMUD right now is we're doing a customer experience excellence initiative where, throughout the entire enterprise of our organization, we're looking at processes, we're looking at every single touch point. We're mapping that out across the entire organization. And we're looking for how we can make that experience optimized to the best interest of the customer, and at the same time, where we can find the efficiencies in terms of costs for us as an operating entity, so that we

can balance that.

I think the other thing that's really important is that we have to figure out how we bring everyone along with us in the journey -- because the demographics of the public are not changing. And so, for example, with SMUD, we have a very, very high percentage, over 20 percent, of our population who qualify for, under the Federal poverty level, for energy assistance. And so one of the things is -- we're in a rate process right now, one of the primary drivers of our rate process is our cost to provide our obligated discount for our energy assistance program.

It is just, through the recession, it has skyrocketed. SMUD, by demographics, is one of the most diverse, ethnically diverse cities, regions, in the United States. And, unfortunately, with that comes a huge amount of first-generation immigrant population, and folks that are really struggling on the edge, on the hairy, hairy edge.

And so that's something that's also very

important, and something that is going to be a very important challenge. And I've been engaged in some of these very, very sensitive debates. Because we love solar, we love new technologies, we love a lot of these things that enable choices for customers. We believe in those things. But at the same time, as those of us who have an obligation to serve, we have to figure out, as we lose revenue on the one hand, and we provide different choices on the other, how do we bring all of our customers along with us? How do we make sure that our grid is accessible, reliable, and open for everybody.

And these are big questions. They're big, deep, philosophical questions.

And so I don't have a quick answer for you. But I think that part of the utility of the future is figuring out how we balance the -- quote-unquote -- "off-grid" options that are very cool, and very exciting, with the fundamental on-grid connectivity that consumers need, to have that basic reliability.

And what I would argue -- and I just got back from an incredible mission with the U.S. Energy Association and USAID in Tanzania, one of the poorest countries in the world, helping their utilities figure out some of these very important challenges. They only have 18 percent access to electricity in their entire country. Their capacity, without reserve capacity, is exactly the same as SMUD. It's just over 3,000 megawatts -- for their entire country. And their largest city, that I visited and stayed in, had over 8 million residents. And so that puts us, it puts these things sharply into focus. How do -- and they're desperately trying to figure out how they get electrification so that they can have clean water, they can have hospitals that can do surgeries, these basics -- that people can have the economic ability to have businesses and do things.

So, as we move forward, part of what we have to figure out for the utility of the future is how we bring our whole community along with us, how we balance connectivity and core

electrification -- which is a very good thing for our economy, for public health, for all these things that we have had the luxury of not thinking about for awhile -- and at the same time balance business models that allow for the innovation and the new options that technology provides.

MS. NICHOLS: I'll add a little bit to that -- and that's in terms of thinking about we're not just asking customers today to enroll in this, and then that's it. And our efforts aren't done when they say, yeah, I'm going to sign up for this. This is a long-term proposition. They can't just sign up this summer, save some kilowatt hours, and then next year, you know, it starts all over.

So how do we keep engaging these customers? It's almost -- you know, if you want to think in terms of seat belt campaigns, or anti-smoking campaigns, it's really changing a mindset, and changing our relationship with our customers, getting them to engage with us not just one time, but over the summer, throughout the

year, and year after year. So it's definitely not a short-term prospect, it's a long-term prospect.

MR. CURRY: I guess my comment, looking at the coming of wars between distributed energy resources and the main grid is: Be careful what you wish for. Because you're going to have to spend a lot of money and decide what is fair for the -- in the case of an equity, investor-owned utility, between the equity side of the house and the regulated side of the house. It's going to make an interesting set of challenges.

MS. SCHWARTZ: But isn't war relative? I mean, you know, this just isn't an area that's been sucking up resources. I mean, so even if they doubled the customer education budgets in every utility, it wouldn't be that much in terms of percentage dollars for the whole utility.

And I think that this is one of things that hasn't had to be funded, and it hasn't been funded.

MR. CURRY: So, I urge you to go to NARUC and sell people at NARUC on that, that

issue, because that's where the rubber meets the road.

Merwin, you had a comment?

MR. BROWN: Well, I put my tent up before the last few comments, so I thought I was going to be saying something a bit controversial.

MR. CURRY: Oh, rats.

MR. BROWN: And now I'm going to be, I think, reinforcing what you just said.

A couple of years ago, when I saw some of these early attempts at trying to engage the customer, particularly in California, they weren't very successful, compared to the ones we've had examples up here. It got to me to ask the question -- why we really want -- and I changed that when I got done to "why we must have -- a smart grid? And I did some study on that, and traced it back to as far as the early 1960s, that's when this all started. This is not a new thing, it's been building over time.

And I, going through that process, identified over a dozen drivers or factors that

have pushed, incrementally, harder and harder on the grid having to deploy this intelligence and other kinds of investments.

And so, what's at stake here, I've decided, isn't this is something kind of nice, like a new way to play music, this is necessary to keep the lights on, and to keep costs in check. There are the promises, that you put up on your slides, down the road. But I think it's going to take awhile to get them.

So, I think you're right in the way you're approaching the customers, but I think you just pointed out that it's just the beginning. And also, in some ways, you're walking a thin line. Because two other things that showed up in both the SMUD and the Oklahoma presentations, that the real drivers were actually back in your utility. There were utility objectives that were utility objectives that were really driving your customer engagement. So the customer engagement was a strategy and not an objective -- to achieve the other objective.

And I think that really nails the issue here. The customer involvement is necessary and important, but it's the tip of the iceberg and the investment and the effort it's going to take to realize the future the way society seems to want it.

So, I guess I'm reinforcing what you just said at the end. But I want, I guess I want to put point is, it's an extremely important one: This isn't something we're playing with here. The future of -- well, as you kind of pointed out, the future of society and the way we live.

MS. BRINTON: May I make a comment?

MR. CURRY: Sure.

MS. BRINTON: Well, first of all, thank you very much for your comments. And it brought up two points I think are very important. One -- and this touches on the cyber conversation you had yesterday. Information technology is absolutely critical to enabling the high-touch and affordable customer engagement that we've been talking about that really gets at the promise of what smart

grid- enabled utilities can offer their customers. All of these programs require degrees of automation -- whether it's everything from how you sign up and engage customers, how you have communication, how you have accuracy. All these types of things are embedded in very, very complicated IT systems that have to have interoperability, have to have data privacy, have to have security, have to have protection, from a cyber perspective, where they touch the operations side of the house.

This is very, very complicated information technology. And so one of the challenges that we're having, quite frankly -- and, Pat, I really appreciated your comments yesterday about the supply chain in procurement -- is that you know this with some of our DoE projects, our pilots. We actually had the funding we had to walk away from, because industry, in the information technology space, they have lots of promises, lots of ads. They do not have the software, the code, that's actually ready for

production-level environments.

So one of the things that we see as our biggest challenge, and something that's going to be a delay in getting the promises, frankly, of the smart grid customer experience, is the fact we don't have the core IT in the marketplace. We're having to rely on a lot of venture- backed startups that have varying degrees and pieces of bits and parts of it -- regardless of what their marketing says.

And the big ones, the big integrators, who also have a lot of great material out there in the marketplace, but it's not in real-time yet. And so what they're doing is they're asking us to spend huge amounts of money to co- develop with them -- which is exhausting, and frustrating, and time-sensitive. And, you know, we -- DoE knows this, but we're in the process of probably going to have to fire one of our vendors on an IT project funded by the smart grid, because they simply cannot deliver the promise that they said in being responsive to their RFP.

So, I put that out there as another thing that we need to really think about, and think about where DoE can invest R&D dollars. And this is becoming a software problem, not just a hardware problem.

MR. CURRY: Thank you. Granger's card was up next. Go right ahead, Granger.

MR. MORGAN: Thank you. I have a couple of comments, and then a question.

Actually, the first comment is related to coffee. The best bumper-sticker I've ever seen was in Costa Rica, where there are bumper-stickers that say, "Juan Valdez drinks Costa Rican coffee." And, of course, they were challenged on that, and they produced a guy named Juan Valdez.

While I run a department in an engineering school, I have a bunch of first-rate social scientists in the department. And they've been involved in a study with Pepco. Incidentally, I've shared the paper with them, and one of them responded, "I'm not surprised that SMUD was the case study cited, or that they were

so successful. In our brief interactions with them, they seemed rigorous and interested in the science."

And they were working on a Pepco project where the time-of-use stuff wasn't part of the package. And so they did studies, for example, looking at what customers expected, and then what they actually got. And, of course, what they expected was very different from what they got.

But my question -- which is, Lester Lave, years ago, did a study in which he estimated that a fairly small fraction, maybe 20 or so percent, of customers in Pennsylvania, residential customers, could account for about 80 percent of the benefit from time-of-use rates. So would the two of you talk a little bit about your view of the extent to which you're trying to promulgate time-of-use rates to all residential customers, as opposed to helping -- I mean, you talked, for example, about low- income customers. It's rather unlikely that a very low- income customer can see -- well, it depends, of course, on the details --

but, in many cases, won't see a big return.

So, talk a little bit about the strategy. Is this across the board? Or is there some effort to, essentially, apply also a cost-effectiveness criteria.

MR. CURRY: Angela, why don't you take it first, because I think yours was an opt-in program. So, by definition --

MS. NICHOLS: It is an opt-in program. And our goal is to engage 20 percent of our customers.

What we've found so far, looking at demographic of those that are enrolled in the program, it's actually pretty evenly split across age demographics, and --

MR. MORGAN: Oh, but I'm not asking about the demographic, I'm asking about the potential saving.

MS. NICHOLS: So, from -- I don't have the savings -- well, I do, but not offhand. We've looked at how much customers are saving across age and income demographics. I can say that because

99 percent of the customers are saving, they are certainly saving. We've looking at it as a percentage as bill, as well as a dollar savings.

I don't have those numbers available, but they are seeing savings at low-income levels, as well.

MR. MORGAN: Let me try one more time. I mean, given that these meters cost money --

MS. NICHOLS: Mm-hmm.

MR. MORGAN: -- what's the cost -- I mean -- and, I mean, Lester's argument was that if I only got about 20 percent of them in to the right customers, I could achieve something like 80 percent of the benefit.

Any insight on that?

MS. NICHOLS: I guess I don't think I have any more insight to add on that.

MS. BRINTON: Well, first of all, we are right now in a rate process, where we are going to be moving out entire residential population to time-of-use as our default rate. We're doing that in a process over a course of a number of years.

So, for example, we're doing the rate process right now, today, if it's approved by our board, then we were going to be going through a process where we're going to be flattening the tiers very gradually, so that there's not sticker shock or rate shock on the actual tails.

And then we'll be transitioning to time-of-use rates in 2017 as our default rate. So that's a different strategy.

We already have 100 percent of all of our commercial customers on time-of-use rates very successfully, including the smallest microbusinesses, which really have load shapes, and function very much like a residential customer.

And why are we doing this? Because -- and to your specific question about low income -- the energy efficiency potential for low-income customers is one of the highest categories that we see. Because, unfortunately, a lot of low-income families or individuals make the wrong energy choices. And so, as a result, we've had -- and

this is something, too, where the DoE has been very, very helpful indirectly. They funded a pilot through the ARRA funds. The monies went into the California Energy Commission we competed for, and it was called our "Home Performance Program."

And through that whole Home Performance Program, we focused on a systemic approach to advanced energy efficiency, and we really focused on low-income customers first. We have a staggeringly high percentage of our low- income customers who are actual homeowners -- which is a very good thing, but it's also, these are old buildings that need not only basic weatherization in many cases, but also just a huge amount of low-hanging fruit for energy efficiency.

So, we're finding, and our whole approach, is that by better education and creating energy literacy with all of our customer segments, including the most low-income, we're able to help them not only get the bill savings, but really dramatically improve the quality of their lives.

Because we're freeing up, in very limited, where they have very limited funds, if we can lower that bill, help them have better quality through better energy efficiency, improve their home, it's a win-win all the way around.

So, that's the --

MR. MORGAN: Yes -- so, I certainly understand that. And I guess the question I was asking is how does that -- I mean, I understand that weatherization and other things like that can have enormous benefits for low-income customers. What I'm not so clear on is whether time-of-use is the most cost-effective way to achieve it.

But, in your case, you're doing it all, so --

MS. BRINTON: Well, the reason we're doing it, in terms of -- we've found, and this is where the early data from this pilot, as well as historic pilots that we've done, as well, on pricing -- actually, time-of-use is a very cost-effective way to get real energy savings. Because for us -- and, see, this is where it's important,

too, where the complexity comes in -- is that our load shapes and our climate creates a needle peak. And so, for us, time-of-use is an incredibly cost-effective and great tool to shift use off peak. That's our biggest challenge.

And so, for our particular utility, with our climate -- and it gets into how we have to, for example, we have a huge percentage of hydro, which is clean and non- carbon emitting, I have to add. We love our hydro, and we wish it was counted as a renewable, so I'll put that little advertisement in there -- one of the things that's really important for us is that when you have a very, if we have a dry year, and this is a dry year, we have some of our biggest peak in late August, early September. What that means is that our hydro capacity is down. We're going to have to go on the market and purchase power when it's the most expensive.

So, one of the things that we're getting is -- we believe in transparency. Time-of-use, essentially, it's congestion-based pricing, if you

think about it from a grid perspective. So we're able to show, and because we're vertically integrated, we're able to directly share that value with our customers.

So, if they shift, and if they get real savings on their bill, it really helps us materially. We ultimately get to transfer that back into -- because we're a non- profit, so we're directly cost-based. If we don't have to go out in the market and purchase really expensive power, that directly goes to our bottom line. So it's very transparent and very clear.

So, for us, because of our business model, because of our climate, our load shapes, et cetera, time-of-use pricing is what we've seen -- whether it's our IRP folks, or whether it's our customer folks, it all comes back to being a very, very best-in-class solution for us, which is why we're going for the whole community.

MR. MORGAN: Thank you.

MS. NICHOLS: Can I add one more thing on that, which I think may help address that.

To the extent that time-of-use can help us delay that additional generation, that's where I think all those customers benefit, as well.

MR. CURRY: Good. Pat.

MS. HOFFMAN: To a couple of things that I summarized, that we talked about value. And the first thing that was mentioned is outage management. And I've been saying that's probably one of the near-term success stories that the industry could get their arms around, and customers can get their arms around as value to them. And that's outage management.

But the thing that I think we have to think about -- I think it was interesting, your conversation about accuracy, because I think PUCs are going after performance metrics of, like, I don't know, 80 percent of the customers restored in three days, or whatever. And I think we've got to find a way, as an industry, to help define that accuracy.

So maybe there is more cushion on the time that's presented on outage management systems

as you're further out, but as you get closer, knowing that you're going to restore within an hour, Tweets go out, or an update goes up on the website. Because customers are making decisions -- whether they move to a hotel, whether they go shopping for two hours. And that accuracy, as you get closer and closer, I think is really important.

And if the industry could think about the best- practices there, and something maybe we can look at as a community, is what are those best-practices with outage management system, because I would love to push that over the finish line from, you know, a general acceptance level of "here are the good practices with outage management" would be a huge success as we talk about near-term value.

You know, the other thing you talked about is peak-load reduction, (inaudible) avoidance. Asset management is coming out with predictive failure. I know STL was doing a lot on the predictive failure side of things.

But as we get into the customer, I know the customer side of the business, or the customer value, would be probably still in development. And, you know, we're still seeing some of those values. Some of the things have been prepaid programs, you know, sizing the solar panels. You know, there's all pockets of value that are coming out on the customer side.

But, Mike asked what's next. And I think, somewhat, the next might be resiliency in how we can look at the smart grid, and how we want to develop a system for resiliency based on the information we get. This is something to put, you know, a thought in your head.

The question I have is, if you had an opportunity to do more pilots, is there something specific you would be interested in doing? Or did we cover kind of the different range of application right now that everybody, you know, where we got a pretty good coverage of the landscape? Or if, you know, if you had the opportunity to do something, is there a need out

there to do another pilot?

Going back to the rate question -- because that's why we did different pilots with different rate designs and customer-behavior analysis, because we're looking at some utilities think that it's maybe two or three different rate structures that might be a good portfolio for the customers, where they could take the last year's data, impose the rate design and say, okay, what kind of value do you get out of it?

And I think that's still a debate with the utility commissions on what to do there, and how to evolve. So it's just kind of trying to aid that analysis.

MR. CURRY: Yes, the hard part of your last comment is that most utility commissions go for multi-year rate cases, because it's most cost-effective. So -- and they give various incentives on return-on-equity for multi- year rate cases to encourage the utilities not to be that flexible, not to be that acute in how they present it. You can have a true-up at the end

that might work.

But let me defer to Sonny. We have one more card up with Paul, but do you want to stick to the 12:40, or -- how are you on time?

MR. POPOWSKY: Sure. Let's hear from Paul, and then I think we can close it up then --

MR. CURRY: Wrap it up then.

MR. POPOWSKY: -- and resume at two o'clock.

MR. CURRY: Sounds good. So, you're standing between us and lunch, Paul.

MR. CENTOLELLA: Okay. I'll be short. In terms of a comment to Granger's question, we actually did look at data with one of our utilities in Ohio. We found that non-low-income customers had much more peak-oriented load shapes that low-income customers so that, in fact, there was a significant cost subsidy going from low-income to high-income customers with flat rates.

A question specifically to Elizabeth: Given what we've heard over the last couple of days about ramping in California, have you thought

about, you know, moving from time-of-use to a more dynamic price signal, with automation that would allow devices in customer homes to actually respond to the changes, you know, ramping requirements as you're moving toward the more renewable power sector?

MS. BRINTON: Well, first of all, there's a journey that we're on. And so, for example, the promise of dynamic pricing across your whole customer base with technology, it's going back to my IT software comment I made a minute ago, I think that's in the future. M But in terms of today, one of the reasons we're moving towards time-of- use is that it's a really good step.

Specific to the ramping question, one of the things we see as an opportunity, we're actively engaged with this with our largest commercial and C&I customers who have more sophistication and, frankly, have the capital budgets when we come in with incentives to help get them their ROI faster, is that there is where

you can partner on the commercial-industrial customers to help do those types of things.

And we've already had success with direct-load control with a couple of our -- it's opt-in, of course, for even our commercial -- but, being able to really partner with them to deal with some of these larger grid questions.

And I think, in California, specifically, across all of our -- and I'll speak for SMUD, but my colleagues, whether they be IOU or POU, I think the C&I and the partnerships that you have that are utilizing your smart grid technology, that's where you're really going to have your first path to help us, really, with these larger grid management questions. That's where you have the first opportunity.

From what we're seeing, and from what we're seeing in the marketplace, broad scale residential solutions that are truly dynamic, and truly in real-time, the infrastructure that you need behind that, from an IT perspective, it's just not there yet at scale.

And so I think that we need to think of this as a journey and as a path. And so that's where a lot of the conversations about rate and pricing options are very important to have now, but I would encourage the regulators to recognize that there's actual physical changes, and things that have to be built, and integration, and so forth, that has to happen behind the scenes to get to, you know, where we need to go.

So, it's really about setting goals, setting vision, and then figuring out a really good transition path.

MR. CURRY: Thank you very much. Let's thank the panel. (Applause.) And, also, Samir has a quick announcement, and then I'll turn it over to Sonny.

MR. SUCCAR: Just two quick announcements. Number one, keep in mind, when the Committee returns, there will be a vote on the Consumer Acceptance paper. So if there are any edits -- and Granger has already provided one suggested edit to the draft -- please provide that

before the Committee resumes so that we have the final text. We won't have time for another break to consolidate edits before the vote.

And, second, along with that, we're resuming at 2:00. I would encourage everyone to plan to be back in the building before 2:00 so that we can start right on time.

MR. POPOWSKY: And I would just add, Samir, that at the end of our smart grid session, at 3:10, that is when we are scheduled for public comments for the folks in the audience who have signed up. And if you haven't signed up yet, please sign up in the back of the room here, or the front the room.

So we do -- this is an open meeting, and we do certainly appreciate any public comments from people who are here in the audience.

So, I look forward to everyone getting back here by two o'clock and finishing up.

Thanks.

(Recess)

MR. POPOWSKY: Okay. Looks like most

folks managed to get back in time for the two o'clock start time.

So if we could, everybody take their seats. And we just have a couple more items to cover.

I'm sorry, Samir, you want to make an announcement?

MR. SUCCAR: Yes, just a couple quick things. First, it would be a great help if folks who haven't signed in for the second day could do so. And I'm just going to pass this around, if you haven't had a chance, for any committee members or panelists who haven't done so today.

Second, there's this USB, mini-USB cable that was found. If it's yours, let me know.

And, third, I just wanted to introduce everyone to Cody Sharp. Raise your hand -- who's in the back of the room. And, as you all know, we lost Paula, sadly, to grad school. And you're going to get to know Cody on all the calls, and she's going to be helping to make sure everything runs smoothly. So, I wanted to introduce Cody.

And, Sonny, back to you.

MR. POPOWSKY: Great. Thanks, Samir -- and welcome, Cody.

Okay. So, I think most of the rest of our agenda is the Smart Grid Subcommittee.

So, Wanda, do you want to get started?

MS. REDER: I sure can. Yes, the first thing that we have on the list is the Consumer Acceptance Paper. And, as I mentioned before, on the heels of our efforts last fall, we realized that this one was bubbling up with some urgency.

So Mike Weedall took the lead, with the support of many of you, to draft the paper -- which we actually had circulated prior to our next meeting, for vote. And there was a lot of interaction, a lot of contributions. And since then, it's been relatively quiet, with the exception of maybe one minor edit that we got today.

So, we can certainly allot some time for discussion, but the one minor edit, I believe, was to incorporate something on the behavioral

sciences. It's just a few words -- right, Mike? Have you heard anything else from anybody?

MR. WEEDALL: No, no. I've looked at it, you know, Granger's suggestion, and it seems a real -- it's a plus, yes.

MS. REDER: Can we get the revised language projected?

MR. POPOWSKY: Sorry, did you have a presentation you wanted to give on the --

MS. REDER: On the paper?

MR. WEEDALL: Yes, yes -- yes, you know, I certainly came with slides. I didn't want to be --

MS. REDER: Yes, go ahead.

MR. WEEDALL: -- naked.

MS. REDER: That's great.

MR. WEEDALL: So, as Wanda just mentioned, this is the august group that worked on this, you know, paper. And there was a heck of a lot of work that was done to get it into the shape that it is today. So I really want to thank all these folks for -- really was just a lot of hard

work.

But -- here we go -- so, just briefly, you know, I'll just editorialize for a minute, you know, you hear me, you know, say periodically, you know, that the utility industry really has to change, and that, you know, we've been so insulated for so long that, you know, it's just silly to think, you know, where things are today, and how I think, you know, it's just, you know, not nearly as responsive as they need to be with, you know, customers.

And I certainly think back on, you know, panel that we had this morning and, you know, you're starting to see that there's change coming. And, you know, once again, you know, to me, it can't come fast enough.

But I could go on for a long time about this but, certainly, you know, as is pointed out in the paper, you know, you're not going to get the benefits out of smart grid, you're not going to be able to get the industry where it needs to be going, you know, without engaging the

customers.

So, you know, I thought it was interesting listening to Elisabeth this morning talk about the fact that, you know, you have this small group of customers out there that really have monopolized the, you know, the bandwidth, if you will. And, you know, they're just, you know, so committed, and so consumed, you know, it really is the tail wagging the dog. And, you know, once again, you know, certainly the utilities, I think, you know, those out on the cutting edge were really surprised at the reaction.

So, it seems like, you know, we've gotten to the point where, you know, there are the right messages to share, and we think that, you know, DoE certainly can play a key role in facilitating, helping, you know, other utilities to be able to, you know, build upon that, you know, hard- earned learning experience.

The topics that we covered in the paper -- you know, the outreach strategies, talking about the health and safety issues, privacy,

regulatory considerations and, ultimately, you know, getting to the appendix, where I think it's just a very, very strong case study that, you know, SMUD was able to put together and to share with us.

So, what are the recommendations that we have in the paper for DoE?

You know, we basically see that DoE's got a role to share, as far as informing the industry, to share the lessons-learned, to bring people together to make sure that we don't have some of those, you know, same painful lessons, you know, that maybe, you know, folks in California really had to share.

And, certainly, you know, one thing that stands out to me -- and certainly was reflected in the question I asked this morning -- where in the heck are we going? This is a journey, this is not just going to be, you know, an endpoint. You know, the industry is going to have to continue to evolve, to make sure that the Department plays a role in, you know, convening regularly, you know,

interested leaders, pulling together the lessons-learned, et cetera, so that, you know, again, you know, the smart grid benefits could be, you know, fully implemented.

So, with that, I will pause. Any questions on the paper? I know that, you know, Sonny, as you said, we want to get the one edit up on the screen. So I'll leave that to Samir to pull that up for us.

Any questions I can answer on behalf of the sub- group?

Dian?

MS. GRUENEICH: I think -- I think it's a great paper.

One thing you might do -- these recommendations, they're nice bullet points -- maybe put them up front. Because the ones -- because there are recommendations in the back, but they're pretty lengthy. And if these are consistent, it might be, you know, an easy, a nice easy read.

And then there were a couple of the

recommendations -- I can do this off-line -- that weren't specifically to the Department. And so I think you just need to tweak a little bit of the language, maybe look at them.

I was a little concerned, on the first recommendation, on page 14, it says, "The Department can also play a strong role in supporting individual State regulatory regimes." And I didn't know what that meant.

And so maybe some clarification -- because I assume it doesn't mean formal intervention, but maybe it is on this, you know, sharing best-practices sort of thing.

And I would like to suggest, on page 5, we eliminate the statement that says "...motivated by the same political priorities that drive Tea Party and Libertarian activities..." because I don't know that we know that. And I don't particularly think we need to make that statement. So, I can show you, but that little phrase jumped out at me.

MR. WEEDALL: Okay. So, I know, Sonny,

you talked about, you know, sort of a process here. How would it work to be able to do the wordsmithing here, and still --

MR. POPOWSKY: Well, the last one, I think -- actually, the last two -- were maybe slightly substantive. So why don't we agree on those, or, anyway, let's see if we agree on those.

The one on page 5, if everyone has it, or if you can pull it up.

MR. SUCCAR: It's on the screen.

MR. POPOWSKY: Okay. Any objection to eliminating the reference to Tea Party and Libertarian activities?

That's a good catch, Dian. So, we'll just eliminate that. And then on page 14, is there a concern, Dian, the use of the use of the word "regimes?" Perhaps "...play a strong role in supporting best-practices by individual State regulators?" or -- does that work better?

MS. GRUENEICH: I don't mind "best practices."

MR. POPOWSKY: Okay -- and

"...identify..." Okay, did you get that, Mike? "...can play a strong role in identifying best-practices?"

MR. WEEDALL: Is it this first bullet, right here?

MR. POPOWSKY: Yes.

MS. GRUENEICH: Yes -- and it's about six lines down.

MR. MORGAN: How about something even simpler, "...a strong role in supporting individual State regulators..." -- period -- or comma -- without --

MS. GRUENEICH: But how would the Department support regulators?

MR. MORGAN: Well, they could do research, they could provide results of various empirical studies and so on. I mean -- I mean, I'm a little allergic to overuse of "best-practice," because best-practice, because best- practice isn't always all that great.

MR. SUCCAR: So what was the final language?

MR. MORGAN: Well, I was suggesting "...supporting individual State regulators."

MR. SUCCAR: And period?

MR. MORGAN: Take "regimes" out. And it's a comma -- keep the sentence as is.

MR. SUCCAR: Okay, I think there's a comment --

MR. MORGAN: Right there.

MS. REDER: Oh, okay. Okay.

MS. RALLS: Yes, this is Mary Ann Ralls for NRECA. I'm filling in for Jay Morrison, who was filling in for Barry Larson. So, I apologize for the revolving seat here.

I also had a concern with that particular phrase, Dian, and I appreciate your raising it. But I'm not certain, from this distance, whether or not I can read this phrase.

So, if somebody would be good enough just to read what that phrase from the sentence reads now?

MR. MORGAN: -- "supporting state regulators." That's probably better.

MR. POPOWSKY: I don't think we could hear it. And Sue had a comment.

MS. KELLY: I actually agreed with Mr. Curry, because "individual State regulators" sounds like, instead of particular people. And let me suggest --

SPEAKER: (off mic)

MS. KELLY: But I was just going to suggest, maybe you can say "support States." And because there are some entities in States that are not regulated. So, that might be the cleanest approach of all.

MS. RALLS: Yes, I think that -- again, this is Mary Ann Ralls for NRECA -- I think that if you make it more generic, you're going to get more buy-in, frankly.

MS. GRUENEICH: And there's two places that, if we were comfortable with that -- and maybe you want to hash it out now, because I'm not sure -- go down to the fourth bullet, this is where -- do you see, we need to -- the fourth and the fifth bullets there don't highlight or make a

recommendation for what DoE should be doing. And since I didn't draft this, I don't know exactly how we'd switch it over. But, maybe those involved could figure it out.

But those were the two bullets that caught my eye.

MR. POPOWSKY: So, are you saying, are you just suggesting -- do we just take those -- well, we don't want to take them out, right? But you're saying they just don't belong in that same list, or --

MS. GRUENEICH: I'm not -- I haven't reviewed it closely. I just know that these are recommendations to DoE, and what DoE should do. And neither of them include that part.

So, I don't know if -- for the people who wrote it, if what they do want is there's something that DoE should be doing in this area, and that's what we add, or if it just doesn't belong there.

MS. REDER: Mike -- or Sonny. We could just put "DoE should encourage utilities and

States to emphasize the messages..." -- something like that.

MS. KELLY: And similarly, in the one before, the sentence that says, "...options should be explored..." -- that's the horrible passive voice. You know, you could perhaps say "DoE should explore options to..." -- utilities and States, and I think that will solve the problem.

MR. POPOWSKY: Okay, is everyone is okay if we can just -- we can work out these final words, I guess. But if we just include the reference to DoE in those two recommendations, then they'd be more parallel?

Mike?

MS. GRUENEICH: I had one other big, big item -- that on the first sentence for Appendix A, for the SMUD: "With the assistance of $127." Everybody's going to be very -- and if this was actually written by SMUD, I think we should state that. Because otherwise, it looks like we wrote it, and it's a little -- could be misconstrued.

MR. WEEDALL: It's good to see someone's

reading this.

MS. KELLY: Did the change get made further up, to the other bullet? I didn't see that happening?

MR. SUCCAR: On page 16?

MS. KELLY: Well, I don't have the draft, so -- that did not have -- that's the other one that didn't have it. Hold on. Go back -- "education and outreach."

MR. SUCCAR: "DoE should encourage..."?

SPEAKER: No. No, it's here, where it says, "Options should be explored..." -- "DoE should explore options." That one didn't have (inaudible). Is that right?

MR. POPOWSKY: Okay, any other additions or corrections? I'm sure that Pat is glad to see that her $127 were well spent. Oh, I'm sorry -- Merwin?

MR. BROWN: I'm not sure this needs a revision this early in the paper, but I'd like to point out that it's creating an essential mindset that I'm not sure is totally accurate.

And that is, in the second paragraph, it talks about the focus of the paper is on the homes and businesses, you know, infrastructure -- which is okay. But it goes, it says, "Consumer acceptance is not typically a controversial issue for smart grid investment."

And I actually would question that, in the sense that these consumers are also potential intervenors in rate cases. And that could end up being questioned.

And the only real ramification of that I want to point out is that a lot of recommendation having to do with DoE -- for example, helping States deal with this, could include also helping them describe and defend why certain rate-case decisions are being made for broader smart grid investment, such as a large synchrophasor measurement investment.

So, that would be --

MS. REDER: Would you recommend deleting that --

MR. BROWN: I'd leave that to you guys.

I'm not sure it's that big a deal. I just wanted to get it on the table, that -- let's be careful that it doesn't create the wrong mindset for us. In other words, I don't think it's a big deal, to hold this all up, but I'll leave it to the subcommittee, (inaudible) bothered by it.

MR. POPOWSKY: Okay, with that, Mike, just delete that sentence. I don't think it's essential. You can get from the first sentence to the third sentence without losing anything.

Okay, Merwin? We'll just delete that sentence there. Thanks.

Any other comments? Questions? Okay, could I get a motion to approve the document as edited?

MR. MORGAN: I move that it be accepted.

MR. CURRY: Second.

MR. POPOWSKY: Okay -- Granger and Bob. Thank you. All in favor?

(Chorus of ayes.)

MR. POPOWSKY: Any opposed?

(No response.)

MR. POPOWSKY: And thanks, Mike, for herding those cats and for getting this done. Thank you.

Wanda?

MS. REDER: All right. Thanks. The next one is the Cyber Security Paper. So, Chris has been working on an outline. You obviously heard the panel.

If you can just fill us in on where you are?

MR. PETERS: Sure. Thanks, Wanda. Yes, as Wanda said, we've been working on an outline for a short white paper on the importance of cyber governance. I've been working with folks from the ICF team. We've had several conference calls, one with DoE a couple weeks ago, Mike Smith, and socialized the concept with him.

We also passed it over to Samara Moore over at the White House. She liked the concept. She liked what we had in the outline, and thought it might be worthy to get engaged, or use the concept for the (inaudible) cyber security

framework. Governance is an area they're going to focus on, and she thought it would be good to leverage -- and best-practices around governance, and how that might help even small to mid-sized entities.

So, we have a good outline. We're going to start putting some content behind the outline.

Pat, I think it aligns nicely with cyber domain in C2M2. So we don't want to do anything to distract from the C2M2, but we do want to maybe, you know, bring that, the importance of governance out a little more. Because I think, you know, as I talk to my peers, the governance area is one of the most critical parts of cyber, that a lot of entities are struggling with, because you can't execute your cyber program and, you know, mature the domains you have outlined in the model without good, strong governance.

And I think it's our position, as well as a few others in the industry, if you have good governance you're going to have good security, and you're going to have strong compliance, as well.

So the three are inextricably linked together.

So we want to focus on that. We want to keep the paper short. We don't want to create another, you know, document or PDF to clog up people's inboxes, but create a short, pithy document, I think, that will, you know, underscore the importance of governance, and also maybe even align with the C2M2.

MR. POPOWSKY: Okay, Granger, you had a comment?

MR. MORGAN: Yes, just two requests. The first is that somewhere in here I would ask that you differentiate the different domains in which cyber security issues arise.

That is, business operations are really different than, you know -- control of the high-voltage grid -- are different from distribution system-level things. So that's the first request.

And the second request is to simply, somewhere in the introductory phrases, note that physical security is also an important point. I

mean, my own view is that because cyber security is so sexy, physical security, which could actually cause much larger and more widespread damage, tends to get underplayed.

So those are the only two (inaudible).

MR. PETERS: And that's a great point, Granger. And let me just pull the thread on that a little further.

I think where we get hung up, in the industry, we focus too much on the cyber, we don't focus enough on multidimensional threats -- physical, personnel, and cyber.

You can't address one and not the others. And then to your point about the business network and operations -- from a governance standpoint, you have to look at the business side, you have to look at the process side. You can't ignore one (inaudible). So those are great points.

MR. POPOWSKY: Okay, any other comments for Chris? And we'll look forward to, hopefully -- you think you'll get something by the October

meeting?

MR. PETERS: We will. Yes.

MR. POPOWSKY: Great. Okay, Wanda.

MS. REDER: Okay, the next one I wanted to talk about is the Smart Grid Research and Development Paper. And I'll just explain, maybe, some boundary discussions that we've had on this, and then turn it over to Clark to relay the status.

But, anyway, there's been an effort within the Transmission Group, under Mike Heyeck's leadership, to initiate an effort on resiliency. And in that, the primary focus has been on aging assets failure mechanisms. We're going to have a panel at our next meeting on resiliency, in part, spurred by, you know, all of the outcomes from Sandy.

So, the thought is that that would cover both transmission and distribution, and it would continue forward. But we'd also do that within an understanding that we are moving in the direction of smart grid technologies, from an R&D

perspective, in the Smart Grid Subcommittee. And this is really focused on hardware, software, incremental innovations, if you will, to facilitate active distribution systems -- you know, kind of get us into the future from, really, the R&D perspective.

So, some of the things that have bubbled up in the smart grid area, you know, we've dealt with some of the softer issues, if you will, and we want to make sure that, from a portfolio perspective, we really have the emphasis continuing in DoE on, you know, the hard innovation piece. Because we realize if it doesn't happen here, if the focus isn't moving forward, you know, we might not have the eye on the right part of the ball.

So, Clark and Billy have been taking a lead. There's actually some text in place, in terms of the innovation and technologies part. We are going to try and understand, as well as we can what is currently in flight, so it's not an overlap of existing efforts. The intent is

really, you know, to move the ball forward.

So that piece is going on. And in a minute, I'll have Clark add to that comment.

Another piece that we are emerging as a separate and parallel effort within smart grid is one on metrics, policy, decision-making framework, tools. And unlike what Clark and Billy and working on, this is much more, you know, the policy and decision-making framework, as compared to the technology piece.

So, obviously, there's going to be interfaces. We'll have some of the same people working on, you know, these respective parts so that it's coordinated. But I wanted to make sure that you guys understood that this is a continuum, and the intent is that they will work together.

And, you know, I think "all in," you know, this idea of distributed generation and its implications to where we're going will probably find its way throughout, and may end up in a separate piece of work -- or at least it will be quite prominent in all three. But, certainly,

that's on the forefront as far as what could possibly be different alternatives, and the implications for risk, et cetera, as we move forward.

Okay, with that -- Clark.

MR. GELLINGS: Well, it's hard, Wanda, to add anything, since I think you just covered it for us -- except I would, first, point to Paul and suggest that Paul was also a part of the group that was working a bit on this technology paper.

The status of that, I will add, is simply that it was drafted, and we're encouraging the subcommittee to provide further comments to it. We really haven't gotten too many of them, although we did start out with a pretty thorough document, I think, to begin with. We do have a -- well, I guess, this month's phone call focused specifically on going through that to see if we can collect some comments.

I think we started with the idea that we have focused quite a bit on some of the customer-facing technologies, such as the ones

that were discussed earlier today. And we've had at least some mild concern that in the ongoing dialogue, even with all the excellent work that's been done by DoE and others about smart grid, we always seem to come back to the meter and the customer interface around the meter. And we wanted an opportunity to be able to remind ourselves that there's a whole array of technologies on the (inaudible) system and the distribution system that will really be necessary, at some level, in order to fully provide the functionality that we would anticipate from a modern transmission and distribution system.

And not to recommend that all of these be deployed everywhere, but to suggest that these are offered perhaps for consideration at various stages of development, and that the industry might be well appraised to take notice of it.

And then part of that, to be able to comment just briefly on where DoE -- DoE, I would say, the folks wouldn't mind if I said you can't do everything. And so, in the spirit of not doing

everything, to acknowledge, in fact, where your primary roles are.

To highlight something that Wanda did say, but perhaps didn't go through it -- there's four separate pieces here, only one -- one of which is brand new, and nothing has yet been written on it, unless Ralph did so in the last few minutes. But there is this R&D piece, technology, smart grid-related -- and I leave it untitled for the moment.

There's a resiliency piece that the Transmission Subcommittee has been working on. David Till did the report on that earlier. And it also will have a technology discussion, in part off of this concept of the aging assets that exist now, and what might be done about those, as well as other efforts to improve the resiliency of the power system, focused on both transmission and distribution. And so that's going on.

In the subcommittee that Wanda had, the discussion about how do you measure resiliency? What are the metrics for resiliency? And then are

there policy implications around resiliency? If you're able to valuate it, if you're able to measure it, are there changes that should be considered somewhere in policies that relate to resiliency?

And the newest piece is -- Ralph has volunteered to outline I think you did, didn't you? Yes. And that has to do with distributed resources as they apply to changes in technology, that have implications both for the smart grid and its evolution as we see it, as well as implications for resiliency overall, and not just as the power system as we know it today, but for resiliency in terms of how individual customers might view their supply of electricity out into the future.

Did I say that well? Okay.

MS. REDER: And Paul has agreed to lead the policy metrics, the tool piece.

I don't know, Paul, if you wanted to add additional thoughts there?

MR. CENTOLELLA: Just briefly. I think,

you know, this started with some work that Tom and I did, that got shared around, you know, a couple of months ago. I think, broadly, what we're looking at is how do we begin to advise the Department on developing technical assistance and tools for regulators, recognizing that there are some real limitations in the way we have been doing kind of incremental benefit-cost analysis that really has been narrowly defined, and in ways that don't necessarily take account of value, or of risk, or of options that are being foregone today by things that we're doing, you know, now, and trying to look at this in a broader context of how do we create the right kinds of tools to support policy choices that will really get us to where we need to be in the future.

MS. HOFFMAN: Just a couple quick comments. As we look at the R&D piece, you know, some of the things that I think about is, is there anything going in ARPA-E that we should include to take to the next step, as part of what DoE is looking for in the R&D portfolio?

AC/DC integration at the distribution level, with the integration with buildings is an opportunity, as well as, you know, looking at transactive loads and issues like that.

The other thing might be on the modeling of the system. I know we started the GridLAB-D -- I think it's the GridLAB-D that models, you know, the distribution system. Is there a way to continue to look at other modules to that?

Uses or ways to integrate the tools out there so States can look at their systems, make better decisions, and have that tool, or other tools that are available?

So, just some quick thoughts.

MR. GELLINGS: Those are great thoughts. And, in terms of the ARPA-E, we have, some of us have spent quite a bit of time with ARPA-E, and are aware of certain of the ARPA-E work that we should reference. Some of the ARPA-E work is less certain, far enough out, that I'm not sure fits in with a horizon.

We hadn't really settled on this, but we

had bounced around the idea that the horizon that we're thinking about is something like 2030. And some of those technologies wouldn't show themselves before 2030, and therefore perhaps wouldn't be considered.

I take your point about modeling. That's an excellent one. It also refers to increased use of open- source software, particularly for distribution modeling, which we've both been working on and have had quite some success with.

So, thanks very much for those. And, others, please, if you think of them, shoot an e-mail to us.

MS. KELLY: I would just ask this to be considered as you're working through it. And this comes, I guess, from the legal perspective -- is safety issues, as well. Just because I know, I've actually been hearing from, through listserves, about members who are telling me that they have customers who are having solar installers tell them things that are not complaint -- that they

claim a -- quote -- "UL approved," you know, when apparently Underwriters Lab doesn't approve things like that.

You know, I just worry about, you know, if we go whole-hog for distributed generation, we've got to make sure that the safety of the system is paramount. And I would just ask that you think about that as you're drafting.

MR. GELLINGS: I can assure you that, coming from the industry, for all of us, safety always is number one.

I couldn't help but think about it as I saw the statue of the lineman. If you haven't worked, actually worked for a utility, you might not appreciate this. But, you know, those people, men, and now women, who are out there working the system for us -- and I know you were referring to contractors and consumers alike -- but, yes, safety absolutely is one of the tenets of the power industry, and should be included where appropriate.

MS. HOFFMAN: Well, I think, as we talk

about the policy issues, it's who is ensuring safety. And it goes back to, you know, the utility being a reliability entity, a safety entity, and what are some of the fundamental roles of the business model in the future, you know, for the utility?

MS. GRUENEICH: Pat, getting back to your comment on transactive energy, I participated in the conference that was held in Portland two weeks ago. And I know DoE, I think, is supporting that. And my memory is that there will be a paper coming out of that conference.

So, I'll try to remember to send it around. But, if not, it's certainly something that I think everybody should take a look at, and understand how it could fit in the context of this.

MS. REDER: Okay. Well, I just want to say thanks to all of you that have contributed and led the various efforts.

So, Mike, congratulations on the Consumer Acceptance panel and paper. Well done.

Clark, Chris, Billy.

Anyway, thanks a lot for everybody's contributions here. Appreciate it.

MR. POPOWSKY: Okay, Great. Are there any other business matters before we open it up to public comment? We see the date of our next meeting, October 2nd and 3rd, here in this room.

And thanks again to NRECA for your hospitality. Are there any of the folks that were here, that are in the audience, that have signed up or would like to address the members of the EAC?

(No response.)

MR. POPOWSKY: Okay, hearing none, can I get a motion to adjourn?

MS. REDER: So moved.

MR. BALL: Second.

MR. POPOWSKY: Moved, seconded. All in favor?

(Chorus of ayes.)

MR. POPOWSKY: Okay. Thank you very much. We really appreciate everybody's efforts to

get all this done.

Thanks.

(Whereupon, at 2:40 p.m., the PROCEEDINGS were adjourned.)

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CERTIFICATE OF NOTARY PUBLIC

COMMONWEALTH OF VIRGINIA

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

(Signature and Seal on File)

Notary Public, in and for the Commonwealth of Virginia

My Commission Expires: November 30, 2016

Notary Public Number 351998

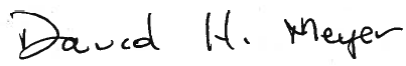
Respectfully Submitted and Certified as Accurate,

Richard Cowart
Regulatory Assistance Project
Chair
DOE Electricity Advisory Committee

9/10/13
Date

Irwin "Sonny" Popowsky
Pennsylvania Consumer Advocate
Vice-Chair
DOE Electricity Advisory Committee

9/10/13
Date



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